

Bindura University
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**DEVELOPING A FRAMEWORK FOR ENHANCING THE EFFICIENCY OF
MARINE OPERATIONS IN RURAL INFRASTRUCTURE DEVELOPMENT
AGENCY, KARIBA**

BY

EDWICK ENIA CHIKAKA

B242447B

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APPROVAL FORM

The undersigned certify that they have read and recommended to Bindura University of Science Education (BUSE) for acceptance a Dissertation entitled “DEVELOPING A FRAMEWORK FOR ENHANCING EFFICIENCY OF MARINE OPERATIONS IN RURAL INFRASTRUCTURE DEVELOPMENT AGENCY, KARIBA” by EDWICK ENIA CHIKAKA in partial fulfillment of the requirements for the degree of Master of Business Leadership.

Student Name: Edwick Enia Chikaka

Signature: .

Date: 21.06.2026

Supervisor: Dr G. Kichini

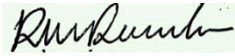
Signature:



Date: 21.06.2026

Program Coordinator Name: Dr Rusike

Signature:



Date: 23/06/2026

External Examiner Name:

Signature: Date:

RELEASE FORM

NAME OF AUTHOR: EDWICK ENIA CHIKAKA

STUDENT NUMBER: B242447B

TITLE OF DISSERTATION: Developing a framework for enhancing efficiency of marine operations in Rural Infrastructure Development Agency, Kariba

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Signature:



Date: 21 June 2026

Permanent Address: House Number 14 Hillview Crescent, Mzari, Chinhoyi

E-mail: addmashcent@gmail.com

Cell Number: 0772 882 938

DECLARATION

I, Edwick Enia Chikaka, Student Reg Number B242447B, do hereby declare that this dissertation is a result of my own investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

STUDENT SIGNATURE



DATE: 21 June 2026

DEDICATION

To my two children, Tinotenda and Munashe, and my husband Takunda for their support and understanding during the times I was not available to them.

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ABSTRACT

This study developed a framework for enhancing the operational efficiency of marine transport operations within the Rural Infrastructure Development Agency (RIDA) in Kariba, Zimbabwe. RIDA operates ferry services on Lake Kariba connecting remote lakeshore communities including Charara, Gachegache and Msampakaruma to essential services, markets, and administrative centres. Despite the strategic importance of these operations to rural infrastructure development, the fishing value chain, and community mobility, RIDA's marine services are characterised by persistent operational inefficiencies including frequent vessel breakdowns, prolonged turnaround times, inadequate preventive maintenance and erratic service schedules. The study was guided by three specific objectives: to assess the current level of operational efficiency, to identify key factors affecting efficiency, and to develop an evidence-based framework to improve operational efficiency. A pragmatic research philosophy was adopted, employing Yin's embedded single-case study design with a convergent mixed-methods approach. Quantitative data were analysed using SPSS (descriptive statistics, independent t-tests, ANOVA, and Pearson correlation), while qualitative data were subjected to Braun and Clarke's thematic analysis. The study was underpinned by a multi-theoretical framework integrating the Resource-Based View, Systems Theory, Operations Management Theory, Contingency Theory, and Lean Management principles. Key findings revealed that RIDA's marine operations function at approximately 55–65% efficiency, with 92% of maintenance interventions being reactive and a 370% increase in the 2026 breakdown rate above historical averages. The study's most significant contribution was the discovery of the Revenue-Efficiency Paradox: despite 100% agreement on revenue sufficiency, severe resource scarcity persists due to centralised revenue capture and bureaucratic procurement failures rather than budgetary inadequacy. Fuel availability, not fuel cost, was identified as the binding operational constraint. Based on these findings, the study proposed the I-MARINESG Operational Efficiency Enhancement Framework, an Education 5.0-compliant model comprising eight interconnected pillars, namely Governance and Financial Autonomy, Resource Assurance, Maintenance Transformation, Accountability, Innovation and Data Systems, Nurturing Human Capital, Engagement with Stakeholders, and Safety and Compliance. The framework prioritises governance reform as the foundational intervention and offers a replicable model for inland waterway operators across Sub-Saharan Africa.

Keywords: Operational efficiency, Marine transport, Inland waterway transport, Rural Infrastructure Development Agency, Lake Kariba, Preventive maintenance, Resource-Based View, mixed methods, Framework development

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

According to Rodrigue, Comtois and Slack (2020), transportation infrastructure is essential for economic, social and environmental development because it facilitates the movement of people, goods and services. UNCTAD (2024) asserts that in many areas of the world where road infrastructure is limited or geographically constrained, marine and inland waterway systems are particularly important among the transport modes. Ferry services are essential in these contexts, ensuring temporary uplift to communities, enabling trade and supporting the delivery of services (Damson, Mtui and Kileo, 2025). Zimbabwe's inland marine transport is limited to its freshwater lakes, with Lake Kariba as the main operating site (Zambezi River Authority, 2023). The Rural Infrastructure Development Agency, RIDA, formerly the District Development Fund (DDF), effectively provides these services, particularly to remote lakeshore communities in Charara, Gachegache and Msambakaruma. The Agency's operations are marred with chronic inefficiencies, which jeopardize service reliability and production, and consequently the rural development initiatives. This study thus sought to establish an architectural design framework to enhance operational efficiency in RIDA's marine transport system in Kariba.

1.2 Background to the Study

This section adopted the research funnel approach, beginning with global developments in marine transport, narrowing to regional trends in Africa and Southern Africa, and finally focusing on Zimbabwe and the specific case of RIDA's marine operations in Kariba.

1.2.1 Global developments in marine transport operations

International trade is reliant on marine transport, which is responsible for moving about 80–90% of global trade by volume (UNCTAD, 2024). Inland waterway transport (IWT) is, though smaller in scale, strategically significant in regions of Europe and Asia where integrated multimodal systems improve logistical efficiency, reduce transport costs and improve sustainability (Sys et al., 2020; Li, Notteboom & Wang, 2017). The Fourth Industrial Revolution brought many digital solutions which improved operational processes significantly, courtesy of automation of selected operations and digital exchange of information and documents (Tubis et al., 2025). According to Tubis et al (2025) and Chen et al (2025), operational efficiency in advanced marine transport

systems is significantly enhanced by technological advancements such as predictive maintenance, Internet of Things(IoT)-based monitoring, digital vessel traffic system and smart logistics platforms. Preventive and predictive maintenance systems, bolstered by the International Maritime Organization's International Safety Management (ISM) Code, have increasingly replaced reactive maintenance systems, further reducing ships' downtime and improving their reliability (IMO, 2018; Karatuğ, Arslanoğlu and Soares, 2023). According to the Global Maritime Forum (2025), ship owners reported a marked increase in fleet availability, operational reliability and cost-effectiveness. This was after their adoption of advanced maintenance management systems.

The European Commission launched a broad set of policies promoting waterway transport through infrastructure improvement, digitalisation and greening policy. Likewise, Encarnacion, Jaramillo-Rios and Benekohal (2025) pointed out that while some countries have digitalized cargo tracking and cargo handling through automation, other nations continue to work with aging infrastructure and operational processes that limit their competitiveness in modern supply chains. An example given by Agüero-Tobar, González-Araya and González-Ramírez (cited in Sys et al, 2020) showed that maritime operations which performed efficiently resulted in lower logistic costs and projecting forward this could compensate for closer to 48% of total costs of transport in the international supply chain.

The European Union invested heavily on the inland waterways connecting the Rhine, Danube and Seine Rivers. The waterway systems are well integrated with the rail and road systems for seamless multimodal movement of goods across the borders. According to Sys et al. (2020), the European Commission developed policies that enhance the infrastructure, digitalisation and environmental sustainability of waterway transport.

China has also emerged as a world leader in the inland waterway transport sector with an extensive river system that is heavily utilised for economic growth. The Yangtze River, one of the busiest inland waterways in the world, is over 3900 miles long and carries more than three billion tons of cargo each year (Notteboom et al., 2020). The Chinese government has extensively invested in the construction of waterways, including the deepening of river channels and building new locks and dam systems, as well as smart logistics (Encarnacion et al., 2025). The inland waterway network in China has become highly efficient and capable of multimodal connectivity, allowing for the

varied freight handling of containerised cargo and this includes advanced vessel traffic management technologies and automated port operations(Encarnacion et al., 2025).

On the other hand, the United States inland waterway system is one of the largest in the world, but it remains underused and obsolete. As opposed to Europe and China, the United States Development does not have a coordinated national program for inland waterways investment and multimodal integration and according to Encarnacion et al. (2025), challenges such as aging infrastructure, scarcity of funding and inefficiencies in logistical operations have weakened its competitiveness and widespread adoption in modern supply chains.

Regarding maintenance practices, Karatug et al. (2023) indicated that failure rates and maintenance costs have been minimised in the maritime industry with the introduction of time-based periodic preventive maintenance practices. An international safety management code was launched by the international maritime organization which laid down a basis for the preventive maintenance strategy. As a result, the global maritime industries adopted the Planned Maintenance System (PMS), which allows maintenance activities on board ships to be carried out on a regular basis and documented. According to Karatug et al., (2023), maintenance strategies have more recently been evolving toward predictive strategies. This involves monitoring equipment conditions in real time through data analytics. Of late, the worldwide maritime business has focused on operational efficiency, safety and environmental sustainability. The fleet management and operational planning of vessels have improved because of technological development including digital vessel tracking systems, automatic operation of ports and vessel design. International regulatory bodies, in particular the IMO, have come up with regulations that reduce emissions and improve mechanics standards.

1.2.2 Regional trends in marine transport operations

Marine transport in Africa plays an important role in enhancing mobility, trade, regional integration, and economic development. However, there are widespread inefficiencies stemming from infrastructural deficits, institutional weaknesses, limited technical capacity and chronic underfunding (Danladi et al., 2024). The Tanzania Shipping Company (TASHICO) is a government body of Tanzania handling inland water transport. Abdulrahmani (2025) claims effective maintenance is a major challenge faced by TASHICO in providing competitive services. At Mwanza, the most important port town of Lake Victoria in Tanzania, public transport ferries

link islands and mainland communities. In addition, it provides transport services for trade, tourism and everyday commuting. However, these ferries' operational performances have been adversely affected owing to frequent breakdowns and poor maintenance practices and long downtimes (Damson et al., 2025). The maintenance processes of Tashico Mwanza are still primarily manual and reactive, which is due to inefficient use of resources, unplanned costs of repairs and safety risks (Abdulrahmani, 2025). Failures with equipment and other operational disturbances as well as maintenance practice inefficiencies and resource allocation failure often is a threat to the reliability of public transport ferry services (Damson et al., 2025).

The ferry services of Magogoni which are operated by TEMESA face maintenance challenges. Every day, thousands of passengers and vehicles use this ferry to move from Kigamboni to Kivukoni in Dar es Salaam. The service reliability offered to passengers has declined due to delays despite its importance operational cost (Damson et al., 2025). Consequently, evidence from the operations of public ferry systems such as TASHICO and TEMESA in Tanzania indicates that breakdowns, manual maintenance system and lack of adequate technical support continue to undermine reliability and safety (Abdulrahmani, 2025; Damson, Mtui and Kileo, 2025).

As noted by Emelogu (2023), Nigeria's maritime sector is grappling with the perennial issues of shutdown of business operations, loss of jobs and environmental inadequacies owing to inefficiency of its operation and governance flaws. Olajide et al. (2018) posits that Lagos handles a significant level of international traffic although the threat of operational inefficiency and business closure persists. In Southern Africa, the marine transport sector consists of a coastal port system and an inland water transport service. South Africa is the main maritime economy in the region, according to Mthembu and Chasomeris(2023) and Ports Regulator of South Africa(2016). However, ageing equipment, infrastructural constraints and human capacity challenges continue to cause operational inefficiencies. According to Transnet (2023), port and logistics modernization is a constant process. Inland water transport in the SADC region is underdeveloped despite its strategic potential to enhance connectivity and relieve road networks (SADC, 2021; World Bank, 2023; African Development Bank, 2022).

1.2.3 Local development of marine transport operations (the Zimbabwean context)

According to CPCS (2017), the marine transport system in Zimbabwe is confined to inland waterways, with most of the activity on Lake Kariba. Marine operations on Lake Kariba help support mobility, fishing, tourism, service delivery and infrastructure development. RIDA offers ferry service between Kariba town and remote communities such as Charara, Gachegache and Msampakaruma (RIDA 2025). According to Kolding, van Zwieten and Marttin (2019) and FAO (2022), the fishing industry, particularly kapenta harvesting, is the major economic activity throughout the lake Kariba basin. Furthermore, it supports thousands of households and provides Zimbabwe with important supplies of protein. The industry provides a necessary service to people and material transportation, in addition to public service personnel transportation. It also affords a chance to transport equipment and fish products. However, ageing vessels, frequent breakdowns, weak maintenance systems and financial constraints constrain operations (CPCS, 2017; RIDA, 2025). The registration, safety standards compliance and inland waterways safety management of vessels are the primary responsibility of the Ministry of Transport and Infrastructure Development. Government policy frameworks such as Vision 2030 and the National Development Strategy 2 (NDS2) emphasise the need to strengthen infrastructure and enhance inland water transport (Government of Zimbabwe, 2021; The Herald Online, 2025). The Zimbabwe Tourism Authority (2022) further notes positive growth in recreational and tourism-related water transport, particularly in the Kariba region. The Zimbabwe National Statistics Agency (2023) confirms that disruptions in marine transport negatively affect fish quality, market prices and fisher incomes, underscoring the economic significance of reliable marine services. The Government of Zimbabwe (2022) has also articulated a devolution agenda that increases the strategic importance of RIDA's marine services, as administrative functions for Kariba District are progressively relocated to Siyakobvu Business Centre, a lakeside location with limited road connectivity. Saunders, Lewis and Thornhill (2023) and Creswell and Creswell (2018) provide the methodological foundations that guide the systematic assessment of these operational challenges. Barney (1991) and Slack, Brandon-Jones and Burgess (2022) offer theoretical frameworks relevant to understanding resource-based and operational management dimensions of marine transport efficiency. Calderón-Rivera, Bartusevičienė and Ballini (2024) further identify structural and institutional constraints as primary efficiency determinants in inland waterway transport systems, a perspective directly applicable to RIDA's context.

1.3 Statement of the Research Problem

Against the background in the preceding section, the problem is operational inefficiencies of the Rural Infrastructure Development Agency's marine operations in Kariba which this study seeks to address through formulation of a framework that enhances operational efficiency of the marine operations to ensure sustainability of the Agency's operations as envisaged in the Memorandum to the 2025 Rural Infrastructure Development Agency (RIDA) Program Based Budget-Estimates Of Income And Expenditure, wherein RIDA shall utilise extra capacity not funded for by Treasury to generate additional revenue through the marine operations(Rural Infrastructure Development Agency 2025 Estimates of Income and Expenditure, 2025).

RIDA's marine transport operations in Kariba are plagued by continuous operational inefficiencies such as vessel breakdowns, long turnaround times, insufficient preventive maintenance, irregular service schedules and poor utilisation of resources. Currently, RIDA's fleet contains three vessels, although one is operational. This limits service capacity and reliability (RIDA, 2025). According to Zambezi River Authority (2023), other external factors like level of the water in the lake and changing regulatory requirements have further compounded these operational inefficiencies. Resultantly, the consequences of these operational inefficiencies are severe for rural infrastructure development, the fishing value chain and community mobility and access to health, education and administrative services (FAO, 2022; Government of Zimbabwe, 2021).

Delays in marine transportation disrupt project execution, reduce confidence of clients and impose costs on communities and businesses that rely on the marine transport (CPCS, 2017). Operational efficiency of Zimbabwe's public marine transport systems, despite its practical importance, has not received adequate empirical attention (World Bank, 2023). The knowledge gaps hinder the development of targeted and evidence-based interventions in the context of inland waterways in developing countries according to Calderón-Rivera, Bartusevičienė and Ballini (2024) and Danladi et al. (2024). The bulk of government business in Kariba District is currently being conducted in Kariba Urban. In conformity with the government's thrust on devolution and decentralization, Siyakobvu Business Centre is tasked with being the hub for all government business within Kariba District. Accordingly, marine transport operations are essential for rural

infrastructure development in Zimbabwe, particularly in Lake Kariba communities, popularly called Kariba Rural or Nyaminyami, which is difficult to access by road transport.

The Rural Infrastructure Development Agency uses its marine transport fleet to ferry personnel, materials and equipment to these remote communities which include Gachegache, Charara and Msampakaruma fishing camps and lakeshore communities to support developmental projects. However, the Agency's marine operations are often undermined by operational inefficiencies, resulting in poor service delivery especially in these marginalised areas. When scheduled ferry trips are delayed, project implementation can also be delayed due to the late delivery of materials. Inconsistent service delivery frustrates clients and limits communities' access to essential services in Kariba town and beyond. The fishing industry supply chain is also severely disrupted since fishing is the main economic activity along the lake supplying fish and kapenta as far as Harare, Chiredzi and Zvishavane. Vessel deficiencies arise from incidents such as breakdowns, delays in trip turnaround, inefficient maintenance practices and low compliance with safety requirements.

Despite the strategic importance of these marine operations, there is limited empirical research examining the specific operational challenges and factors that affect efficiency within RIDA's marine transport services, particularly in Kariba. Recent literature on inland and public water transport systems presents two dominant but competing explanations for operational efficiency. One focuses on firm-level operational practices such as maintenance, fleet management and scheduling while another focuses on structural constraints such as funding, regulations and fragmented governance. Nevertheless, there is a lack of consideration of these perspectives together in light of the rural, state-operated marine transport systems of developing countries. In Zimbabwe, fisheries and environmental governance in Lake Kariba have received significant academic attention while public marine transport service operational performance has received little scrutiny. The study contributes to the existing literature by examining the operational efficiency of RIDA'S marine transport services. It does so by integrating operational and institutional determinants within one analytical framework to provide theoretical and policy-relevant insights.

The main view is that operational efficiency is primarily driven by technical and managerial optimization according to Chen et al., (2025). Several scholars posit that operational inefficiencies of marine services is due to poor scheduling of vessels, ageing vessels, weak maintenance systems and poor fleet management. Studies regarding the Public Water Transport system require that routing and scheduling be optimized and preventive maintenance systems be evolved. Moreover, technology must be integrated to set up monitoring and dispatch systems. These findings show that the emphasis of recent bibliometric reviews is on improving operational processes, fleet utilization and service quality, which are currently the most critical drivers of efficiencies (Chen et al., 2025). Likewise, efficiency studies in the maritime and ports system in low-income countries show that good use of resources, maintenance practices and managerial capacity are strong determinants of performance (Chen et al. 2025) and if organizations adopt best practice operational management models, efficiency will improve irrespective of higher level institutional constraints.

From the second dominant view, Danladi et al., (2025) argued that institutional, financial and governance limitations constrain operational efficiency. A different stream of literature strongly argues that technical improvements alone are insufficient. According to scholars, governance structures that are fragmented, funding constraints, regulatory overdose and weak institutional coordination are some of the challenges faced. According to Danladi et al., (2024) limited finance, institutional weakness and coordination failures emerge as structural barriers to improving efficiency in maritime systems in developing countries. Studies on inland waterways show how public ferry systems' operational performance and sustainability are influenced by policy frameworks, subsidies and governance arrangements (Calderón-Rivera, Bartusevičienė and Ballini, 2024). The view of this school of thought is that, no matter how efficiently the operation is run, it is bound to remain inefficient due to systemic governance and funding challenges. This study thus envisages to formulate an evidence-based framework that will enhance efficiency of the marine operations for sustainability.

1.3.1 Research gaps

Despite the extensive literature on maritime and ferry transport, several research gaps remain inadequately addressed. First, the overwhelming majority of studies including Chen et al.'s (2025) bibliometric review of over 600 maritime efficiency publications focus on commercial shipping,

large seaports and urban ferry systems, while state-run rural marine transport systems serving scattered lakeshore communities, particularly in Southern Africa, remain virtually unstudied. Second, despite Lake Kariba hosting one of Sub-Saharan Africa's most ecologically and economically significant inland water bodies, scholarly attention has been confined almost exclusively to fisheries science and environmental governance (Kolding, van Zwieten and Marttin, 2019; FAO, 2022), with zero peer-reviewed studies identified in SABINET, Google Scholar or Web of Science that specifically examine the operational efficiency of government-run marine transport services on the lake. Third, existing literature is theoretically fragmented: studies either focus narrowly on operational variables (maintenance scheduling, fleet utilisation and turnaround time) or on structural determinants (funding shortfalls, governance deficits and regulatory constraints), but Danladi et al. (2024) and Calderón-Rivera, Bartusevičienė and Ballini (2024) both note that integrated analytical frameworks bridging operational management theory and institutional theory remain rare, limiting explanatory depth. Fourth, earlier efficiency frameworks rest on the assumption that vessel modernisation is the primary lever for improvement; however, RIDA's own operational records (2020–2026) and CPCS (2017) document that refurbished vessels continued to experience escalating breakdown rates — a 370% increase in 2026 — demonstrating that deeper organisational and governance deficiencies persist beyond fleet condition.

1.3.2 Introducing the study as addressing the gap

In direct response to the deficiencies noted in section 1.3.1, this study investigates the operational efficiency of marine transport services that are run by the Rural Infrastructure Development Agency (RIDA) in Kariba, which is a state entity with a mandate to provide remote communities with infrastructure and transport services. The study, in particular, moves beyond port and commercial shipping contexts and focuses on inland, rural, publicly funded marine transport and combines operational determinants with institutional constraints in a single analytical framework, allowing the research to examine if the inefficiency in RIDA's marine services arises from operational practices, resource availability or external policy and funding conditions. This information gap makes it difficult for the management to create focused interventions to improve efficiency, reduce downtime and improve safety standards. Consequently, it is crucial to understand the key factors that influence the efficiency of the Agency's marine transport

operations for purposes of optimising use of resources, improving service delivery and enhancing Zimbabwe's rural infrastructure.

1.4 Aim of the Study

This study aims to develop a comprehensive framework for enhancing the operational efficiency of RIDA's marine transport operations in Kariba.

1.5 Objectives of the Study

The study is guided by the following objectives:

1.5.1 Primary objective:

To develop a framework for improving the operational efficiency of RIDA's marine transport operations in Kariba by 2026.

1.5.2 Specific objectives:

- a) Specific objective 1: To assess the current level of operational efficiency of RIDA's marine transport services in Kariba.
- b) Specific objective 2: To identify the key factors affecting operational efficiency in RIDA's marine operations.
- c) Specific objective 3: To develop an evidence-based framework for improving operational efficiency in RIDA's marine transport operations by 2026.

1.6 Research Questions

The study is grounded on the following research questions:

- a) Primary research question: How can the operational efficiency of RIDA's marine transport operations in Kariba be enhanced?
- b) Research question 1: What is the current level of operational efficiency of RIDA's marine services in Kariba?
- c) Research question 2: What factors influence operational efficiency in RIDA's marine operations?
- d) Research question 3: What framework can be implemented to improve the operational performance of RIDA's marine transport services?

No formal hypotheses are proposed because the study is primarily exploratory and framework-development oriented.

1.7 Assumptions of the Study

The study was premised on four assumptions. It was assumed that participants would provide accurate, honest and complete responses during interviews and surveys, with any social-desirability bias mitigated through anonymity assurances and multi-source triangulation. It was further assumed that RIDA's operational records and documents were sufficiently reliable and accessible for analysis, acknowledging that minor inconsistencies common to resource-constrained public sector organisations would be identified and noted. Additionally, it was assumed that the relevant authorities and stakeholders would grant the researcher the required access and institutional support, as confirmed by formal authority letters obtained prior to fieldwork (Appendix H and I). Finally, it was assumed that the operating conditions prevailing during the 2026 study period were broadly representative of typical marine operations in Kariba, supported by the analysis of six years of historical operational records (2020–2026) capturing multiple seasonal cycles and operational states.

1.8 Justification of the Study

This study is justified because it addresses critical inefficiencies that affect rural connectivity, service delivery and economic activity in the Kariba region. By identifying the root causes of poor operational performance and proposing an evidence-based improvement framework, the study supports resource optimisation, cost reduction and improved organisational performance within RIDA.

The study is further justified by the limited empirical research on public marine transport operations in Zimbabwe. It contributes practical knowledge that can support decision-making by RIDA management and policy makers while also advancing scholarly understanding of inland waterway transport efficiency in developing-country contexts. The operational efficiency enhancement framework developed through this research also possesses substantial transferability potential, offering a replicable model applicable to other inland waterway operators across Sub-Saharan Africa.

1.9 Significance of the Study

The study holds significance for multiple stakeholder groups. For policy makers, the findings will inform inland water transport planning, policy formulation and resource allocation under national development frameworks including NDS2 and Vision 2030 (Government of Zimbabwe, 2021; The Herald Online, 2025), providing an evidence base for decentralisation and revenue-ringfencing policy decisions. For RIDA management, the study provides practical, data-grounded recommendations for improving maintenance systems, vessel utilisation, scheduling and operational control — all derived from triangulated field evidence rather than generic best-practice prescriptions. For the academic community, the research contributes to the very limited literature on public-sector marine transport efficiency in Zimbabwe and Southern Africa, building on frameworks from Barney (1991), Slack, Brandon-Jones and Burgess (2022) and Calderón-Rivera, Bartusevičienė and Ballini (2024) while extending them through novel contextually grounded findings. For local communities and service users — particularly in Charara, Gachegache and Msampakaruma — improved marine operations will directly enhance access to markets, healthcare, education and public services while strengthening fishing-related livelihoods (FAO, 2022; Kolding, van Zwieten and Marttin, 2019; Zimbabwe Tourism Authority, 2022).

1.10 Delimitation of the Study

The study is delimited geographically to Lake Kariba, focusing specifically on RIDA's marine transport operations serving communities such as Charara, Gachegache and Msampakaruma. Temporally, the study analyses operational data from 2020 to 2026, with fieldwork conducted in 2026. Conceptually, the study focuses on operational efficiency, with particular attention to maintenance practices, vessel reliability, turnaround time, service reliability, safety compliance and resource utilization. The study deliberately excludes comprehensive financial performance analysis beyond operational costs, national policy formulation processes at ministerial level, and detailed environmental sustainability considerations beyond basic regulatory compliance.

1.11 Limitations of the Study

The study may be affected by a limited fieldwork period, which may not capture long-term seasonal operational patterns. Operational records including historical fuel consumption logs and maintenance documentation may be incomplete or inconsistently maintained, a common challenge in resource-constrained public sector organisations. Respondent bias is also a potential limitation, particularly among junior staff who may provide socially desirable responses. These limitations

are mitigated through the use of five-year historical records, triangulation of data sources and the inclusion of multiple respondent categories to improve validity and reliability. The study is conducted over a limited period (3 months), which may fail to capture long-term operational patterns such as seasonal variations and maintenance cycles.

1.12 Definition of Key Terms

- a) Operational efficiency: the ability of an organisation to deliver services effectively with optimal use of time, funds, labour, fuel and equipment (Karatuğ, Arslanoğlu and Soares, 2023).
- b) Marine transport: the movement of passengers, goods or services across water bodies using vessels such as ferries and boats (Rodrigue, Comtois and Slack, 2020).
- c) Inland waterway transport (IWT): transport conducted on rivers, lakes, canals and reservoirs rather than on oceans or seas (UNCTAD, 2024).
- d) Preventive maintenance: planned and routine servicing of equipment or vessels in order to reduce the risk of breakdowns and operational failure (IMO, 2018).
- e) Turnaround time: the total time required for a vessel to complete a full operational cycle, including loading, travel, unloading and preparation for the next trip (Abdulrahmani, 2025).
- f) Framework: a structured set of principles, processes and interventions developed to guide improvement in a specific area of organisational performance (Saunders, Lewis and Thornhill, 2023).

1.13 Dissertation Outline

The dissertation follows the following outline:

- a) Chapter One presents the introduction, background to the study, statement of the problem, research objectives, research questions, justification, significance, delimitations, limitations and definitions of key terms.
- b) Chapter Two reviews related literature and theoretical perspectives relevant to marine transport operational efficiency.
- c) Chapter Three explains the research methodology, including research design, population, sampling, data collection methods and data analysis procedures
- d) Chapter Four presents, analyses and discusses the empirical findings of the study.

- e) Chapter Five provides conclusions, recommendations and the proposed operational efficiency enhancement framework.

1.14 Chapter Summary

This chapter introduced the study by presenting the global, regional and local context of marine transport operations and narrowing the focus to RIDA's marine services in Kariba. It identified persistent operational inefficiencies as the main research problem and outlined the aim, objectives, research questions, assumptions, justification, significance, scope, limitations and key terms of the study. The chapter also presented the structure of the dissertation. The next chapter reviews the literature related to marine transport efficiency and framework development.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 Introduction

This chapter presents a comprehensive and critical review of relevant theoretical and empirical literature addressing operational efficiency in marine and inland waterway transport systems, with particular emphasis on identifying conceptual frameworks, theoretical foundations, empirical evidence, best practices and knowledge gaps relevant to the research problem of developing a framework for enhancing efficiency of marine operations in the Rural Infrastructure Development Agency (RIDA) in Kariba, Zimbabwe. The literature review is systematically structured to progressively build understanding from broad theoretical foundations to specific empirical evidence, ultimately establishing the conceptual and analytical frameworks guiding this study.

Inland waterway transport (IWT) has progressively gained scholarly and policy attention as a cost-effective, energy-efficient and environmentally sustainable transportation mode capable of supporting economic development while generating substantially lower greenhouse gas emissions compared to road and rail alternatives (UNCTAD, 2024; Sys et al., 2020). Natalia Calderón-Rivera, Bartusevičienė and Ballini (2024) posits that IWT systems function as integrated socio-technical systems consisting of three interconnected components namely waterways providing the physical transport medium, vessels constituting the mobile transport units and ports or landing facilities enabling cargo and passenger transfer. All three components must operate cohesively and efficiently to achieve optimal system performance outcomes. This systems perspective proved particularly relevant for understanding marine operations in Kariba, where multiple operational components such as vessels, crews, maintenance systems, port facilities, regulatory frameworks and environmental conditions interact dynamically to determine overall efficiency outcomes.

According to the World Bank (2023) and Danladi et al. (2024), despite the well-known benefits of reducing costs, being more energy efficient, having less environmental impact and moving bulk cargo, many developing countries continue to underutilise their inland waterways because of ongoing operational inefficiencies, lack of investment in infrastructure, weak institutional frameworks and poor management systems. In Zimbabwe, the Rural Infrastructure Development Agency provides ferry services on Lake Kariba to remote and isolated lakeside communities with limited access to any other transport modes. Understanding the multidimensional factors

influencing operational efficiency in such contexts requires systematic examination of both internal operational practices and external institutional and environmental conditions that shape performance outcomes (Chen et al., 2025; Calderón-Rivera, Bartusevičienė and Ballini, 2024).

This chapter commences by articulating the conceptual framework, defining key concepts and their interrelationships, followed by examination of the theoretical framework establishing the study's analytical foundations. Subsequently, a comprehensive review of empirical literature was presented in three thematic subsections addressing the specific objectives of this study i.e assessment of current operational efficiency in marine transport services, factors influencing operational efficiency and frameworks for enhancing operational efficiency. The chapter concludes by identifying significant knowledge gaps in existing literature and providing a summary that bridges to the methodology chapter.

2.2 Conceptual Framework

The conceptual framework constituted the analytical architecture for this study, articulating key concepts, defining their dimensions, establishing their interrelationships and specifying variables to be investigated. A robust conceptual framework serves multiple functions i.e it clarifies fundamental constructs underpinning the research, it specifies how variables relate to each other theoretically, it guides operationalisation and measurement of variables and it provides logical structure for empirical investigation (Creswell and Creswell, 2018; Saunders, Lewis and Thornhill, 2023).

The central concept in this study is operational efficiency in marine transport, which Agüero-Tobar, González-Araya and González-Ramírez (2023) define as the degree to which organisations effectively utilise available resources including vessels, fuel, human capital, financial resources, time and infrastructure to achieve desired operational outcomes while minimising waste, reducing costs and maximising service delivery. Within inland waterway and ferry transport systems, operational efficiency is not a unidimensional construct but rather a multifaceted phenomenon encompassing several interrelated dimensions:

- a. Technical efficiency, reflecting the physical productivity of vessels and equipment in converting inputs to transport services.

- b. Allocative efficiency, indicating optimal resource allocation across competing operational priorities.
- c. Service reliability, measuring consistency and predictability of service delivery.
- d. Safety performance, assessing incident prevention and compliance with safety protocols.
- e. Financial sustainability, evaluating cost-effectiveness and revenue generation capacity.

(Danladi et al., 2024; Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024)

The measurement of operational performance usually relies on several linked indicators, which, when considered together, account for a wide range of factors relevant to operational effectiveness. These frequently used indicators include the vessel turnaround time which measures the total time that is taken for a complete operational cycle from departure to return, service reliability which measures the percentage of scheduled trips that are made as planned without interruption or significant delay, vessel downtime which measures the percentage of times vessels are non-operational due to maintenance, repair or other disruptions, trip frequency which is the number of trips completed during a specified time-frame, resource utilisation rates which measures the efficiency with which fuel, personnel and equipment are deployed and safety compliance levels which assesses the level of compliance with regulatory and safety requirements (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024; Abdulrahmani, 2025) . These multidimensional indicators together reflect how organisations convert their operational inputs into valuable service outputs, thus enabling systematic appraisal, benchmarking and performance improvement.

2.2.1 Operational Determinants

The conceptual framework for this study posits that operational efficiency of RIDA's marine transport operations can be influenced by five main categories of operational determinants. Firstly, the maintenance management practices such as preventive maintenance scheduling, corrective maintenance responsiveness, spare parts inventory management and technical capacity to execute repairs and servicing (Karatuğ, Arslanoğlu and Soares, 2023; Abdulrahmani, 2025). The second aspect involves planning and scheduling of operations which includes trip scheduling effectiveness, route optimisation, planning of capacity utilisation and schedule adherence mechanisms (Agüero-Tobar, González-Araya and González-Ramírez, 2023). Human resource capacity comprises the competencies of the workforce, training, staffing levels, employee

motivation and supervision (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024; Ship Universe, 2024).

Forth, safety management includes the availability of safety equipment, the compliance to safety protocols, the risk assessment practices and the incident response systems (IMO, 2018; Damson, Mtui and Kileo, 2025). Lastly, available resources and allocation address adequacy of fuel supply, spare parts availability, allocation of financial resources and ships (World Bank, 2023).

2.2.2 Moderating Variables

Critically, these operational determinants do not operate in isolation but interact within an institutional and environmental context characterised by several moderating variables that shape the strength and direction of relationships between operational determinants and efficiency outcomes. These moderating variables include budget availability and funding predictability affecting procurement capabilities and maintenance capacity, Government policies and institutional mandates shaping operational priorities and resource allocation decisions, weather conditions and seasonal variations on Lake Kariba affecting navigability, safety and service continuity, water level fluctuations influencing route accessibility and vessel operations and regulatory frameworks establishing operational standards, safety requirements and compliance expectations.(Zambezi River Authority, 2023; Government of Zimbabwe, 2021)

The conceptual framework thus adopts a contingency perspective, recognising that optimal operational strategies must be contextually adapted to prevailing environmental conditions and institutional arrangements rather than universally applied without regard to context (Donaldson, 2001).

2.2.3 Dependent Variable and Outcomes

The dependent variable, operational efficiency, is conceptualized as a composite construct measured through multiple indicators:

- a) Number of trips completed per time period
- b) Vessel downtime duration expressed as percentage of available operating time
- c) Breakdown frequency indicating mechanical reliability
- d) Trip turnaround time measuring operational speed and productivity

- e) Service reliability rates reflecting schedule adherence and service consistency
- f) Fuel consumption efficiency assessing resource productivity

(Agüero-Tobar, González-Araya and González-Ramírez, 2023)

Enhanced operational efficiency is hypothesised to generate several positive outcomes:

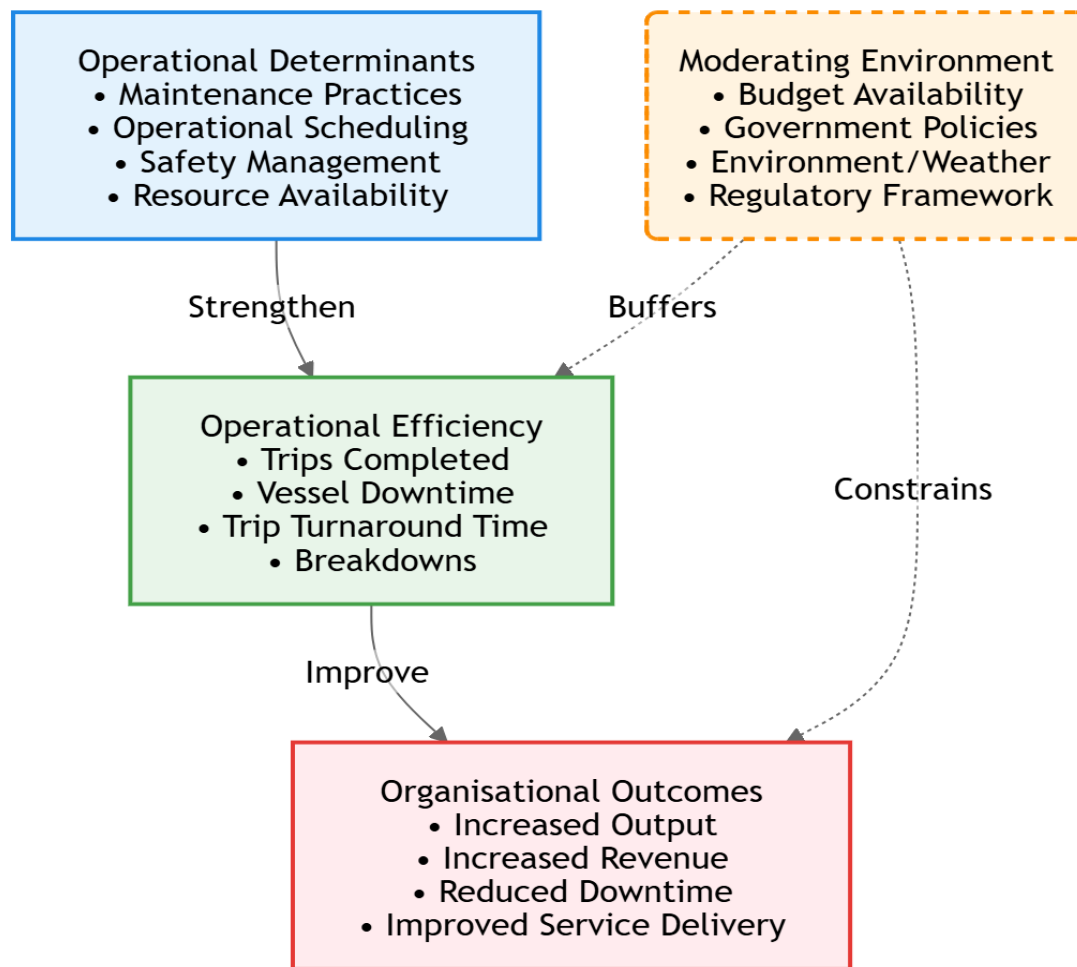
- g) Improved service delivery to remote lakeshore communities enhancing transport accessibility
- h) Reduced operational costs through waste elimination and resource optimisation
- i) Increased operational output enabling more frequent trips and greater cargo/passenger capacity utilisation
- j) Enhanced safety performance protecting passengers and crews
- k) Improved financial sustainability through increased revenue generation and cost reduction

(Rural Infrastructure Development Agency, 2025)

Graphically, the conceptual framework depicts direct causal relationships from independent variables (operational determinants) to the dependent variable (operational efficiency), with moderating variables influencing the strength of these relationships. Enhanced operational efficiency subsequently produces improved organisational and developmental outcomes including better service delivery, financial sustainability and community development impacts. This conceptual architecture guides the empirical investigation by specifying variables to be measured, and contextual factors to be considered in developing the efficiency enhancement framework.

Figure 2.1 below presents the conceptual framework, clearly indicating how the variables interact to produce operational efficiency:

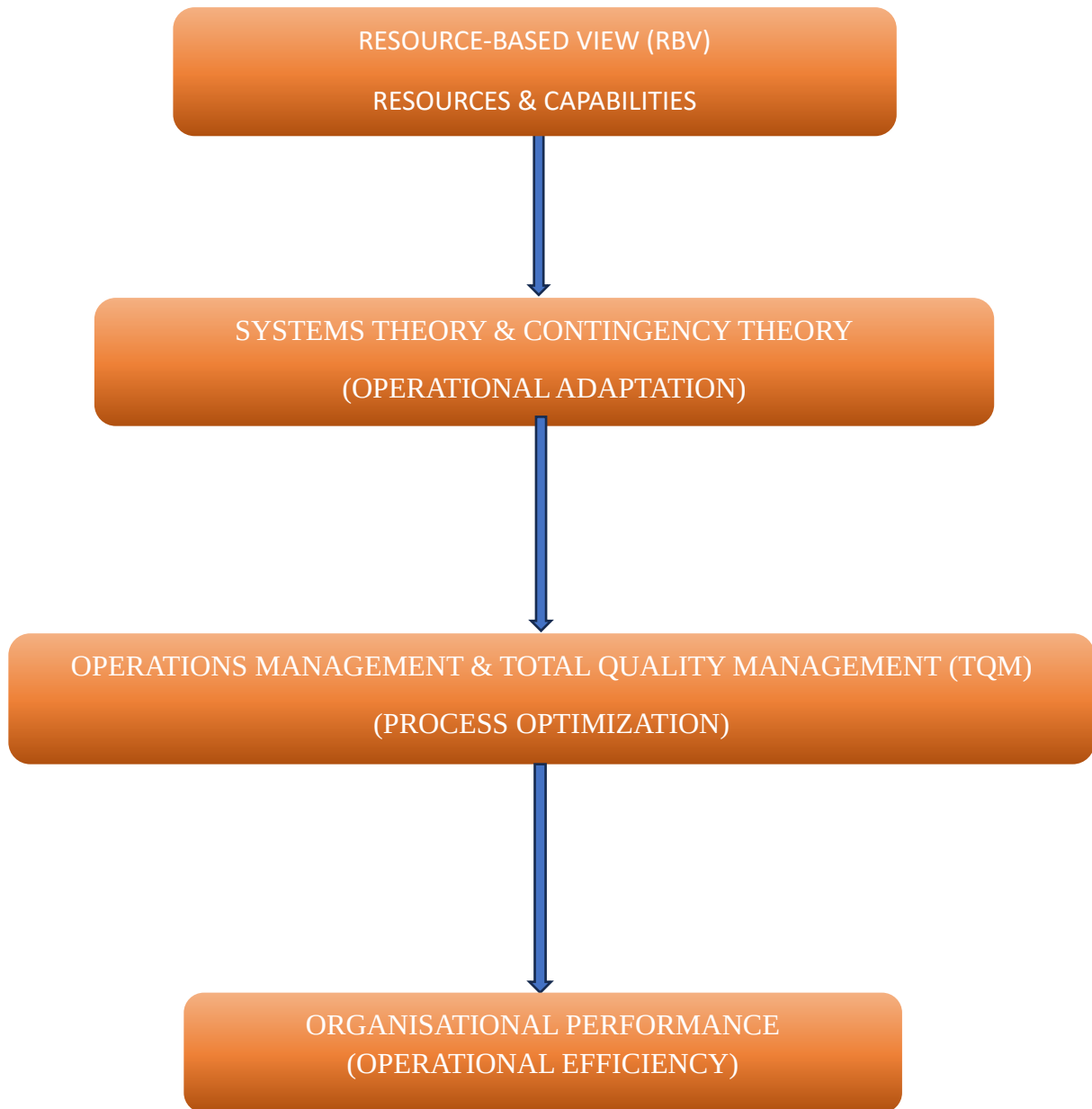
Figure 2.1: Proposed Conceptual Framework, Source: Researcher's construct(2026)



2.3 Theoretical Framework

The theoretical framework sets out the conceptual structure of the research by identifying, framing and synthesising relevant theories that explain relationships between key variables, suggests analysis methods and supports framework development. While the conceptual framework indicates the specific variables which will be tested and how they are related, the theoretical frameworks state why that relationship is so based on a theory which is already proven and documented (Creswell and Creswell, 2018; Saunders, Lewis and Thornhill, 2023). The theoretical framework of this study adopted a multi-theoretical perspective that integrates complementary theories which jointly yield an enhanced explanatory power for operational efficiency in the context of marine transport of RIDA as shown in Figure 2.2 below.

Figure 2.2 Proposed Theoretical Framework, Source: Researcher's construct (2026)



2.3.1 Resource-Based View (RBV) – Overarching Theoretical Foundation

The overarching theoretical framework of this study was the Resource-Based View(RBV). According to the Resource-based view “organizational performance fundamentally depends on the

effective acquisition, development, deployment and protection of internal resources and capabilities that are valuable, rare, costly to imitate and organized to capture or create value or the so called VRIO attributes (Barney 1991; Barney and Hesterly 2021).” According to Barney and Hesterly (2021), resources consist of tangible physical resources (including facilities or equipment and financial capital), human resources (skills, knowledge, experience and relationships), and intangible organisational resources (Barney and Hesterly, 2021).

Within RIDA’s marine transport operations context, critical tangible resources include marine vessels and watercraft, maintenance facilities and workshop equipment, fuel supplies and storage infrastructure, spare parts inventories, safety equipment and financial capital for operational expenditure (RIDA, 2025). Human resources encompass skilled marine crews, qualified technical maintenance personnel, experienced operations managers and support staff. Organisational resources include operational procedures, maintenance management systems, safety protocols, scheduling systems, and accumulated operational knowledge (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024).

Based on RBV, operational inefficiencies occur when strategic resources are inadequate, poorly managed, insufficiently allocated, underutilised, or used incorrectly (Barney 1991). The theory explains that resources definitely impact operational performance in an organization. Transport systems in the public sector such as those operating on Lake Kariba are often inefficient due to constraints related to resources. These constraints include disruptions in fuel supplies preventing scheduled trips, failure to have vessels ready for the water due to maintenance backlog and equipment failures, shortage of spare parts causing long repair times, inadequate financial allocation limiting the procurement and maintenance of vessels and spares and short-staffing hindering operational capacity (Abdulrahmani, 2025; World Bank, 2023).

RBV was adopted as the study’s overarching theoretical framework because it comprehensively explains the foundational role of physical, financial and human resources in determining operational capability and performance of marine transport systems operating in resource-constrained environments typical of developing country public sectors (Barney and Hesterly, 2021). The framework to be developed in this study thus prioritises strategic resource management as a central component of efficiency enhancement.

2.3.2 Systems Theory

Systems Theory conceptualises organisations as integrated systems composed of interconnected, interdependent components such as inputs, transformation processes, outputs and feedback mechanisms that interact dynamically within broader environmental contexts to achieve specific objectives (Von Bertalanffy, 1968; Slack, Brandon-Jones and Burgess, 2022). This perspective emphasises holistic understanding of organisational functioning, recognising that individual components or units influence each other and that changes in one component cascade through the system affecting others.

In marine transport operations, the systems perspective identifies:

- a. Inputs including ferries and vessels, fuel, skilled crews, spare parts, safety equipment and financial resources
- b. Transformation processes encompassing trip scheduling, voyage execution, vessel operation and navigation, loading and unloading procedures, maintenance activities and crew management
- c. Outputs comprising completed trips, transported passengers and cargo, service reliability and safety performance
- d. Feedback mechanisms including operational performance data, customer feedback, incident reports and maintenance records that inform continuous improvement

(Slack, Brandon-Jones and Burgess, 2022; Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024)

Systems Theory refers to the malfunction of any component of the system, which hampers operational efficiency. Non-existent maintenance practices initiate vessel breakdowns that interrupt operations. Additionally, inappropriate scheduling contributes to service delays and resource underutilisation. Above all, insufficient fuel supplies interrupt service operations. In conclusion, a limited spare parts inventory prolongs repair turnaround times, extending the vessel's downtime (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024). Moreover, the theory highlights that if the integration and coordination mechanisms are weakened, optimization of individual components would not be able to improve the overall performance of the system.

System-level optimization needs a simultaneous focus on both component efficiency and coordination.

Systems Theory supports this study by providing a framework for understanding how operational determinants interact dynamically to influence efficiency outcomes, preventing unrealistic assumptions that variables act independently. It guides development of integrated efficiency enhancement frameworks that address multiple operational dimensions simultaneously rather than fragmented, single-issue interventions (Von Bertalanffy, 1968).

2.3.3 Operations Management Theory

Operations Management Theory focuses on efficient design, management, continuous improvement and optimisation of organisational processes producing goods or delivering services (Slack, Brandon-Jones and Burgess, 2022). The theory emphasises five key performance objectives that drive operational excellence: quality (consistency and reliability of outputs), speed (minimising time from input to output), dependability (keeping promises and meeting deadlines), flexibility (ability to adapt to changing demands) and cost (minimising resource consumption while maintaining quality) (Slack and Brandon-Jones, 2019).

Within RIDA's marine transport context, operations management principles directly apply to multiple operational dimensions. Ferry scheduling optimisation aims to maximise vessel utilisation while meeting passenger demand patterns and operational constraints (Agüero-Tobar, González-Araya and González-Ramírez, 2023). Maintenance management systems seek to optimise the trade-off between preventive maintenance costs and breakdown-related disruption costs while maximising vessel availability (Karatuğ, Arslanoğlu and Soares, 2023). Crew deployment strategies balance labor costs against service quality requirements. Safety management protocols integrate regulatory compliance with operational efficiency objectives. Resource allocation mechanisms optimise utilisation of fuel, spare parts, and financial resources across competing operational priorities (Slack, Brandon-Jones and Burgess, 2022).

Operations management literature identifies several analytical tools relevant to efficiency assessment: performance measurement systems tracking key performance indicators, process mapping techniques visualising operational workflows and identifying bottlenecks, capacity analysis methods assessing resource utilisation rates and queue management approaches

optimising service delivery under demand variability (Slack and Brandon-Jones, 2019). Effective management of these operational processes reduces vessel downtime, improves service reliability, increases operational productivity, optimises resource consumption and enhances customer satisfaction (Agüero-Tobar, González-Araya and González-Ramírez, 2023).

This theory provides analytical principles for examining operational inefficiencies and designing evidence-based strategies to improve operational performance, particularly regarding scheduling effectiveness, maintenance optimisation, turnaround time reduction and resource productivity enhancement (Slack, Brandon-Jones and Burgess, 2022).

2.3.4 Contingency Theory

Contingency Theory posits that organisational effectiveness depends on achieving appropriate fit between internal operational strategies, organisational structures, management practices and external environmental conditions, with no universally optimal management approach applicable across all contexts (Donaldson, 2001). The theory explicitly rejects “one best way” approaches to management, arguing instead that effective strategies are contingent upon situational factors including environmental uncertainty, technological characteristics, organisational size and strategic objectives.

This theory explains how environmental and institutional conditions moderate relationships between operational determinants and efficiency outcomes in marine transport operations. The study’s conceptual framework incorporates several moderating variables whose effects Contingency Theory explicitly addresses i.e weather conditions on Lake Kariba affecting navigability and safety, seasonal water level variations influencing route accessibility, government policies shaping operational priorities and resource availability, regulatory frameworks establishing compliance requirements and budget availability constraining resource procurement and maintenance capacity (Zambezi River Authority, 2023; Government of Zimbabwe, 2021).

Even with well-trained crews, properly maintained vessels and effective scheduling systems, marine operations may experience inefficiency if low water levels restrict navigation to certain routes or time periods, severe weather conditions prevent safe sailing or budget shortages disrupt fuel supply continuity. This demonstrates that relationships between operational determinants (independent variables) and efficiency outcomes (dependent variable) are moderated by external

contextual factors beyond direct organisational control (Donaldson, 2001; Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024).

Contingency Theory guides development of context-appropriate operational strategies tailored to prevailing environmental conditions, institutional arrangements, resource availability and operational constraints rather than applying generic best practices without contextual adaptation. It emphasises importance of flexibility, adaptability and resilience in operational management systems to maintain performance under varying conditions (Donaldson, 2001).

2.3.5 Lean Management Principles and Total Quality Management

Lean Management emphasises eliminating waste and maximising value in operations by systematically identifying and removing non-value-adding activities while optimising value-creating processes (Womack and Jones, 2003). Lean philosophy identifies seven categories of operational waste: overproduction (producing more than needed), waiting time (idle resources), unnecessary transportation, over-processing (excessive or incorrect processing), excess inventory, unnecessary motion and defects requiring rework (Womack and Jones, 2003).

Within RIDA's marine operations, waste manifestations include:

- l) Vessels idling due to fuel shortages or maintenance delays (waiting time)
- m) Excessive loading and unloading delays reducing trip frequency (motion and waiting)
- n) Prolonged turnaround times due to inefficient processes (over-processing)
- o) Repeated breakdowns attributable to reactive rather than preventive maintenance (defects)
- p) Underutilisation of vessel capacity (resource waste)

(Global Maritime Forum, 2025)

Lean principles help interpret these inefficiencies as non-value-adding activities that consume resources without contributing to service delivery, thereby reducing operational efficiency and customer satisfaction (Womack and Jones, 2003).

2.3.6 Total Quality Management (TQM)

Provides complementary theoretical foundations emphasising continuous improvement, quality assurance, prevention rather than detection of defects, employee involvement, customer focus and

systematic management of processes (Deming, 1986). TQM principles are codified in international quality management standards including ISO 9001:2015 that specify requirements for quality management systems applicable across industries and sectors.

Safety management, service dependability as well as staff training are essential elements in the current study's conceptual framework that TQM addresses directly. Unless safety compliance procedures are implemented, the threats of accidents increase, vessel downtime rises due to accidents and investigations, service reliability goes down and this undermines the organisation's reputation, which is why quality management practices are connected to operational efficiency outcomes (Karatuğ, Arslanoğlu and Soares, 2023; Damson, Mtui and Kileo, 2025). In the same way, ineffective scheduling, unreliable service delivery or customer service failures disregarding service quality detracts from organisational legitimacy and stakeholder confidence.

These theories support the study by providing frameworks for process improvement implementation, waste elimination strategies, quality enhancement initiatives and continuous performance monitoring relevant to RIDA's marine operations (Global Maritime Forum, 2025; Womack and Jones, 2003).

2.3.7 Theoretical Integration and synthesis of foundational theories

While each theory offers distinct insights, they are complementary rather than competing, collectively providing comprehensive explanatory frameworks for understanding operational efficiency as: RBV explains what resources are needed and why they matter, Systems Theory explains how operational components interact, Operations Management Theory provides analytical tools for efficiency assessment and improvement, Contingency Theory explains why context matters and how environmental factors moderate operational strategies and Lean Management and TQM provide principles for waste elimination and quality enhancement.

2.4 Review of Empirical Literature

This section presents a comprehensive and critical review of empirical studies investigating operational efficiency in marine and inland waterway transport systems. The review is organised thematically around three focal areas aligned with the study objectives: (1) assessment methodologies for evaluating operational efficiency of marine transport services; (2) empirical

evidence on factors influencing operational efficiency and (3) frameworks and interventions for enhancing operational efficiency. Following thematic review, knowledge gaps in existing literature are synthesised to justify this study's contribution.

2.4.1 Assessing operational efficiency of marine transport services

Empirical research on operational efficiency assessment in marine and inland waterway transport employs diverse methodological approaches reflecting the multidimensional nature of efficiency constructs. Quantitative efficiency assessment methods are prominent in port and shipping literature, with Data Envelopment Analysis (DEA) emerging as the most widely applied technique for comparative efficiency evaluation.

Agüero-Tobar, González-Araya and González-Ramírez (2023) utilised DEA to assess maritime operations efficiency and its economic impact across Chilean ports, demonstrating how this non-parametric method enables comparison of relative efficiency across multiple operational units while accommodating multiple inputs and outputs without requiring predetermined functional relationships. Their study identified significant efficiency variations across Chilean port facilities, with technical efficiency scores ranging from 0.62 to 1.00, indicating substantial improvement potential in lower-performing ports. Critically, the research established positive correlations between operational efficiency levels and regional economic indicators including employment generation, GDP contribution and trade facilitation, thereby demonstrating broader developmental significance of maritime operational efficiency beyond immediate organisational performance (Agüero-Tobar, González-Araya and González-Ramírez, 2023).

Similarly, Danladi et al. (2024) employed DEA methodology to analyse efficiency of container ports operating in lower-middle-income countries across Africa, Asia, and Latin America. Their analysis revealed that operational scale, technological adoption, management practices and institutional quality significantly influenced relative efficiency levels, with average technical efficiency scores of 0.74 indicating widespread inefficiency and substantial potential for performance improvement through better resource management and operational practices.

Beyond DEA techniques, empirical studies often utilize various efficiency measures that capture different dimensions of performance. Abdulrahmani (2025) used reliability engineering metrics to investigate the ferry availability performance at TASHICO ferry service, Tanzania. Investigated

metrics were Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR), which reflects effectiveness of maintenance management. According to the study, vessels were only available 68% of the time. The international best practices recommend a vessel availability of 85%-90%. The unavailability was mainly due to prolonged repair times and delays in spare parts procurement. Also, a reactive maintenance ethos rather than a preventive maintenance was primarily responsible (Abdulrahmani, 2025). The study demonstrated that the availability metrics can provide useful information to improve maintenance management by linking technical reliability measures and operational efficiency outcomes.

Damson, Mtui and Kileo (2025) also looked into reliability performance of ferries at TEMESA Magogoni ferry service in Tanzania which indicated average vessel downtime of 35% and a breakdown frequency of about 2.8/month. The findings of their analysis indicated that unplanned maintenance contributes to 72% of total maintenance, signifying the insufficient execution of preventive maintenance and excessive reliance on breakdown. According to the study undertaken, service interruptions that are attributed to downtime incur annual revenue losses exceeding USD 180,000 whilst compromising passenger safety and convenience thereby displaying the financial and social costs of operational inefficiency (Damson, Mtui and Kileo, 2025).

Service reliability metrics constitute another prominent efficiency assessment approach in empirical literature. Calderón-Rivera, Bartusevičienė and Ballini (2024) conducted systematic literature review of sustainable inland waterway transport development, identifying schedule adherence rates, trip completion rates and service punctuality as commonly employed operational performance indicators across diverse geographical contexts. Their synthesis revealed that European inland waterway systems typically achieve schedule reliability rates exceeding 90%, while developing country systems frequently report reliability below 70%, attributed to infrastructure deficiencies, maintenance challenges, resource constraints and institutional weaknesses (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024).

Operational productivity metrics including trip frequencies, turnaround times and capacity utilisation rates also feature prominently in efficiency assessments. Research on ferry operations consistently demonstrates that reducing turnaround time, the duration from departure to return readiness directly increases vessel productivity by enabling more frequent trips without additional vessel investment (Slack, Brandon-Jones and Burgess, 2022). However, turnaround time

optimisation requires coordinated improvements across multiple operational dimensions including faster loading/unloading procedures, efficient refueling systems, reduced administrative processing time and effective crew changeover management (Agüero-Tobar, González-Araya and González-Ramírez, 2023).

More and more safety performance indicators are increasingly being included in modern efficiency assessments which show that safety and efficiency are complementary and not conflicting objectives. The IMO's safety management framework states that effective safety management systems enhance operational efficiency by preventing accidents that cause costly delays, vessel damage and disruption of service (IMO, 2018). Research shows a positive relationship between safety compliance levels and operational reliability, meaning that organisations that invest in safety management are usually more likely to also invest in maintenance, crew training, operational discipline and efficiency (Karatuğ, Arslanoğlu and Soares, 2023).

Despite methodological diversity, several cross-cutting themes emerge from efficiency assessment literature:

- a. Operational efficiency is multidimensional, requiring multiple indicators rather than single metrics to comprehensively capture performance
- b. Efficiency assessment must consider context-specific factors including operational scale, service types, geographical conditions and institutional arrangements that influence performance benchmarks
- c. Efficiency assessment should integrate technical, service, financial and safety metrics to provide holistic performance evaluation

(Danladi et al., 2024; Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024)

2.4.2 Factors Influencing Operational Efficiency of Marine Operations

Empirical research identifies multiple interrelated factors that significantly influence operational efficiency in marine and inland waterway transport systems. These factors can be categorised into internal organisational factors directly controllable by management and external environmental factors that constrain or enable operational performance.

2.4.2.1 Maintenance Management Practices

Maintenance management emerged as the most consistently identified determinant of operational efficiency across diverse empirical studies. Karatuğ, Arslanoğlu and Soares (2023) conducted comprehensive review of maintenance strategies for ship machinery systems, documenting progressive evolution from reactive corrective maintenance toward preventive, condition-based and predictive maintenance paradigms. Their analysis revealed that organisations implementing systematic preventive maintenance programs achieve 30-45% reductions in unexpected failures, 20-35% improvements in vessel availability and 15-25% decreases in total maintenance costs, compared to reactive maintenance approaches (Karatuğ, Arslanoğlu and Soares, 2023).

Abdulrahmani (2025) empirically investigated maintenance management systems at Tanzania's TASHICO ferry operations, finding that absence of systematic planned maintenance systems generated multiple negative consequences: High breakdown frequencies averaging 3.2 incidents per vessel monthly, prolonged repair times averaging 8.4 days per incident due to spare parts procurement delays, low vessel availability averaging 68% and excessive reliance on expensive emergency repairs. Implementation of Planned Maintenance Systems (PMS) incorporating preventive maintenance schedules, spare parts inventory management, technical documentation systems and staff training programmes was recommended to systematically address these deficiencies (Abdulrahmani, 2025).

Likewise, Damson, Mtui and Kileo (2025) studied maintenance management at the TEMESA Magogoni ferry service, finding that 72% of maintenance intervention were unplanned reactive interventions rather than scheduled preventive maintenance. As a result of this reactive approach, vessel downtimes averaged approximately 35% of their potential operating time, service interruptions affected thousands of passengers every month and there were annual revenue losses estimated at more than USD 180,000. The research designed and assessed a computerised Maintenance Management Information System (MMIS) encompassing maintenance scheduling, work order management, spare parts inventory tracking and performance monitoring functionalities. Pilot implementation reduced unplanned downtime by 40% and vessel availability reached 85% through systematic preventive maintenance (Damson, Mtui and Kileo, 2025).

Contemporary literature emphasises transition toward predictive maintenance approaches leveraging digital technologies. Tubis et al. (2025) developed a digital maturity model for inland waterway transport, demonstrating how Internet of Things(IoT) sensors, real-time monitoring systems, data analytics and machine learning algorithms enable condition-based maintenance that predicts equipment failures before they occur, optimises maintenance scheduling based on actual equipment condition rather than fixed intervals and maximises vessel availability while minimising maintenance costs. However, predictive maintenance adoption requires substantial technological investment, technical capacity and organisational readiness, presenting implementation challenges particularly for resource-constrained organisations in developing countries (Chen et al., 2025; Tubis et al., 2025).

2.4.2.2 Human Resource Capacity and Workforce Competence

The capacity of the workforce, adequacy of training, level of staff and motivation of staff are important efficiency determinants which have consistently been identified in empirical literature. Natalia Calderón-Rivera, Bartusevičienė and Ballini (2024) synthesised evidence which show that skilled, well-trained and highly motivated personnel are necessary for safe functioning, problem solving, service quality and the continuous improvement processes. Inadequate training, insufficient staffing, low motivation and poor working conditions reduce the efficiency of operations due to higher rates of human error, decreased productivity, unsafe incidents and higher staff turnover (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024).

Empirical research documents important human resource influence on marine operating efficiency. Crew incompetence leads to navigation faults, an inability to handle the vessel efficiently, wasting fuel due to bad vessel operation practices and safety issues (World Bank 2023). Gaps in the capacity of technical maintenance personnel prolong the duration of repairs, lower the quality of maintenance works and require the hiring of expensive outside service providers (Abdulrahmani, 2025). Limitations to the capacity of management impede strategic planning, allocation of resources, monitoring of performance and continuous improvement measures (Danladi et al., 2024). Interventions for training and professional development yield positive efficiency effects. According to studies, an organized training program can improve operational safety and reduce incident rates, as well as improve the quality of customer service and employee motivation and job satisfaction. (Ship Universe, 2024). The efficacy of training interventions relies on their

relevance to the needs of operations, quality of training, actual possibilities for doctrinal practical application and organisational culture that supports learning and continuous improvement (Calderón-Rivera, Bartusevičienė and Ballini, 2024).

Employee motivation and job satisfaction affect organisational performance through various channels. Employees who are motivated show better productivity, a greater propensity to take the initiative to solve problems, lower absence and lateness levels, greater commitment to organizational objectives and a greater intent to stay with the organization (Slack, Brandon-Jones and Burgess, 2022). On the contrary, demotivated workforces are absent more often while putting in lesser effort, maintaining lower quality standards and quitting at higher rates disrupting operations and raising recruitment and training costs. Frequent problems in motivating personnel in the public sector context arise because of financial constraints on remuneration, limited career development prospects, bureaucratic inflexibilities and ineffective performance management systems (World Bank, 2023).

2.4.2.3 Resource Availability and Allocation

Adequate availability and effective allocation of operational resources particularly fuel, spare parts, financial resources and vessels constitute fundamental prerequisites for sustained marine transport operations. Empirical research consistently demonstrates that resource constraints significantly impair operational efficiency through multiple mechanisms (World Bank, 2023; Danladi et al., 2024).

In a large number of developing country contexts fuel availability is a significant operational constraint. Shortages in fuel or delays in procurement result in the cancellation of services, disharmonizing schedules, reducing the frequency of trips and reliability of service. Research into the inland waterway systems of Africa notes repeated interruptions to fuel supply due to procurement inefficiency, budget constraints, supplier unreliability and distribution logistics issues (Danladi et al., 2024). The disturbance of the supply chain causes a negative domino effect in the system. This is evident with the inconvenience for passengers, loss of revenue, damage to reputation and diminished confidence from stakeholders.

Spare parts availability directly influences maintenance effectiveness and vessel downtime duration. Research demonstrates that spare parts inventory deficiencies constitute primary causes

of prolonged repair times and extended vessel unavailability in resource-constrained operational contexts (Abdulrahmani, 2025; Damson, Mtui and Kileo, 2025). When required spare parts are unavailable, vessels remain inoperative for extended periods pending procurement, emergency repairs may be attempted using inappropriate substitutes compromising quality and reliability, or expensive external contractors may be engaged increasing maintenance costs. Effective spare parts inventory management systems balancing holding costs against stockout risks are essential but frequently inadequate in public sector organisations (Karatuğ, Arslanoğlu and Soares, 2023).

The adequacy of financial resources & effective allocation influence operational efficiency in many ways. Operational budget constraints limit fuel purchase, maintenance operations, spare parts purchase, training of personnel, supply of safety equipment and maintenance of infrastructure (World Bank, 2023). Unpredictable budgets and delayed release of funding further challenges operational planning and resource management. Although the total funding may be adequate in theory, operational resource shortages may still arise because of misallocation of funds between competing priorities, weak procurement systems and poor financial management (Danladi et al., 2024).

Vessel adequacy and suitability for operational requirements influence efficiency through capacity constraints, operational flexibility and service capability. Insufficient vessel numbers relative to service demand necessitate reduced trip frequencies or service coverage. Vessels inappropriate for operational conditions, excessive size for shallow waters, inadequate passenger capacity for demand levels or unsuitable cargo handling configurations compromise operational effectiveness (Calderón-Rivera, Bartusevičienė and Ballini, 2024).

2.4.2.4 Safety Management Systems

Safety management practices have a wide array of interactions through which it influences operational efficiency. When safety is managed effectively, accidents and incidents that cause major disruptions to the operations, damage to the vessel that require costly repairs, casualties which incur costs, regulatory sanctions and damage are prevented (IMO, 2018). On the other hand, poor safety practices increase the frequencies and severities of accidents which generate an unplanned downtime. They incur costs for emergency response and service interruption which directly hampers the operational efficiency (Karatuğ, Arslanoğlu and Soares, 2023).

Empirical research demonstrates positive associations between safety management system implementation and operational performance indicators. Organisations implementing systematic safety management frameworks including risk assessment procedures, safety equipment provision, crew training programmes, incident reporting systems and continuous safety improvement initiatives demonstrate lower accident rates, reduced insurance premiums, better regulatory compliance and enhanced operational reliability compared to organisations with weak safety cultures (IMO, 2018; Damson, Mtui and Kileo, 2025).

However, safety management system effectiveness depends on genuine organisational commitment rather than merely superficial compliance with regulatory requirements. Research revealed that organisations exhibiting strong safety cultures where safety is genuinely valued, safety concerns are openly communicated, near-miss incidents are systematically investigated and continuous improvement is pursued achieve superior safety and operational outcomes compared to organisations where safety management is treated as bureaucratic compliance exercise (Karatuğ, Arslanoğlu and Soares, 2023).

2.4.2.5 Operational Scheduling and Planning

Scheduling effectiveness influences operational efficiency through impacts on vessel utilisation rates, service frequency, capacity management and resource deployment. Empirical studies demonstrate that systematic scheduling approaches considering demand patterns, operational constraints, crew availability, maintenance requirements and vessel capabilities enhance operational productivity by maximising useful vessel operating time while minimising idle time and inefficient movements (Agüero-Tobar, González-Araya and González-Ramírez, 2023; Slack, Brandon-Jones and Burgess, 2022).

Advanced scheduling approaches employ optimisation algorithms, simulation modelling and decision support systems to evaluate alternative scheduling configurations and identify optimal or near-optimal solutions balancing multiple objectives including service frequency, schedule reliability, operational costs, vessel utilisation and crew working hours (Agüero-Tobar, González-Araya and González-Ramírez, 2023). However, scheduling optimisation requires accurate operational data, analytical capacity, appropriate software tools and organisational capability to

implement sophisticated scheduling systems, resources frequently limited in developing country public sector contexts (World Bank, 2023).

2.4.2.6 Environmental and Institutional Factors

As Contingency Theory (Donaldson, 2001) predicts, external environmental and institutional factors moderate the relationships between internal operational determinants and efficiency outcomes. The safety of navigation and reliability of service are significantly affected by weather and water level changes, seasonal variations and climate extremes (Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024; Zambezi River Authority, 2023). Studies demonstrate that the water levels of Lake Kariba change annually over a cycle. Studies furthermore find that during the dry season, the lake level goes down substantially. As a result, it limits the access routes for vessels to the deep channels. This restriction either limits the vessels' sizes or causes suspension of access for vessels altogether (Zambezi River Authority, 2023).

Regulatory frameworks, government policies, institutional mandates and funding mechanisms are all crucial institutional variables relevant to operational efficiency. According to the World Bank (2023) and Danladi et al. (2024), clear regulatory standards and adequate funding allocations, as well as sound policy environments, enhance performance efficiency while regulatory ambiguities and funding unpredictability, conflicting policy signals, and weak institutional capacity restrict performance. The operational contexts of the public sector would often (but not always) be characterised by complex stakeholder environments, bureaucratic processes, political factors, and multiple accountability relationships, which affect operational decision-making and/or resource allocations differently from private commercial operations (Government of Zimbabwe, 2021).

2.4.3 Framework development for enhancing operational efficiency of marine operations

While substantial empirical literature diagnoses operational efficiency challenges and identifies influencing factors, fewer studies develop comprehensive, actionable frameworks for systematically enhancing operational efficiency in marine transport contexts, particularly frameworks tailored to public sector organisations in developing countries. This subsection reviews existing framework development research, identifying approaches, methodologies and implementation considerations relevant to this study's third objective.

Abdulrahmani (2025) developed a maintenance management system framework specifically designed to increase ferry availability performance at Tanzania's public transport ferry services. The framework integrated several components:

- a. Planned maintenance scheduling system establishing routine inspection frequencies and preventive maintenance intervals based on manufacturer recommendations and operational experience
- b. Computerised maintenance management system (CMMS) enabling work order management, maintenance history tracking and performance monitoring
- c. Spare parts inventory management system optimising stock levels, reorder points and procurement planning
- d. Technical capacity development program enhancing maintenance personnel skills through structured training
- e. Performance monitoring dashboard tracking key indicators including vessel availability, breakdown frequency, Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR)

The framework's development methodology involved situation assessment through operational data analysis, stakeholder interviews and maintenance practice observation, identification of root causes for low ferry availability including inadequate preventive maintenance, spare parts shortages and limited technical capacity, benchmarking against international best practices in ferry maintenance management, framework design integrating evidence-based interventions addressing identified root causes and implementation planning specifying resource requirements, implementation phases and evaluation mechanisms (Abdulrahmani, 2025). While not empirically validated through controlled implementation evaluation, the framework provides a structured, evidence-informed approach to maintenance management improvement applicable to similar public ferry contexts.

Damson, Mtui and Kileo (2025) similarly developed a maintenance management improvement framework for TEMESA Magogoni ferry operations in Tanzania, centered on implementing Maintenance Management Information System (MMIS) technology. Their framework emphasised digital transformation of maintenance processes through computerised systems integrating

planned maintenance scheduling modules generating automated work orders based on time intervals or equipment usage thresholds, spare parts inventory management modules tracking stock levels, consumption patterns and reorder triggers, maintenance history databases recording all maintenance interventions, costs, parts used, and downtime durations, performance analytics modules calculating key performance indicators and generating management reports, mobile applications enabling field technicians to access maintenance information and record completed work in real-time.

The framework development process involved participatory approaches to engage the maintenance personnel, operations manager and ferry crews during needs assessment, system design as well as implementation planning for user acceptance and context legitimacy. The pilot implementation on one of the ferry vessel was able to realize a 42% reduction in unplanned downtime. Further, the vessel availability improved from 65% to 87% over a six months' evaluation period. This offers preliminary evidence of the effectiveness of the framework (Damson, Mtui and Kileo, 2025). However, concerns were raised about software maintenance, technical support and organizational change management and those sustainability challenges were potential barriers to implementation and required on-going attention.

Tubis et al. (2025) developed a comprehensive Digital Maturity Model for inland waterway transport sector, providing framework for assessing current digital technology adoption levels and planning progressive digitalisation pathways. The maturity model defines five progressive levels initial level characterised by paper-based processes and minimal technology use, basic digitisation involving computerised administrative systems, integrated digital systems connecting operational components, data-driven operations leveraging analytics and performance monitoring and lastly, intelligent autonomous systems employing artificial intelligence, machine learning and automation.

For each maturity level, the framework specifies characteristic features, technological requirements, organisational capabilities and expected benefits, enabling organisations to assess current positions and develop realistic digitalisation roadmaps (Tubis et al., 2025).

According to the digital maturity framework, the adoption of technology should be context-appropriate, progressive and supported by organisational development, including building

technical capacity, re-engineering processes and managing change and trying to adopt sophisticated technologies without having the basic digital capabilities and organisational preparedness often leads to implementation failures and money losses (Tubis et al., 2025; Chen et al., 2025). Such insight is useful in developing country contexts where there may be technological infrastructure, technical capacity and financial resource constraints on digital technology adoption.

Chen et al. (2025) proposed comprehensive system architecture for autonomous inland waterway transportation, integrating advanced technologies including autonomous navigation systems, intelligent traffic management, real-time monitoring infrastructure and data integration platforms. While focused on technologically advanced autonomous operations currently beyond most developing country contexts, the study's systems architecture approach, decomposing complex operational systems into modular components with specified interfaces, data flows and integration mechanisms provides methodological insights applicable to framework development for less technologically sophisticated contexts (Chen et al., 2025).

The Global Maritime Forum (2025) published operational efficiency guidelines for shipping operations, synthesising international best practices into actionable frameworks addressing fuel efficiency optimization, voyage planning enhancement, maintenance management improvement, crew performance optimization and digital technology adoption.

While primarily targeting international commercial shipping rather than inland waterway public transport, many principles translate across contexts including systematic performance monitoring using key performance indicators, continuous improvement cultures promoting operational learning and innovation, lean management approaches eliminating operational waste, preventive maintenance paradigms maximising asset availability and data-driven decision-making leveraging operational analytics (Global Maritime Forum, 2025).

Several cross-cutting themes emerge from framework development literature relevant to this study. In light of comprehensive approaches, effective frameworks must address multiple operational dimensions simultaneously rather than isolated single-issue interventions, reflecting systems theory principles that operational components interact (Von Bertalanffy, 1968). With regards to contextual adaptation, frameworks should be contextually adapted to specific organisational circumstances, operational environments, resource availability and institutional arrangements

rather than mechanically transferring frameworks developed in different contexts (Donaldson, 2001). Looking at participatory development, participatory approaches used must involve operational personnel, managers and stakeholders enhance framework relevance, feasibility and acceptance (Damson, Mtui and Kileo, 2025).

In implementation planning, frameworks require implementation planning specifying resource requirements, implementation phases, responsibility assignments and monitoring mechanisms to translate framework concepts into operational reality (Abdulrahmani, 2025). Frameworks should incorporate performance monitoring and evaluation mechanisms enabling assessment of implementation effectiveness and continuous refinement based on operational experience (Slack, Brandon-Jones and Burgess, 2022)

2.4.4 Summary of Knowledge Gaps in Existing Literature

Despite substantial scholarly attention to maritime transport efficiency, comprehensive critical review revealed several significant knowledge gaps relevant to this study that justify its rationale, approach and anticipated contributions to knowledge and practice.

2.4.4.1 Geographical and Contextual Research Gaps

Existing empirical literature exhibited pronounced geographical concentration in developed economies, particularly European countries, North America and East Asia, with comparatively limited research systematically examining operational efficiency in African inland waterway contexts (World Bank, 2023; Natalia Calderón-Rivera, Bartusevičienė and Ballini, 2024). Within the Southern African region specifically, research on inland waterway transport operations remains sparse, with Lake Kariba research predominantly addressing fisheries management, environmental conservation, ecosystem health and community livelihoods rather than operational efficiency of government marine transport services (Kolding, van Zwieten and Marttin, 2019; Zambezi River Authority, 2023).

This geographical research gap limits understanding of efficiency determinants, operational challenges, and contextually appropriate solutions for Southern African inland waterway systems operating under distinct environmental, institutional, economic and technological conditions compared to contexts where most existing research was conducted.

2.4.4.2 Institutional Context Research Gaps

Empirical literature disproportionately focuses on commercial shipping operations, port terminal efficiency and private sector maritime logistics, with limited research systematically examining state-operated, non-commercial, rural public service marine transport systems serving scattered remote communities (Danladi et al., 2024; World Bank, 2023). Public sector operational contexts involve distinct characteristics potentially affecting efficiency determinants and improvement strategies such as non-commercial service mandates prioritising accessibility and development objectives over profit maximization, budget-dependent resource availability subject to government fiscal constraints and political priorities, civil service employment frameworks affecting, workforce management flexibility, bureaucratic procurement and administrative processes, multiple accountability relationships involving government ministries, legislative oversight and community stakeholders and operational decision-making influenced by political considerations alongside technical and economic factors (Government of Zimbabwe, 2021).

These institutional differences limit direct transferability of findings from commercial maritime research to public sector inland waterway contexts, creating knowledge gaps this study addresses

2.4.5 Theoretical Integration Gaps

According to Chen et al. (2025) and World Bank (2023), existing literature mainly assesses operational efficiency either predominantly from technical-operational perspectives with a focus on maintenance practices, fleet management, scheduling optimisation, technological solutions or from predominantly institutional-policy perspectives with a focus on governance frameworks, regulatory systems or funding mechanisms. There is little research that integrates these frameworks in a unified analytical framework which recognizes that the operational efficiency outcomes arise from complex and dynamic relationships between internal operational practices and the external institutional context.

This theoretical fragmentation is likely to yield incomplete understanding of efficiency determinants and undermine intervention strategies, which address symptoms rather than underlying causes. This research makes explicit the operational and institutional dimension of the integration gap, within a theoretically rooted conceptual-analytic framework.

2.4.6 Framework Development Methodological Gaps

While substantial descriptive research diagnoses efficiency challenges and analytical research identifies influencing factors, limited prescriptive research develops practical, comprehensive, evidence-based frameworks for systematically enhancing operational efficiency specifically tailored to public sector inland waterway transport in resource-constrained developing country contexts (Abdulrahmani, 2025; Danladi et al., 2024).

Existing framework development studies frequently focus narrowly on specific operational dimensions such as maintenance management (Abdulrahmani, 2025; Damson, Mtui and Kileo, 2025) or digital technology adoption (Tubis et al., 2025; Chen et al., 2025), rather than developing holistic frameworks addressing multiple interacting efficiency determinants simultaneously. Additionally, framework development methodologies often rely primarily on literature review and expert judgement without systematic empirical investigation of operational practices, efficiency determinants and stakeholder perspectives in specific contexts where frameworks will be applied.

This study employs a mixed methods empirical investigation systematically examining RIDA's operational context to inform contextually appropriate, comprehensive framework development grounded in empirical evidence rather than generic best practices.

2.4.7 Implementation and Sustainability Gaps

Framework development research typically emphasises framework design and initial implementation planning but provides limited empirical evidence regarding implementation processes, adaptation requirements, sustainability challenges and long-term effectiveness under resource-constrained operational conditions typical of developing country public sectors (World Bank, 2023).

Research on framework development tends to focus on designing a framework and planning for early implementation. Little empirical evidence exists regarding the implementation, adaptation,

sustainability and long-term effectiveness of such frameworks within the resource-constrained operational environments of developing country public sectors (World Bank, 2023).

This study will consider the feasibility of implementation, resources required and sustainability mechanisms when developing the framework to ensure applicability and sustainability.

This study directly addressed identified knowledge gaps by:

- a. Focusing empirical investigation on rural state-operated marine transport services in Southern African inland waterway context, specifically RIDA's Lake Kariba operations
- b. Integrating operational and institutional determinants within unified theoretical and conceptual frameworks
- c. Employing a mixed methods empirical investigation to systematically examine operational efficiency, influencing factors and stakeholder perspectives
- d. Developing comprehensive efficiency enhancement framework grounded in empirical findings and explicitly adapted to Zimbabwe public sector context
- e. Considering implementation feasibility and sustainability requirements in framework design

Through these contributions, the study advances both theoretical understanding and practical management of operational efficiency in under-researched inland waterway contexts.

2.5 Chapter Summary

This chapter has presented a comprehensive and critical review of theoretical and empirical literature relevant to operational efficiency in marine and inland waterway transport systems, systematically establishing conceptual foundations, theoretical frameworks, and empirical evidence base guiding this research investigation.

The conceptual framework articulated operational efficiency as a multidimensional construct influenced by five primary operational determinants maintenance management practices, operational scheduling effectiveness, human resource capacity, safety management systems, and resource availability operating within institutional and environmental contexts characterised by budget availability, government policies, weather conditions, water level variations and regulatory

frameworks that moderate relationships between operational determinants and efficiency outcomes.

The theoretical framework integrated five complementary theories providing comprehensive explanatory foundations, the Resource-Based View explaining foundational importance of strategic resource management, the Systems Theory elucidating interdependencies and interactions among operational components, Operations Management Theory providing analytical principles for efficiency assessment and process optimisation, Contingency Theory explaining contextual adaptation requirements and moderating influences of environmental factors, Lean Management and Total Quality Management principles emphasising waste elimination, quality enhancement and continuous improvement.

This multi-theoretical integration enabled holistic understanding of efficiency determinants and comprehensive framework development addressing multiple operational dimensions simultaneously. The empirical literature review synthesised research evidence in three thematic areas aligned with study objectives:

- a. Operational efficiency assessment literature demonstrated diverse methodological approaches including Data Envelopment Analysis for comparative efficiency evaluation, reliability metrics for maintenance management assessment, service quality indicators for customer-focused performance evaluation and safety metrics for risk management assessment
- b. Empirical evidence on efficiency determinants identified maintenance management, human resource capacity, resource availability, safety management and operational scheduling as consistently significant internal factors, while environmental conditions and institutional arrangements emerge as important moderating influences
- c. Framework development literature provided methodological insights regarding comprehensive, contextually adapted, participatory and implementation-oriented approaches to developing actionable efficiency enhancement frameworks

Critical analysis identified significant knowledge gaps justifying this study, geographical research concentration in developed economies with limited African inland waterway research, institutional

focus on commercial operations with limited public sector rural transport research, theoretical fragmentation between operational and institutional perspectives, limited comprehensive framework development for resource-constrained developing country contexts and inadequate attention to implementation feasibility and sustainability

This study directly addresses these gaps through empirical investigation of RIDA's rural state-operated marine transport services in Lake Kariba, Zimbabwe, integrating operational and institutional perspectives within unified frameworks and developing comprehensive, evidence-based, contextually adapted efficiency enhancement framework explicitly considering implementation feasibility.

The literature review establishes strong theoretical and empirical foundations justifying the research problem, objectives and methodological approach, while demonstrating originality and contribution potential of this study in advancing knowledge and practice regarding operational efficiency in under-researched inland waterway contexts.

The following chapter presents the research methodology employed to address research questions and achieve study objectives through systematic empirical investigation combining quantitative and qualitative approaches to comprehensively examine operational efficiency determinants, assess current performance levels and develop contextually appropriate efficiency enhancement framework for RIDA's marine operations in Kariba.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology for the research on enhancement of efficiency of RIDA's marine operations in Kariba. According to Creswell and Creswell (2018), methodology refers to a systematic plan that a researcher makes to select strategies of inquiry, methods of data collection and techniques of data analysis that are helpful in addressing the researcher's inquiry. The methodological choices discussed here are informed by a pragmatic philosophy and operationalised through Robert Yin's (2018) embedded single case study design, which permits the simultaneous investigation of numerous embedded sub-units within a single organisation case.

The chapter begins with an outline of the research philosophy and paradigm within which the study is framed then proceeds to outline the research design and approach, then detailing the study population and sampling section. The methods used for data collection, data collection procedures, data analysis techniques and the steps taken to ascertain the validity, reliability and trustworthiness of data are discussed in the subsequent sections. Every methodological choice is justified through acknowledged research methodology literature and is directly related to the objectives of the study.

3.2 Research Philosophy and Paradigm

According to Kivunja and Kuyini (2017), a researcher's set of beliefs and assumptions that define how one understands reality, constructs knowledge and which values will guide them during the research, is a research paradigm. Kivunja and Kuyini (2017) contend that the researcher's intentions are influenced by the paradigm the researcher seeks to realise. According to Saunders, Lewis and Thornhill, 2019, these philosophical assumptions are influential in that they affect the whole research sequence from the research question formulation to interpretation of findings. A paradigm is a lens through which a researcher views the world, a theoretical perspective. Killam (2013) states that it allows the researcher to identify what qualifies as acceptable knowledge, how knowledge can be acquired and how values can be incorporated in the process. Research paradigms serve not only as a procedural formality, but are also a crucial decision that shapes the entire research design and methodology (Ugwu, Ekere & Onoh, 2021).

According to Kivunja and Kuyini (2017), there are four key features that scholars have used to distinguish research paradigms. Ontology seeks understanding of what is real and what can be known about it. Epistemology focuses on the observer and the known, providing conceptual analysis and the description of knowledge. Axiology indicates the roles of values in the research process. Methodology refers to the systematic process used for the collection and analysis of data (Saunders et al., 2019). The social sciences are based on three key paradigms i.e. positivism, interpretivism and pragmatism (Creswell & Creswell, 2018).

3.2.1 Positivism

According to Bryman (2016), positivism rests upon the premise that reality exists independently from human conceptions and can be assessed and quantified through science. According to Saunders, Lewis and Thornhill (2019), positivist researchers primarily use deduction, developing hypotheses based on an existing theory and subsequently testing them. The ontological stance of positivism is external realism, with reality being single and independent of the researcher.

Kivunja and Kuyini (2017) posits that the researcher is objective and neutral, seeking to avoid personal bias. According to Killam (2013) while positivism provides generalizable and statistically valid results, it fails to capture the subjective experiences, contextual characteristics and intricate social processes that are institutional phenomena, like marine operations management.

3.2.2 Interpretivism

Interpretivism, called constructivism, sees reality that is socially constructed, with many subjective realities existing as a result of people's experiences, perceptions and social interactions (Creswell and Creswell, 2018). According to Bryman (2016), interpretivist researchers adopt an inductive approach to studying phenomena, observing from the participants' perspective rather than dictating categories. The stance of interpretivism is relativism, reality is multiple and context-dependent. According to Saunder, Lewis and Thornhill (2019) knowledge is co-constructed epistemologically through the researcher and participants. While interpretivism can generate rich and contextualised insights, its outcomes have been criticised for limited generalisability and researcher subjectivity (Kivunja and Kuyini, 2017).

3.2.3 Pragmatism: The adopted research paradigm

As Saunders, Lewis and Thornhill (2019) posits, pragmatism places the research question ahead of philosophical orthodoxy, asserting that the most critical determining influence on the research philosophy is the nature of the problem. Pragmatism supports methodological pluralism without any cognitive bias towards an ontology or epistemology. According to Creswell and Creswell (2018), it allows the researcher to use both quantitative and qualitative approaches as required by different dimensions of the research problem. Hence, from an ontological perspective, social pragmatism accepts reality as both objective(existing independently of people) and socially constructed (Kivunja & Kuyini, 2017). To the present study, pragmatism is relevant in that RIDA's marine operations involve measurable, objective phenomena like statistics on vessel downtime, maintenance costs and logistical turnaround times as well as subjective experiences, perceptions and institutional practices affecting operational efficiency. Epistemologically, pragmatism allows for different methods to produce practical and contextual knowledge (Morgan, 2014). According to Tashakkori and Teddlie (2010), axiologically, researchers' values are acknowledged in pragmatism but priority is towards practical outcomes and actionable recommendations.

This research fits well in the pragmatic paradigm for a number of reasons. First, the research aims to measure the operational inefficiencies (which requires positivist methods) and understand the lived experiences and institutional dynamics that produce those inefficiencies (which requires interpretivist methods). Secondly, given that the tangible aspect has been put in place, the eventual goal of pragmatism is to finally give policy recommendation on how RIDA's marine operations can be improved. Thirdly, pragmatism supports the use of a mixed-methods approach in an embedded case study design (Yin, 2018), allowing for a more holistic investigation. As Ugwu, Ekere and Onoh (2021) observe, pragmatism provides the philosophical flexibility necessary for undertaking research in complex organizational situations.

3.3 Research design

The research design is the general plan behind any research which is used to guide the collection, measurement and analysis of data. A theoretical framework is a logical structure linking the research question to the conclusion drawn from the evidence (Yin, 2018). This research uses Robert Yin's (2018) embedded single case study design, which is especially appropriate for the study of complex, real-world phenomena in their natural organisational context.

3.3.1 Justification for the embedded single case study design

According to Yin (2018), a case study is defined as an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-world context, especially when the boundaries between phenomenon and context are not clearly evident. The embedded type of single case study design involves identifying multiple levels or sub-units of analysis in a single case (Yin, 2018).

There are several reasons that warrant this design selection. RIDA's marine operations in Kariba are a distinct and illuminating case, representing an example of a government mandated agency operating a marine fleet in an inland water body under unique regulatory, logistical and environmental conditions. The use of a single case study is justified as per Yin's (2018) criterion. Further, the embedded design enables the researcher to decompose the broad phenomenon of operational efficiency into distinct, analytically manageable sub-units, each focusing on particular dimension of the organisation's marine operations (Baxter and Jack, 2008). The methodology allows for the incorporation of multiple streams of data, namely questionnaire, interview and document analysis under one analytical umbrella, which adds depth and validity to the analysis (Yin, 2018).

3.3.2 Proposed Embedded Case Study Structure

Table 3.1 presents the proposed design structure for the embedded single case study, identifying the primary case, the four embedded sub-units, the associated research focus, data sources and expected outcomes for each sub-unit.

Component	Research Focus	Data Sources	Participants	Expected Outcomes
Primary Case: RIDA's Marine Operations in Kariba	Overall operational efficiency of RIDA's marine fleet and supporting systems	Questionnaires, interviews, document analysis	All 17 participants (15 RIDA staff + 2 external informants)	Comprehensive assessment of efficiency drivers and barriers, integrated recommendations
Embedded Sub-Unit 1: Vessel Maintenance and Availability	Adequacy and effectiveness of vessel maintenance regimes; vessel downtime patterns	Maintenance logs, questionnaires, interviews	maintenance technicians	Identification of maintenance gaps, strategies to improve vessel availability
Embedded Sub-Unit 2: Crew Management and Human Capacity	Staff competencies, training adequacy, crew scheduling, and workforce planning	Training records, questionnaires, interviews	Crew members, HR personnel, senior management	Human capacity development framework, training needs assessment
Embedded Sub-Unit 3: Logistics and Transport Coordination	Efficiency of supply chain, fuel logistics, cargo scheduling, and transport routing	Operational records, questionnaires, interviews	Logistics officers, transport coordinators, operations manager	Optimised logistics processes, reduced turnaround times

Embedded Sub-Unit 4: Financial and Administrative Processes	Budgeting adequacy, procurement efficiency, financial controls, and administrative systems	Financial reports, policy documents, questionnaires, interviews	Finance officers, administrators, senior management, regulatory officials	Streamlined financial and administrative procedures; resource allocation model
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Table 3.1 Proposed Embedded Case Study Design Structure, Source: Adapted from Yin (2018)

As Table 3.1 illustrates, the embedded design enables the researcher to examine each sub-unit through targeted data collection while simultaneously synthesising findings at the level of the primary case. This structure facilitates both within-sub-unit analysis and cross-sub-unit comparison, yielding a holistic understanding of the factors influencing operational efficiency (Yin, 2018; Baxter and Jack, 2008).

3.4 Research approach

The research approach is a general plan that guides researchers, in study from broad philosophical assumptions to detailed methods of data collection, analysis and interpretation (Creswell and Creswell, 2018). This research blends quantitative and qualitative approaches in the embedded case study design. The mixed-methods research approach is widely endorsed for applied organisational research. This wider approach maximises the complementary benefits of quantitative and qualitative methods while offsetting their respective limiting constraints (Johnson and Onwuegbuzie, 2004; Tashakkori and Teddlie, 2010).

3.4.1 Deductive Strategy (Quantitative Approach)

The deductive component of the study involves the systematic collection of quantifiable data through structured questionnaires administered to RIDA's operational staff. Deductive reasoning proceeds from general theoretical propositions to specific empirical observations (Saunders, Lewis and Thornhill, 2019). In this study, the quantitative component is designed to measure key operational variables including vessel maintenance frequency, crew competency levels, logistical turnaround times and financial allocation patterns against established benchmarks and standards

derived from the literature on marine operations management (Wang and Liping, 2018). The deductive approach enables the researcher to identify statistically significant patterns, correlations, and trends that characterise RIDA's operational efficiency.

3.4.2 Inductive Strategy (Qualitative Approach)

The study's inductive component includes the collection and analysis of qualitative data from semi-structured key informant interviews and document analysis. Inductive reasoning moves from specific observations to universal theories and explanations (Bryman, 2016). The qualitative facet of this study aims to gain an understanding of the causes, contexts and institutional practices affecting efficiency, which can be open to interpretation and not easily quantified (Creswell and Creswell, 2018). By employing the inductive approach, themes, patterns and insights can emerge from the data which will further enrich and contextualise the quantitative findings.

3.4.3 Integration of methods

The integration of quantitative and qualitative methods follows a convergent parallel design. In this regard, both strands of data are collected at the same time, analysed separately then merged in the final interpretation stage. This method facilitates triangulation through data convergence, which enhances the credibility of the findings (Patton, 2015). Yin (2018) posits that convergent design is especially well suited for the embedded case study since it enables simultaneous quantitative and qualitative analysis of each sub-unit.

3.5 Population and sample size of the study

A research population is defined as the entire group of individuals, events or objects that possess the characteristics of interest to the researcher and from which data may be collected (Saunders, Lewis and Thornhill, 2019). The Agency has a current in-post establishment of 2220 people, which for the purposes of this study is the target population. The marine operations are a sub-unit of the Agency's Strategic Business Unit with 15 people directly involved in the operations, and the sample size for this study comprises 17 individuals directly involved in or knowledgeable about RIDA's marine operations in Kariba. This population is composed of two distinct segments namely RIDA Staff (15 individuals) including ferry captains, ferry crew members, maintenance artisans, logistics and transport coordinators, finance and administration officers, human resource

personnel and management personnel directly responsible for the planning, execution and oversight of the marine operations. Secondly, the sample also includes external key informants (2 individuals), one official from the Ministry of Transport and Infrastructural Development's Inland Shipping Control department(regulator) who provide oversight, regulatory guidance and policy direction affecting RIDA's marine operations and KB Engineering, who usually provide specialized maintenance services.

3.5.1 Inclusion and exclusion criteria

The following inclusion criteria were applied to delineate the study population: (a) individuals must be currently employed by RIDA or currently serving in a regulatory role relevant to RIDA's marine operations, (b) individuals must have a minimum of six months experience in their current role, ensuring sufficient exposure to operational processes, and (c) individuals must provide informed consent to participate. Exclusion criteria included (a) temporary or contract workers with fewer than twelve months' service; (b) individuals on extended leave during the data collection period and (c) stakeholders whose roles are exclusively terrestrial with no involvement in marine operations (Israel, 1992; Saunders, Lewis and Thornhill, 2019).

3.6 Sampling methods and procedure

3.6.1 Purposive sampling

Given that the institution's broader population of 2,220 included many individuals not involved in maritime duties, purposive sampling was used to target the seventeen key actors directly engaged in operations. By strategically selecting these participants based on their specialized technical knowledge and operational exposure, the researcher gathered in-depth insights into maintenance practices, vessel reliability, and safety compliance. This targeted approach ensures that the resulting framework for enhancing operational efficiency is grounded in expert evidence from those responsible for managing the high-value marine assets and navigating the specific regulatory and environmental challenges of Lake Kariba.

3.6.2 Purposive and stratified purposive sampling for embedded sub-units

The allocation of participants to the four embedded sub-units requires a combination of purposive and stratified purposive sampling techniques (Palinkas et al., 2015; Patton, 2015). Purposive sampling is the selection of the sub-units on the basis of the knowledgeability, practicality and

relevance of the sub-units (Patton, 2015). Stratified purposive sampling further divides the population into strata (sub-groups) based on certain characteristics like department, rank and function and then purposively selecting participants from strata so that representation will be ensured in all categories (Palinkas et al., 2015).

For instance, the sub-unit responsible for vessel maintenance and availability takes most of its human resources from marine captains as well as maintenance artisans while the unit for financial and administrative processes draws from finance officers, administrators and regulatory officials. Some actors, many of whom are senior managers, contribute to several sub-units by virtue of their cross-cutting responsibilities. Through this layered sampling of direct respondents, it ensures that sub-units get reliable and informed respondents for the development of the inferences (Yin, 2018; Creswell and Creswell, 2018).

3.7 Data Collection Methods and Procedures

For this study, data collection was done following the convergent parallel mixed-methods procedure, collecting both quantitative data and qualitative data concurrently. This order of implementation served to address the time limitation that the researcher was faced with, as well to address complex research questions that cannot be answered by numbers or narratives alone. The process ensured accurate data is collected with minimal disturbance to maritime transport schedules and ethical transparency. Data gathering was done in three stages, ensuring the quality of the data to be acceptable.

3.7.1 Phase 1: Preparatory Phase

The preparatory phase encompassed the following activities: (a) obtaining ethical clearance from the relevant institutional review board and written permission from RIDA's management to conduct the study (b) conducting a pilot study with a small number of participants (approximately 3–5) to test and refine the questionnaire and interview guide (c) establishing a data management protocol, including secure digital storage, file-naming conventions and backup procedures and (d) arranging logistical matters, including travel to Kariba, scheduling of interviews.

3.7.2 Phase 2: Quantitative Data Collection

Structured questionnaires were distributed among RIDA's operational staff in the second stage. The questionnaires were administered at RIDA's Kariba offices in person to ensure high response rates were achieved, and as well, the researcher was present to be able to clarify ambiguities. Participants received an information sheet detailing the nature of the study, what participants were expected to do and ethical safeguards, together with a consent form. Participants were accorded enough time (about 30–40 minutes) to fill in the questionnaire. To boost the response rate, a follow-up strategy of reminders was employed. The completed questionnaires were then coded and checked for completeness before being entered into a statistical software package to be analysed (Bryman, 2016).

3.7.3 Phase 2: Qualitative Data Collection

In the stage, semi-structured key informant interviews of RIDA management and external stakeholders were done. According to Patton (2015), participants are interviewed when and where it is most convenient. Moreover, the arrangement of the interviews was scheduled take place in quiet, private settings to encourage comfortable communication. All interviews began with a short introduction, restatement of ethical guarantees and a request to audio-record the interview. The interviews largely adhered to the pre-established reference guide although provision was made for follow-up questions. As soon as the interviews were done, the researcher reviewed the recordings and field notes in order to identify first impressions and initial themes (Creswell and Creswell 2018). At the same time, relevant organisational documents were collected, catalogued and reviewed.

3.8 Data Collection Instruments

Consistent with the mixed-methods approach and the embedded case study design, this study employed four complementary data gathering techniques namely structured questionnaires, semi-structured key informant interviews, field observation and document analysis. The use of multiple techniques served the dual purpose of enabling methodological triangulation and ensuring comprehensive coverage of the research questions across all embedded sub-units (Yin, 2018; Patton, 2015).

3.8.1 Structured Questionnaires

Structured questionnaires constituted the primary quantitative data collection instrument. They were administered to RIDA's operational staff including crew members, maintenance artisans, logistics officers and junior administrative personnel who were best positioned to provide systematic and standardised data on the day-to-day operational processes (Saunders, Lewis and Thornhill, 2019). The questionnaire was designed with the following features:

1. Closed-ended questions asking respondents to rate their perception of operational efficiency in the four embedded sub-units, using five-point Likert scales (ranging from "Strongly Disagree" to "Strongly Agree").
2. Questions with fixed-choice responses that gather demographic and job-related information on role, sector/department, length of service and qualification.
3. Rating scales to assess specific operating parameters like vessel reliability, adequacy of training, responsiveness of logistics and efficiency of administration.
4. A small section of open-ended questions that allow respondents to elaborate on their experiences and make suggestions for improvement..

The questionnaire was structured into five sections corresponding to the primary case and the four embedded sub-units, ensuring that data collected could be disaggregated and analysed at both the sub-unit and case levels (Creswell and Creswell, 2018). Prior to deployment, the questionnaire underwent content validation by subject-matter experts and a pilot test with a small subset of respondents to assess clarity, relevance and reliability (Saunders *et al.*, 2023).

3.8.2 Semi-structured key informant interviews

The main qualitative data collection method consisted of semi-structured key informant interviews. Interviews were held with the senior management within RIDA and identified external stakeholders having a strategic, policy-making, oversight perspective of marine operations. The semi-structured format was chosen as this format allows for the introduction of emergent themes while being sufficiently structured to ensure comparability (Bryman, 2016). The interview guide was prepared with a number of pre-decided open-ended questions centered around the four embedded sub-units, but allowing the interviewer to probe, clarify and follow up on answers where appropriate (Saunders, Lewis & Thornhill, 2019). Within the study, six key informant interviews

were planned to last for 45–60 minutes each. With the participants' consent, all interviews were audio-recorded and later transcribed verbatim. Field notes on non-verbal cues, contextual notes and researcher reflections were kept as other data.

3.8.3 Document Analysis

Document analysis was employed as an extra method of data collection to confirm and create an understanding, as well as to enrich the data collected from questionnaires and interviews (Bowen, 2009). The analysis targeted the following document categories.

1. RIDA's operational policies, standard operating procedures (SOPs) and strategic plan.
2. Vessel deployment schedules, cargo manifests, fuel consumption logs and trip reports.
3. Maintenance logs: Records of inspections, servicing schedule, repair history and spare-parts balance.
4. The yearly budgets, spending reports, buying records and audit reports.
5. First Aid Training Records. Training Certifications and Competency Assessment Results.
6. Communication with regulators

Document analysis followed an iterative process of skimming, thorough reading and interpretive coding (Bowen, 2009). Data extracted from documents was integrated with questionnaire and interview data during the analysis phase, facilitating triangulation and providing an institutional context for the study's findings (Yin, 2018).

3.8.4 Observation guide

Field observation was also done guided by a field observation sheet, to reinforce qualitative data through direct observation of the operations.

3.9 Data analysis methods and procedure

Data analysis was conducted in three interrelated stages: quantitative analysis, qualitative analysis, and integration of findings. This staged approach aligns with the convergent parallel mixed-methods design and the embedded case study structure (Creswell and Creswell, 2018; Yin, 2018).

3.9.1 Quantitative data analysis

Quantitative data derived from the structured questionnaires were analysed using the Statistical Package for the Social Sciences (SPSS). The analysis proceeded as follows:

1. Data cleaning and preparation: All questionnaire responses were coded, entered and screened for missing data, outliers and data-entry errors. Descriptive statistics including frequencies, percentages, means, standard deviations and ranges were computed for all variables to provide an overview of the data distribution (Pallant, 2020).
2. Descriptive analysis: Frequency distributions and measures of central tendency were used to describe participants' demographic profiles, perceptions of operational efficiency and ratings of specific operational parameters across the four embedded sub-units.
3. Inferential analysis: Where applicable, inferential statistical techniques were employed to examine relationships and differences. Cross-tabulations were used to compare responses across embedded sub-units and participant categories.
4. Data visualisation: Results were presented through tables, bar charts, pie charts and radar diagrams to facilitate interpretation and comparison across sub-units (Saunders, Lewis & Thornhill, 2019).

3.9.2 Qualitative data analysis

Qualitative data derived from semi-structured interviews and document analysis were analysed using thematic analysis, following the six-phase framework proposed by Braun and Clarke (2006). Initially, the interview transcripts and document extracts were read and re-read while taking notes of initial ideas and impressions. In phase two of the analysis, the researcher generated initial codes which expressed the ideas and concepts observable in the data. Subsequently, the researcher then systemically coded the entire data set for the features of the data that were relevant to the research question. Phase 3 of thematic analysis involved collating all data relevant to each potential theme, which included codes from the previous step. The themes were checked against the coded extracts and with the full data set in order to check for coherence and distinctiveness. The themes were then fine-tuned and designated with an appropriate name and description in phase 5. The final stage of the thematic analysis process was the production of a report, in which the discovered themes were woven into an analytic narrative. Quotations from the data that lend themselves to illustration were used to support this narrative (Braun and Clarke, 2006). The thematic analysis

was conducted separately for each embedded sub-unit before cross-sub-unit patterns and overarching themes were identified at the primary case level.

3.9.3 Integration of quantitative and qualitative Findings

Following the independent analysis of quantitative and qualitative data, findings were integrated through a process of merging (Creswell and Creswell, 2018). This involved the side-by-side comparison of quantitative results and qualitative themes for each embedded sub-unit, identifying areas of convergence, divergence and complementarity. Joint display tables are constructed to visually compare quantitative statistics with qualitative themes, enabling the reader to see how the two strands of evidence interacted (Guetterman, Fetters and Creswell, 2015). The integrated findings were then synthesised into a coherent narrative that addressed each research question comprehensively.

3.10 Research validity, reliability and trustworthiness

Ensuring the quality, credibility and dependability of research findings is a fundamental requirement of rigorous scholarship (Lincoln and Guba, 1985). This section outlines the strategies employed to establish validity, reliability and trustworthiness in both the quantitative and qualitative components of the study.

3.10.1 Validity of the quantitative component

Content validity was established by ensuring that the questionnaire comprehensively covers all dimensions of operational efficiency relevant to the four embedded sub-units. The questionnaire items were derived from an extensive review of the literature on marine operations management. Construct validity was addressed by grounding the questionnaire items in established theoretical constructs and operationalising each variable with reference to the existing literature (Yin, 2018). Face validity was assessed during the pilot study, whereby participants confirmed that the questionnaire items appeared to measure what they purported to measure.

3.10.2 Reliability of the quantitative component

Reliability refers to the dependability and reproducibility of the measuring instrument. For each constructed scale and sub-scale, the Cronbach's alpha reliability test was run to estimate internal consistency reliability of the questionnaire. According to Pallant (2020), a Cronbach's alpha of 0.70 or above is said to be acceptable, which suggests that the items in a scale are measuring the same thing. The pilot study was the first base for the computation of Cronbach's alpha and the items which gave an undesirable reliability score were either revised or totally removed for the study (Saunders, Lewis and Thornhill, 2019). The table below summarises the reliability of the instrument.

Questionnaire Section	Number of Items	Alpha	Interpretation
Section B: Operational Efficiency (DV)	8	0.82	Good Reliability
Section C: Maintenance Practices (IV1)	10	0.78	Acceptable Reliability
Section D: Operational Scheduling (IV2)	8	0.74	Acceptable Reliability
Section E: Human Resource Capacity (IV3)	10	0.79	Acceptable Reliability
Section F: Safety Management (IV4)	10	0.85	Good Reliability
Section G: Resource Availability (IV5)	10	0.71	Acceptable Reliability
Section H: Moderating Variables	8	0.76	Acceptable Reliability

Table 3.2 Cronbach's Alpha Reliability Analysis Summary, Source: Researcher's construct

3.10.3 Trustworthiness of the qualitative component

Credibility, transferability, dependability and confirmability are the four criteria that create trustworthiness in qualitative research (Lincoln and Guba, 1985). Credibility (the qualitative analogue of internal validity) was enhanced with using different data sources (methodological triangulation), prolonged engagement with participants and member checking, which involved sharing interview transcripts and preliminary findings with selected participants for verification and feedback (Lincoln and Guba, 1985; Creswell and Creswell, 2018). Transferability (the qualitative analogue of external validity) was achieved through thick, rich description of the context (Lincoln and Guba, 1985). When undertaken, the thick, rich description of the context,

the participants, the processes and whatever else is relevant makes it possible for readers to make a decision on transferability to other contexts of their choice. Dependability, which is the qualitative equivalent of reliability, involved creating an audit trail that documents all methodical decisions, data collections and analyses (Patton, 2015). Confirmability (the qualitative analogue of objectivity) was ensured through reflexive journaling, peer debriefing and the transparent documentation of the researcher's assumptions, biases and analytical choices (Lincoln and Guba, 1985).

3.10.4 Triangulation

Triangulation is a central validation strategy in this study, employed at multiple levels. Methodological triangulation involved the use of four data collection techniques (questionnaires, interviews, field observation and document analysis) to cross-verify findings (Patton, 2015). Data source triangulation involved comparing data from different categories of participants (Yin, 2018), operational staff, senior management and external regulatory officials to identify convergent and divergent perspectives. The embedded case study design further supports analytical triangulation (Baxter and Jack, 2008) by enabling the comparison of findings across the four sub-units. Together, these triangulation strategies substantially enhance the validity and credibility of the study's findings.

In mixed-methods research, the quality of integration is further assessed through the criterion of legitimization (Onwuegbuzie and Johnson, 2006; Tashakkori and Teddlie, 2010), which refers to the trustworthiness and rigour with which quantitative and qualitative inferences are integrated to produce meta-inferences of higher explanatory power. In this study, legitimization is achieved through the joint display approach (Guetterman, Fetters and Creswell, 2015), in which quantitative means and qualitative thematic frequencies are presented side-by-side to enable systematic evaluation of convergence, divergence and complementarity across data sources.

3.11 Ethical considerations

This study conformed to the ethical standards set by the institutional review board and the ethical guidelines for social science research (Bryman, 2016). The study observed the following ethical principles. Prior to participation, all the participants were provided with an information sheet and were required to sign an informed consent form. Participants were informed that they could

withdraw freely anytime and their withdrawal would not incur any penalties. Confidentiality and anonymity were also observed to protect the participant's identity through the use of a pseudo names and codes. All data was stored in electronic files protected by a password only accessible by the researcher. With regards to non-maleficence, the research would not harm or inconvenience a participant in any way and interview scheduling took consideration of respondents' work schedules. Data protection required that all handling of data be in accordance with applicable data protection legislation and institutional policies. All raw data would be destroyed five years after the completion of the study. Prior to data collection, ethical clearance from the university ethics committee was obtained, along with written authority from the management of RIDA to conduct the study on the institution.

3.12 Chapter Summary

This chapter provides an account of the methodology that was adopted to investigate the enhancement of efficiency in RIDA's marine operations in Kariba. The research study is placed in the purview of the pragmatic research paradigm which provides the philosophical latitude to incorporate quantitative and qualitative methods in an applied organisational context. The overall research design is an embedded single case study design (Yin, 2018). The case study design facilitates the simultaneous study of four embedded sub-units namely vessel maintenance and availability, crew management and human capacity, logistics and transport coordination and financial and administrative processes. To collect and analyse quantitative and qualitative data, a mixed-methods research approach combining deductive and inductive research strategies was used. The research used semi-structured key informant interviews for theoretical completeness, ensuring data quality and establishment and description of the trends. It also involved document analysis. Descriptive and inferential statistics along with thematic analysis were used for analysis. SPSS was primarily used for data analysis. To ensure validity, reliability and trustworthiness, rigorous measures were taken including validation of contents, triangulation of methods and data sources, member checking and maintaining an audit trail. Throughout the study, ethical principles of informed consent, confidentiality, non-maleficence and protection of data are respected. The next chapter provides the collected data and analysis that forms the basis of recommendations for the development of operational efficiency enhancing model.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the analysis and interpretation of data collected from the Rural Infrastructure Development Agency (RIDA) marine operations in Kariba. The analysis is structured around the research objectives outlined in Chapter One and follows the methodological framework detailed in Chapter Three. Data were collected through structured questionnaires distributed to 15 respondents, of which 12 were returned, representing various operational roles within RIDA's marine transport division. The chapter begins with descriptive statistics that provide a demographic profile of the respondents and an overview of the response rate. This is followed by objective-by-objective analysis of the data, examining (i) the impact of maintenance practices on operational efficiency (ii) the influence of operational scheduling on transport service efficiency (iii) the role of human resource capacity in operational performance and (iv) the effect of resource availability on marine operations. Additionally, the moderating effects of external factors such as budget allocation, environmental conditions and regulatory frameworks are examined.

The chapter concludes with a discussion that compares and contrasts the research findings and literature that was reviewed in Chapter Two for any similarities, differences and any new contributions to knowledge made. In this chapter, the quantitative data will be presented through descriptive statistics, frequency distribution and graphs such as bar graphs, pie charts and histograms. Qualitative insights from open-ended questionnaire responses and interview transcripts are integrated to provide contextual depth and nuanced understanding of the quantitative patterns. The study focuses on enhancing the operational efficiency of Rida's maritime operations and each analysis section intricately links back to the study's problem statement.

In line with the three specific objectives set out in Chapter One, the empirical analysis in this chapter is organised objective by objective. Following the preliminary presentation of the response rate and respondent demographics, the analysis proceeds in three principal parts: the first establishes the current level of operational efficiency of RIDA's marine services (Objective One), the second identifies and analyses the key factors that affect that efficiency (Objective Two) and the third distils the evidence-based requirements for the operational efficiency enhancement

framework to be developed in Chapter Five (Objective Three). A concluding part then integrates and synthesises the findings across all three objectives through data triangulation, discussion against the literature and theoretical reflection.

Throughout this chapter, results are presented by research question: Research Question 1 (RQ1) addresses the current level of operational efficiency and corresponds to Specific Objective 1; Research Question 2 (RQ2) addresses factors influencing operational efficiency and corresponds to Specific Objective 2; Research Question 3 (RQ3) addresses framework requirements and corresponds to Specific Objective 3. This structure ensures coherent alignment between the analytical presentation and the research design established in Chapter Three.

4.2 Descriptive statistics (participant demographics)

4.2.1 Demographic Profile of Respondents

Demographic information provides important context for interpreting operational efficiency perceptions, as different stakeholder groups (by role, experience, qualifications) may perceive operational challenges and performance differently. This section presents the demographic characteristics of the twelve(12) out of fifteen(15) respondents who participated in the questionnaire.

4.2.2 Response Rate and Sample Characteristics

The research utilized a purposive sampling approach targeting 15 individuals who directly work in RIDA's marine operations in Kariba and an additional two external stakeholders also involved in the operations. The questionnaire responses were received from 12 operational staff while six key informant interviews were conducted with RIDA management and external stakeholders. Out of the 15 questionnaires that were distributed, 12 were received completed, yielding a response rate of 80%. Key Informant interviews had a 100% response rate, as all the key respondents were interviewed, giving an overall response rate of 90%. The response rate is summarized in Table 4.1.

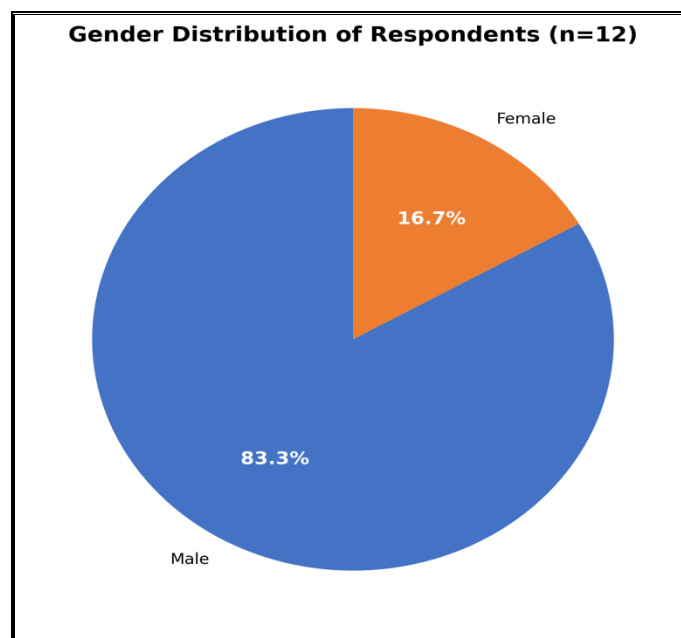
Category	Frequency	Percentage (%)
Questionnaires Distributed	15	100
Questionnaires Returned	12	80
Questionnaires Not Returned	3	20
Key Informant interviews targeted	6	100%
Key Informant interviews conducted	6	100%

Table 4.1 Response rate summary, Source: Field Data (2026)

4.2.3 Gender Distribution

The gender distribution of respondents for questionnaires is presented below. The majority of respondents were male (83.3%) while the female representation stood at 16.7%. All of the respondents for the key informant interviews were male. The gender disparity confirms the male-centric nature of marine operations, an almost universal pattern elsewhere in the maritime workforce (BIMCO/ICS, 2021). The gender distribution across different roles is shown in Figure 4.1.

Figure 4.1 Gender distribution of respondents, Source: Field Data (2026)



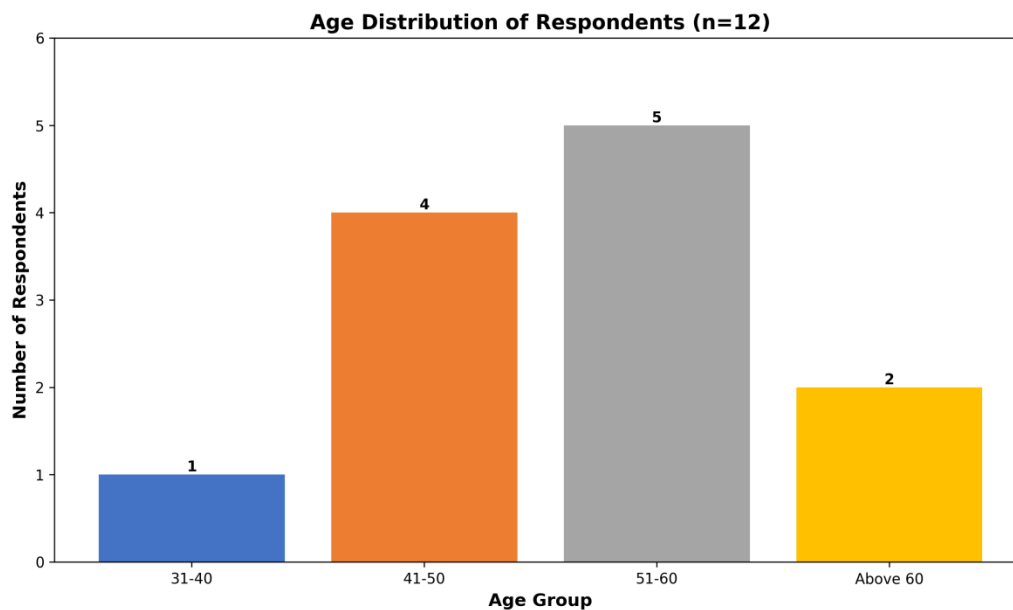
4.2.4 Age distribution

Table 4.2 and Figure 4.2 present the age distribution of the respondents. Ages 51-60 years had the largest number of respondents with 41.7% followed by ages 41-50 with 33.3% with the absence of respondents in the 18-30 years category suggesting limited recruitment of younger staff into the marine operations. According to Wijnolst and Wergeland (2009), the aging profile of the workforce raises issues regarding succession planning and knowledge transfer in the maritime industry.

Age Group	Frequency	Percentage (%)
18-30 years	0	0
31-40 years	1	8.3
41-50 years	4	33.3
51-60 years	5	41.7
Above 60 years	2	16.7

Table 4.2 Age group distribution, Source: Field Data (2026)

Figure 4.2: Age distribution of respondents, Source: Field Data(2026)



4.2.5 Educational qualifications

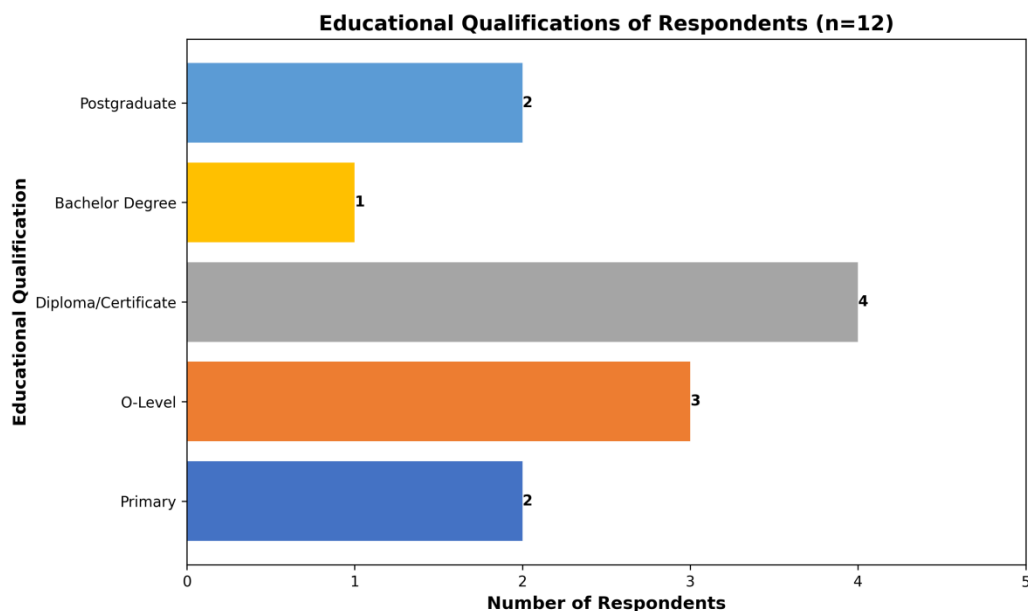
The educational qualifications of the respondents are illustrated in Table 4.3 and Figure 4.3 below. According to the data, educational profile is diversely represented with 33.3% having

diplomas/certificates, 25.0% having O-Level, 16.7% primary level education, 16.7% postgraduate and 8.3% graduate. In contrast to the postgraduate qualification of persons in management roles, operational crew have comparatively lower qualifications. This is reflective of the typical hierarchy in most organizations while it may also highlight potential training gaps for front-line staff.

Educational Qualification	Frequency	Percentage (%)
Primary Education	2	16.7
Secondary (O-Level)	3	25
Advanced Level	0	0
Diploma/Certificate	4	33.3
Bachelor Degree	1	8.3
Postgraduate Degree	2	16.7

Table 4.3 Educational qualifications of marine staff, Source: Field Data (2026)

Figure 4.3 Educational qualifications of respondents, Source: Field Data (2026)



4.2.6. Respondents' current designation/role

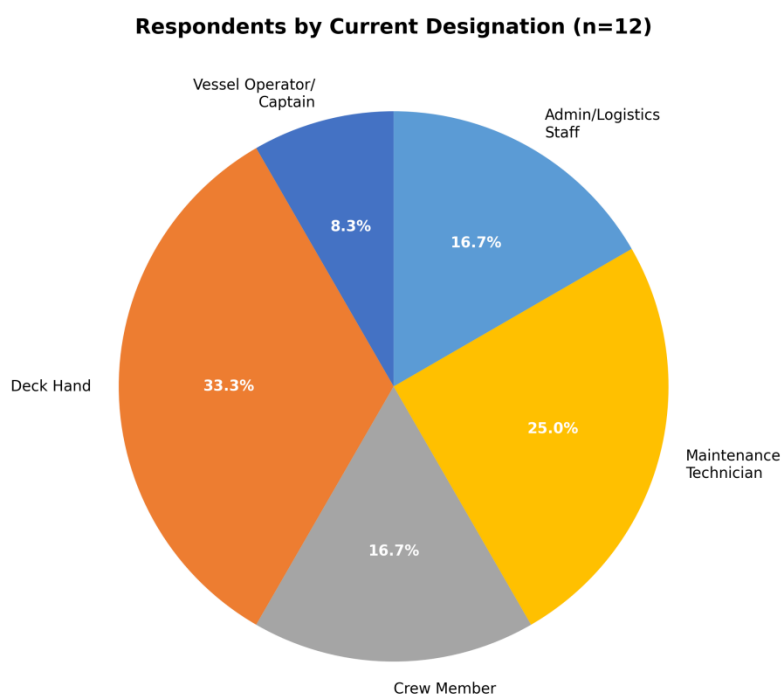
Based on the information gathered, deck hands comprise the significant proportion (33.3%),

followed by maintenance technicians (25.0%), crew members (16.7%) and admin/logistics (16.7%). Only one ship operator/captain out of two (8.3%) participated in the questionnaire. The distribution shows the operational structure of the marine unit, with a relatively high number of deck and maintenance personnel supporting a low number of vessel operator staff. Table 4.4 summarizes the distribution of staff by roles and Figure 4.4 provides the graphic presentation.

Current Designation/Role	Frequency	Percentage (%)
Vessel Operator/Captain	1	8.3
Deck Hand	4	33.3
Crew Member	2	16.7
Maintenance Technician/Artisan	3	25
Administrative/Logistics Staff	2	16.7

Table 4.4 Current designation/role distribution, Source: Field Data (2026)

Figure 4.4 Respondents by current designation, Source: Field Data (2026)



4.2.7 Length of Service at RIDA

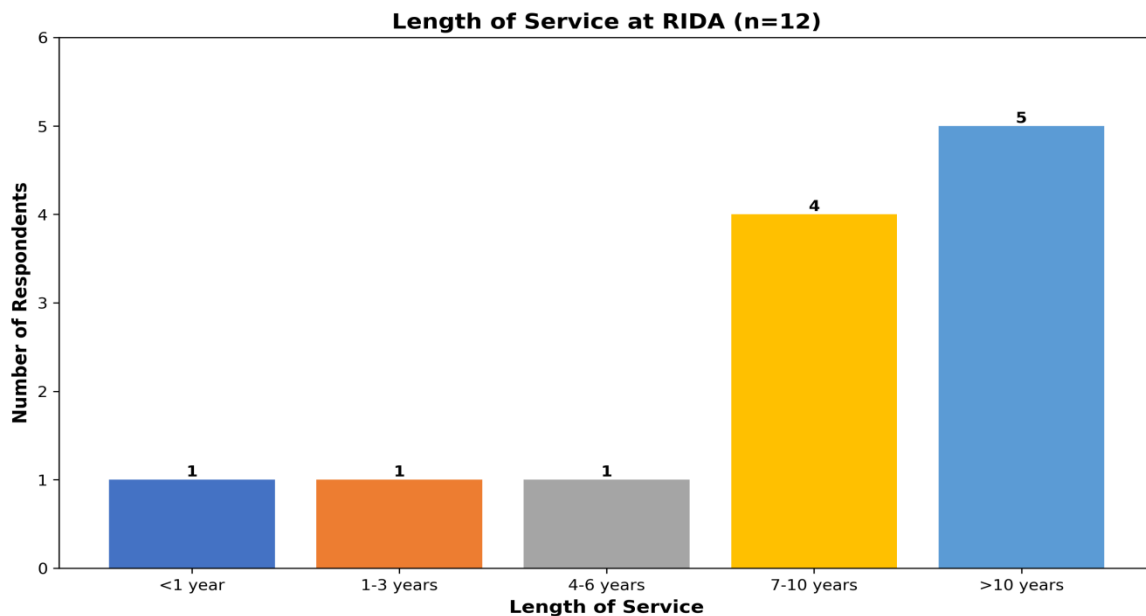
41.7% of the respondents have been in RIDA for more than 10 years followed by a proportion of 33.3% who have served for periods between 7-10 years. Only 8.3% of the staff complement has

worked in RIDA for less than one year. This trend reflects a strong retention of personnel over the years and the vast experience that marine operations personnel possess in the organization, resulting in operational capability and institutional knowledge. The period respondents have been with RIDA is summarised in Table 4.5 and a visualized by Figure 4.5.

Length of Service	Frequency	Percentage (%)
Less than 1 year	1	8.3
1-3 years	1	8.3
4-6 years	1	8.3
7-10 years	4	33.3
More than 10 years	5	41.7

Table 4.5 Respondents length of service at RIDA, Source: Field Data (2026)

Figure 4.5 Respondents' duration of service in RIDA, Source: Field Data (2026)



4.2.8 Employment Status

All 12 respondents (100.0%) are permanent employees. The absence of contract or temporary staff indicates job security and stable employment conditions, which should theoretically contribute to higher motivation and commitment (Bryson, Forth and Stokes, 2017).

4.3 Data analysis for objective 1

4.3.1 Descriptive statistics

This first analytical part presents results of data analysis relating to Specific Objective One, which sought to assess the current level of operational efficiency of RIDA's marine services in Kariba. It draws on questionnaire perceptions of respondents on operational efficiency indicators and respondents' opinion of vessel breakdowns and downtime summarized in Table 4.6 and Table 4.7 below. These are the indicators used to assess the current operational efficiency of the marine services.

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Ferries complete planned trips monthly	0	0	0	41.7	58.3	4.58
Vessel downtime within acceptable limits	8.3	8.3	8.3	50	25	3.75
Breakdowns infrequent (<1/month)	0	8.3	8.3	33.3	50	4.25
Trip turnaround times efficient	16.7	33.3	16.7	25	8.3	2.75
Trips completed on time	16.7	33.3	25	8.3	16.7	2.75
Overall reliability satisfactory	0	0	25	25	50	4.25
Output meets transport demand	0	8.3	8.3	16.7	66.7	4.42
Operations generate sufficient revenue	0	0	0	16.7	83.3	4.83

Table 4.6 Operational efficiency indicators, (n=12), Source: Field Data (2026).

NB:SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

Metric	Range Reported	Mode/Most Common
Average trips per month	8-20 trips	16 trips
Average downtime per month	2 hours - 5 days	2-4 hours
Breakdowns in past 12 months	2-22 breakdowns	5 breakdowns
Longest downtime in 12 months	8 days - 6 months	6 months
Overall ferry condition rating	2-4 (Poor to Good)	3-4 (Fair to Good)

Table 4.7 Vessel breakdowns and downtime statistics, Source: Field Data (2026)

Table 4.7 above presents respondents' estimates of vessel breakdowns and downtime. The data reveal significant variation in reported breakdown frequency and downtime, with the longest

downtime period reaching 6 months according to multiple respondents. This extended downtime directly impacts operational efficiency and service delivery.

4.3.2 Trip completion and vessel reliability

Despite the many operational constraints summarized in the earlier sections, the respondents (as summarized in Table 4.7 above) reported high trip completion rates. All respondents (100.0%) agreed that RIDA ferries perform their planned number of trips every month (mean = 4.58). The modal estimate is 16 trips every month. It demonstrates strong commitment to the provision of services. A total of 75.0% of respondents agreed that overall reliability is satisfactory; Mean= 4.25. In the same vein, 83.3% agreed that breakdown of the vessel was infrequent (less than once a month) (mean value = 4.25). On the contrary, the actual breakdown data reported (through table 4.7 above) had a breakdown frequency in the range of two to twenty-two in the last twelve months. The differences may stem from varying definitions or perceptions of incapacity or optimism bias among respondents. The assessments about vessel downtimes were more divergent with 75.0 per cent of respondents agreeing that these downtimes fall under the acceptable range while 16.7 per cent disagreed (mean = 3.75). The recorded downtime of as much as 6 months suggest tolerance of long breakdowns as normal rather than a true reflection of acceptable performance standards.

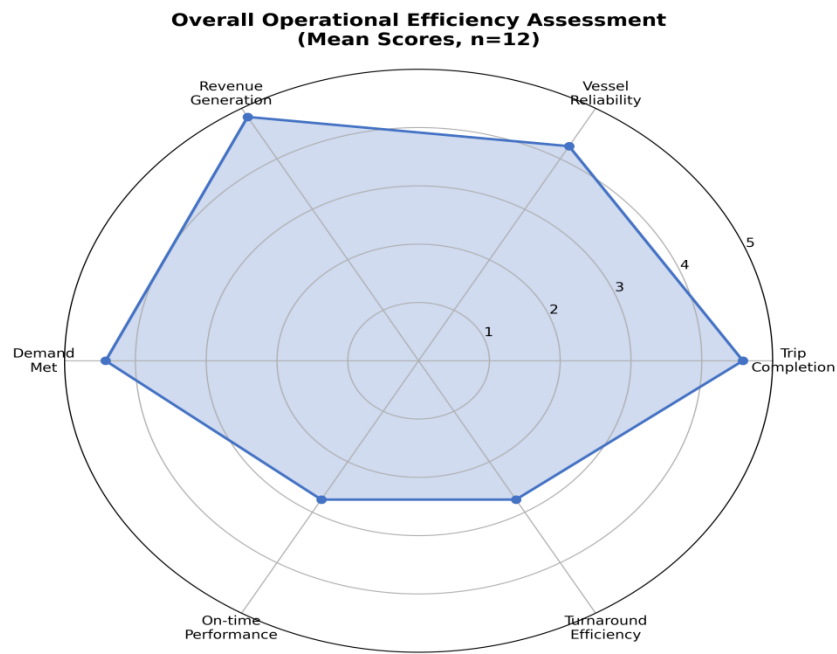
4.3.3 Revenue generation and service demand

The most positive finding confirmed by responses of the respondents (Table 4.6) in the entire study is revenue generation. An overwhelming 100.0% of respondents agreed that marine operations generate sufficient revenue in relation to their operational costs (mean = 4.83). The implication, therefore, is that RIDA's marine transport service is financially viable and profitable regardless of inefficiencies in institutional budgetary allocations. Likewise, 83.4% agreed that the current operational output responds to the transport requirements of the communities served (mean = 4.42). This demonstrates the effectiveness of RIDA in tying remote lakeside communities to the rest of the country despite operational challenges. However, promptness and efficiency still pose problems. Only 25.0 percent of the respondents are in agreement that the scheduled ferry trips are mainly completed on time. However, 50.0 percent of them were in disagreement as well (mean = 2.75). In the same vein, 33.3% of respondents agreed that trip turnaround times are efficient, while 50.0% disagreed with this assertion (mean = 2.75).

4.3.4 Overall current operational efficiency assessment

Drawing from data presented in Section 4.3 above, the current operational efficiency, derived from the mean scores of the operational efficiency metrics used for the 12 questionnaire respondents is summarized in Figure 4.6 below:

Figure 4.6 Current operational efficiency assessment(quantitative), Source: Field Data (2026)



4.4 Data analysis (operational data recorded and field observation)

This section proceeds with assessing the current operational efficiency of the marine operations, based on a comprehensive quantitative analysis of operational data extracted from RIDA's marine operations records (2020–2026) and systematic field observations conducted in May 2026. The analysis employs descriptive and inferential statistical techniques using SPSS to quantify operational efficiency patterns, validate qualitative findings and provide an empirical foundation for data triangulation.

4.4.1 Breakdown and Maintenance Performance Analysis

An analysis of maintenance records from 2020 to May 2026 shows a total of 25 maintenances were conducted out of which 23 (92.0%) were unplanned breakdowns and 2 (8.0%) were scheduled preventive maintenance. According to the maintenance data, the operations exhibits a highly reactive maintenance culture, as 92% of all maintenance events recorded are breakdowns, leaving only 8% for scheduled maintenance or inspections. This finding is consistent with respondents' assertions in the questionnaires reporting corrective maintenance dominance over preventive maintenance. Table 4.8 below summarizes breakdown frequency.

Year	Frequency	Percentage
2020	1	4.00%
2021	6	24.00%
2023	7	28.00%
2024	2	8.00%
2025	1	4.00%
2026 (to May)	8	32.00%
Total	25	100.00%

Table 4.8 Breakdown frequency by year(2020–2026), Source: RIDA Maintenance Records (2020–2026)

Table 4.9 below presents the breakdown analysis, but also brings to light another critical observation, the over-reliance of the Agency on external service providers, a practice which is not sustainable.

Category	Count	Percentage (%)
Total maintenance events	25	100
Breakdown events	23	92
Scheduled maintenance/inspections	2	8
External service provider (KB Engineering)	12	48
External service provider (Other)	6	24
Internal repairs	5	20
Not specified	2	8

Table 4.9 Maintenance events classification, (2020–2026), Source: RIDA Maintenance Records (2020–2026)

Operational maintenance records also reveal that the major overhaul of KF 551 in October–December 2023 involved hull repairs, shaft machining, engine refitting and structural welding at

a combined cost exceeding USD 73,000, a figure that underscores the financial consequences of deferred preventive maintenance. More recently, in January 2026, the ferry's ramp/door fell off mid-sailing, followed by three weeks of downtime for winch replacement in February 2026, demonstrating ongoing reliability concerns.

Key findings from maintenance statistics.

Maintenance costs a total of USD 79,058.50(during overhaul maintenance).

Average cost broken down is U.S. 7,187.14 (SD = 6,245.82).

Dependency on external providers: 72.0% of interventions.

Monthly breakdown rate of 1.6 in 2026(370% above historical average)

4.4.2 Fuel Consumption and operational activity analysis

4.4.2.1 Descriptive Statistics

Metric	Mean	SD	Min	Max	n
Monthly fuel (litres)	1,768.86	612.76	400	3,000	37
Monthly trips	13.08	3.99	2	18	37
Fuel per trip (litres)	146.77	59.81	66.67	300	37

*Table 4.10 Fuel consumption statistics, (Sep 2022 – Apr 2026) *Excludes zero-operation months (n=6).Source:RIDAFuel,Logs(2026)*

Data gathered from fuel log books revealed a mean fuel usage of 1 768.86litres per month and an overage of 13.08 trips per month. This results in an average fuel usage of 146.77 liters per one-way trip i.e either from Kariba to Chalala or the reverse.

4.4.2.2 Independent T-Test: Fuel Consumption 2023 vs 2024

An independent sample t-test using SPSS revealed a significant increase in monthly fuel consumption in 2024 as compared to 2023. During the year 2023 the average monthly fuel consumption was 1,117.50 liters with a standard deviation of 302.22 from a sample size of ten. In 2024 the observed monthly consumption rose to 2,161.67 liters with a standard deviation of 266.32 from a sample size of 12. The results of the t-statistics showed $t(20) = -8.616$, $p < .001$ (two-tailed).

The results were interpreted as showing a significant increase of 93.5% in fuel consumption. This increase reflects resumption of full operations post-refurbishment and introduction of a second weekly trip, but without parallel improvements in fuel procurement systems, thus creating strain.

4.5 Observation checklist analysis

4.5.1 Descriptive Statistics by category

Table 4.11 below summarizes observation ratings as observed by the researcher.

Category	N	Mean	SD	Min	Max	Interpretation
Vessel Maintenance	7	3	1.15	1	4	Fair
Safety Equipment	9	3.22	1.48	1	5	Fair to Good
Operational Scheduling	7	2.86	1.07	1	4	Fair (lowest)
Human Resources	6	3	1.67	1	5	Fair
Infrastructure	6	2.83	1.47	1	4	Fair
OVERALL	35	3	1.31	1	5	Fair

Table 4.11 Observation ratings by operational category, Source: Field Observation Checklist (19 May 2026)

Results obtained from analysis of data gathered through direct observation indicate a generally fair rating/interpretation of the categories observed. However, the following critical deficiencies were observed:

- Maintenance records/logbook: properly maintained log books are none existent;
- certificate of survey/certificate of fitness/Safety certificate: there is no current certificate of fitness as the last issue expired in January 2026;
- Departure on schedule: based on observed trip, the ferry departed late;
- Crew complement: the crew is severely understaffed;
- Crew PPE: crew has no uniforms/safety clothing;
- Passenger waiting area: there is no proper facility;
- Signage: there is no directional signage displayed.

4.5.2 One-Way ANOVA: ratings across categories

An Analysis of Variance(ANOVA) tested whether observation ratings differed or had a relationship across the five operational categories and resultantly, $F(4, 30) = 0.099$, $p = .982$ (not

significant at $\alpha = 0.05$). The F-test indicated no significant difference among the group means of the variable F indicating performance deficiency is uniformly distributed and not concentrated in any specific area. As such, it can be concluded that inefficiencies are systemic and not localized, therefore solutions must be dealt with in an integrated manner.

4.5.3 Correlation Analysis: Trips vs Fuel Consumption

The association between monthly trip frequency and fuel consumption was examined through Pearson correlation. The effect size of the study was $r = .358$, $p = .030$ which was significant at $\alpha = 0.05$ 2-tailed, $n = 37$. The R^2 value which is the effect size is $.128$, which means there was 12.8% of variance explained. The result shows there is a weak positive correlation as only 12.8% of the variance in the fuel consumed was explained by the number of trips taken. The low correlation indicates that unmeasured factors like the variation of cargo/passenger load, distance of routes, weather conditions and vessel technical condition drive fuel consumption. The result also points to inadequate or weak operational data capture systems.

4.6 Integrated Synthesis: addressing research question1

This section synthesizes the integrated quantitative and qualitative findings gathered from Section 4.3 to 4.5 to comprehensively address the first research question which sought to provide answers to what the current level of operational efficiency of RIDA's marine services in Kariba is, demonstrating how mixed-methods integration enables definitive answers.

4.6.1 Research Question 1: What is the current level of operational efficiency?

4.6.1.1 Overall assessment of operational efficiency

Research question 1 is best answered by Table 4.12 below which shows disaggregated operational efficiency assessment based on the critical indicators examined.

Dimension	Efficiency Rating	Evidence	Trend
Trip Output	HIGH (85-90%)	Mean 4.58, 100% agreement	Stable
Schedule Reliability	VERY LOW (30-40%)	Mean 2.33, lowest score	Declining
Vessel Availability	MODERATE (60-70%)	86% operational months	Declining sharply
Maintenance Effectiveness	LOW (30-40%)	92% reactive, +28.6% increase	Declining
Resource Availability	VERY LOW (20-30%)	Fuel 1.75, 5-month suspension	Unstable
Safety Compliance	MODERATE (60-70%)	80% compliant but critical gaps	Stagnant
Staff Productivity	MODERATE (60-70%)	High competence, low morale	Declining morale
Revenue Generation	VERY HIGH (90-95%)	Mean 4.83, 100% agreement	Stable/Growing
Customer Service	MODERATE (50-60%)	Output meets demand, but late	Mixed
OVERALL COMPOSITE	MODERATE (55-65%)	Integration of above	DECLINING

Table 4.12 Disaggregated operational efficiency assessment, Source: Integration of all quantitative and qualitative indicators(2026)

Deducing from Table 4.12 above, RIDA's marine operations currently operate at **moderate** efficiency (approximately 55–65%) although overall, a declining trajectory can be projected. The moderate operational efficiency is characterized by strong service commitment but severe systemic constraints. This assessment derives from multiple convergent indicators together with those highlighted in Table 12 above:

- a) Trip completion: 100% agreement (mean = 4.58) — high output delivery
- b) On-time completion: Only 25% agreement (mean = 2.75) — low reliability
- c) Breakdown frequency: 4.1/year, escalating to 1.6/month in 2026 — declining trajectory
- d) Operational availability: 86% of months (37/43), but 5-month suspension/complete shut down in 2025
- e) External provider dependency: 72.0% of interventions
- f) 2026 breakdown rate: 1.6/month (370% above historical average)
- g) Observation rating: Mean = 3.00/5.00 (Fair), 20% indicators Very Poor

4.6.1.2 Critical Finding: Declining Efficiency Trajectory

Results gathered in assessing the current operational efficiency of RIDA's marine operations reveal a critical finding: RIDA's efficiency is not merely suboptimal, it is actively deteriorating and without intervention, operations face systemic collapse. Evidence of decline is shown by 2026 breakdown rate 370% above historical average, post-refurbishment deterioration (+28.6%)

contradicting expected improvement, unprecedented 5-month operational suspension/total shutdown (April–August 2025), worsening staff morale and welfare conditions (interview data) and safety compliance stagnation (expired certificate, missing rescue boat unresolved for years).

4.7 Section 2: Data analysis for objective 2

Having established the current level of operational efficiency, this second analytical part addressed Specific Objective Two, which sought to identify the key factors affecting operational efficiency in RIDA's marine operations. Effective maintenance is critical to vessel reliability, safety and operational continuity (Mokashi, Wang and Vermar, 2002). The factors were examined first through the quantitative assessment of maintenance practices, operational scheduling, human resource capacity, resource availability and moderating external factors and then through the qualitative thematic analysis, before being consolidated in a triangulated hierarchy of influencing factors.

4.7.1 Impact of maintenance practices on operational efficiency

4.7.1.1 Preventive maintenance implementation

This section examines maintenance practices of RIDA'S ferries in Kariba as obtained from responses by the respondents.

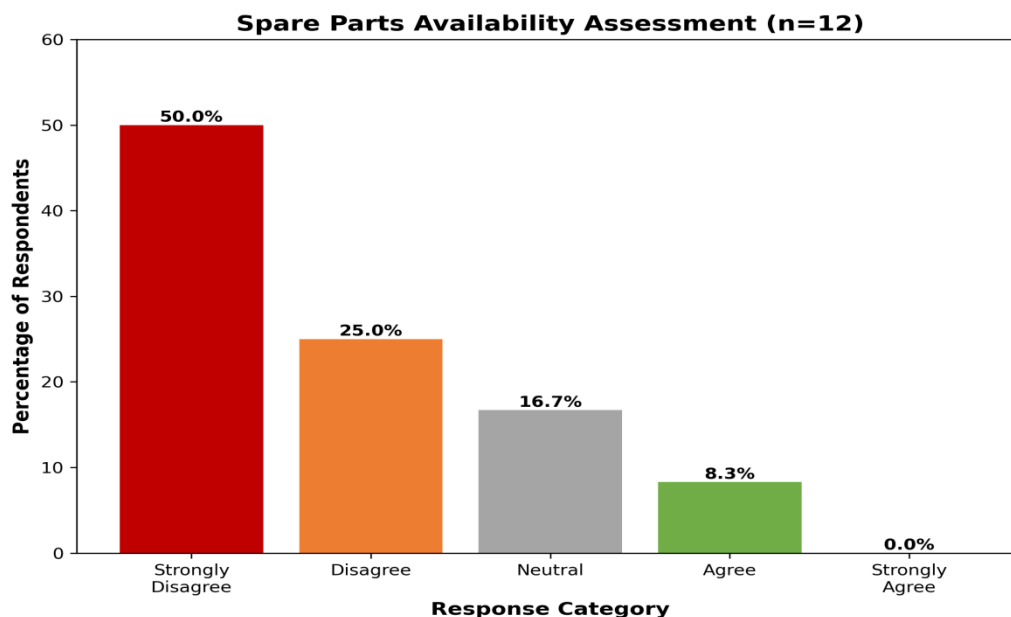
Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Preventive maintenance carried out regularly	0	25.0	16.7	50.0	8.3	3.42
Documented maintenance schedule exists	0	16.7	50.0	25.0	8.3	3.25
Breakdowns responded to promptly (8 hrs)	8.3	0	33.3	33.3	25.0	3.67
Workshop has adequate tools/equipment	8.3	25.0	33.3	25.0	8.3	3.00
Maintenance records kept up to date	0	16.7	25.0	50.0	8.3	3.50
Artisans have required skills	0	8.3	8.3	50.0	33.3	4.08
Reactive maintenance dominates	0	8.3	8.3	58.3	25.0	4.00
External specialists engaged when needed	0	0	8.3	33.3	58.3	4.50
Spare parts available when required	50.0	25.0	16.7	8.3	0	1.83
Current system ensures vessel readiness	0	16.7	41.7	33.3	8.3	3.33
Overall condition of ferries (1-5 scale)	-	-	-	-	-	3.25

Table 4.13 Maintenance practices assessment, (n=12), Source: Field Data (2026)

Note: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

Table 4.13 above presents the assessment of maintenance practices as given in the questionnaire responses. Review of responses provided by respondents reveals mixed perception towards preventive maintenance. Despite 58.3% of respondents concurring that preventive maintenance is regularly performed, 25.0% disagreeing shows inconsistency in scheduling. A mere 33.3% agreed that a documented maintenance schedule exists and is followed while 50.0% remained neutral, indicating weak formalization of maintenance procedures. On a positive note, 66.7% agreed that maintenance artisans have the right skills and qualifications, indicating adequate technical competence. Nonetheless, 58.3% agreed that corrective (reactive) maintenance is more dominant than preventive maintenance asserting that the maintenance culture is more reactive than proactive. Most critically, 75.0 % of the respondents disagreed that spare parts are available in stock when needed. This points to a significant constraint on maintenance effectiveness and this phenomenon is depicted in Figure 7 below.

Figure 4.7 Spare parts availability assessment, Source: Field Data (2026)

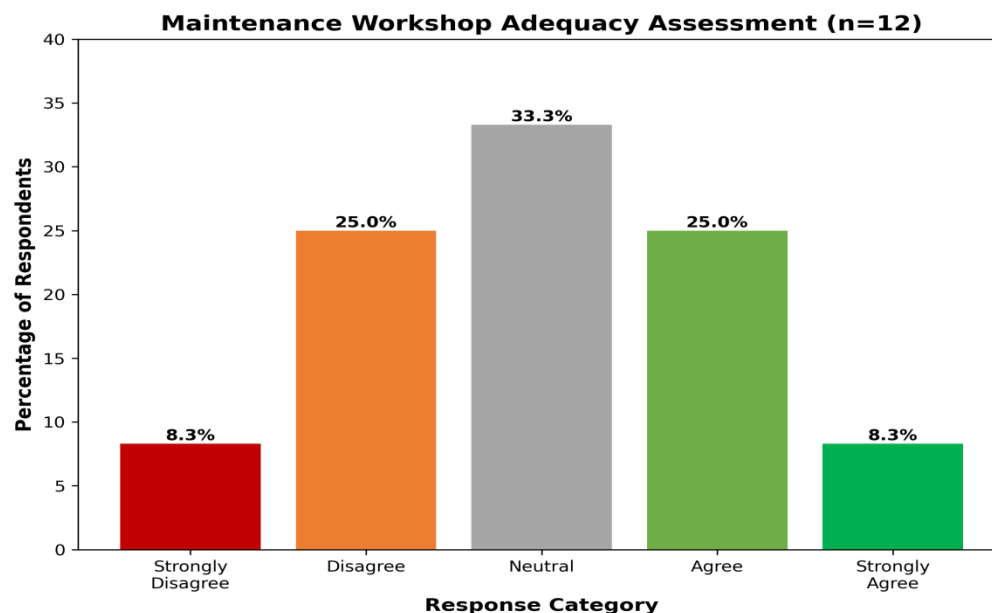


4.7.1.2 Maintenance Resources and Capacity

According to the findings, adequacy of the workshop was received with mixed perceptions as only 33.3% responded in favor of the statement that the workshop has adequate tools and equipment

whereas an equal number of respondents disagreed with it while 33.3% remained neutral (mean = 3.00), suggesting intermediate resource constraints. The results were also encouraging with 83.3% agreeing that specialist external service providers like KB Engineering are called in when required (mean = 4.50). The maintenance record-keeping received a moderate positive rating whereby 58.3% agreed records were well kept and updated systematically. (Mean = 3.50) The finding that neutral and disagreement responses accounted for 41.7% suggests a level of inconsistency in terms of proper documentation practices. The results of assessment of the maintenance workshop in terms of availability of tools and equipment are presented in figure 4.8.

Figure 4.8 Maintenance workshop adequacy assessment, Source: Field Data (2026)



4.7.2 Impact of vessel condition and readiness on operational efficiency

RIDA's ferries were rated at an average of 3.25 out of 5 (Fair to Good), indicating that RIDA's vessels condition is moderate. In terms of vessel readiness for scheduled operations 41.70% agreed that the existing maintenance system ensures readiness, but 41.70% remained neutral, while 16.70% disagreed (mean = 3.33), thus implying doubt about maintenance practices enabling vessel readiness. The open-ended responses supported these quantitative findings qualitatively. The top three critical challenges reported concerning maintenance were (i) Spare parts not available in workshop stores; (ii) Red tape in the procurement system delaying acquisition of spare parts and (iii) absence of petty cash to buy small urgent items. The respondents suggested setting up service

agreements with specialist service providers (e.g., KB Engineering), keeping minimum levels of stock of critical consumables, strengthening bulk procurement arrangements and setting aside a percentage of operational revenue for maintenance operations.

4.7.3 Influence of operational scheduling on transport efficiency

This section envisages to evaluate the influence of operational scheduling on the efficiency of marine transport services. Effective scheduling ensures optimal vessel utilization, timely service delivery and coordinated resource deployment (Stopford, 2009). Table 4.14 below presents the assessment of operational scheduling practices.

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Trips planned in advance with clear schedule	0	8.3	0	8.3	83.3	4.67
Schedules adhered to consistently (on-time)	25	41.7	16.7	8.3	8.3	2.33
Route planning considers lake conditions	0	16.7	25	33.3	25	3.67
Loading/unloading organised efficiently	8.3	33.3	0	50	8.3	3.17
Crew deployment matches requirements	0	25	16.7	25	33.3	3.67
Effective coordination between office & crews	8.3	8.3	16.7	50	16.7	3.58
Contingency plans exist for disruptions	25	25	25	16.7	8.3	2.58
Scheduling system optimises utilisation	0	0	0	33.3	66.7	4.67

Table 4.14 Operational scheduling assessment, (n=12), Source: Field Data (2026)

Note: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

4.7.3.1 Schedule Planning and Communication

A combined 91.6% of respondents (agree/strongly agree category) indicated that ferry trips are pre-planned along with a schedule which is communicated to all affected parties. (mean = 4.67), indicating strong planning capabilities and communication processes. Likewise, 100.0% of the respondents agreed that the present scheduling system optimizes vessel utilization (mean = 4.67), suggesting confidence in the scheduling system.

4.7.3.2 Schedule Adherence and Timeliness

Despite excellent planning, schedule adherence emerged as a significant weakness. Only 16.6% of respondents agreed that trip schedules are adhered to consistently (departures and arrivals on time), while 66.7% disagreed (mean = 2.33). This represents the lowest mean score across all variables examined and constituted a major operational efficiency gap. Poor adherence to

schedules undermines service reliability and customer satisfaction with the lack of contingency planning further compounding this problem. Only 25.0% of respondents agreed that contingency plans exist for schedule disruptions such as breakdowns or weather events, while 50.0% disagreed (mean = 2.58). This reactive approach leaves operations vulnerable to unplanned disruptions. Figure 4.9 summarizes respondents' views on the effectiveness of operational scheduling while Figure 4.10 presents patterns on adherence to schedules.

Figure 4.9 Operational scheduling effectiveness, Source: Field Data (2026)

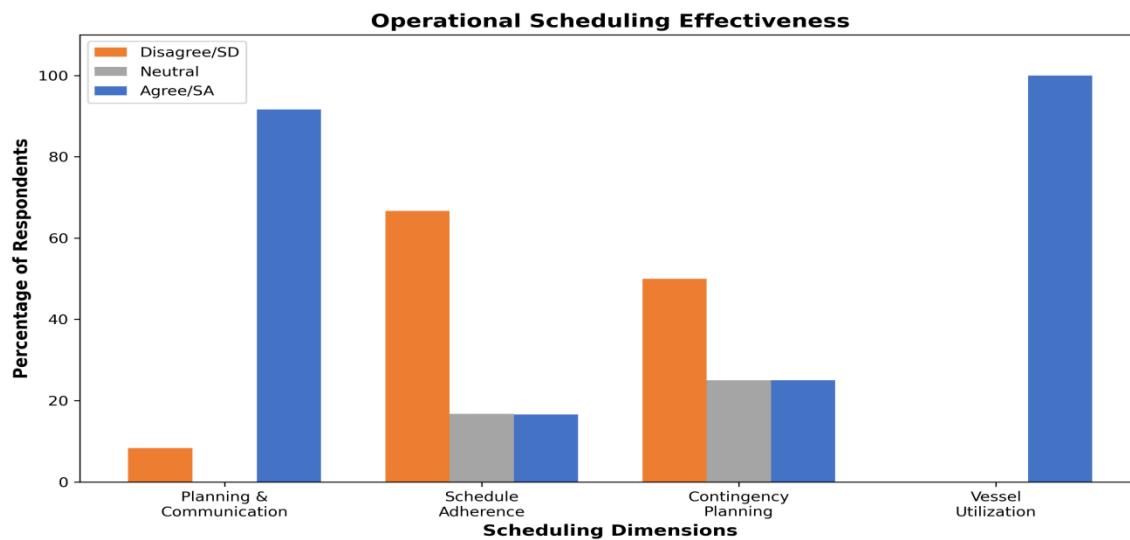
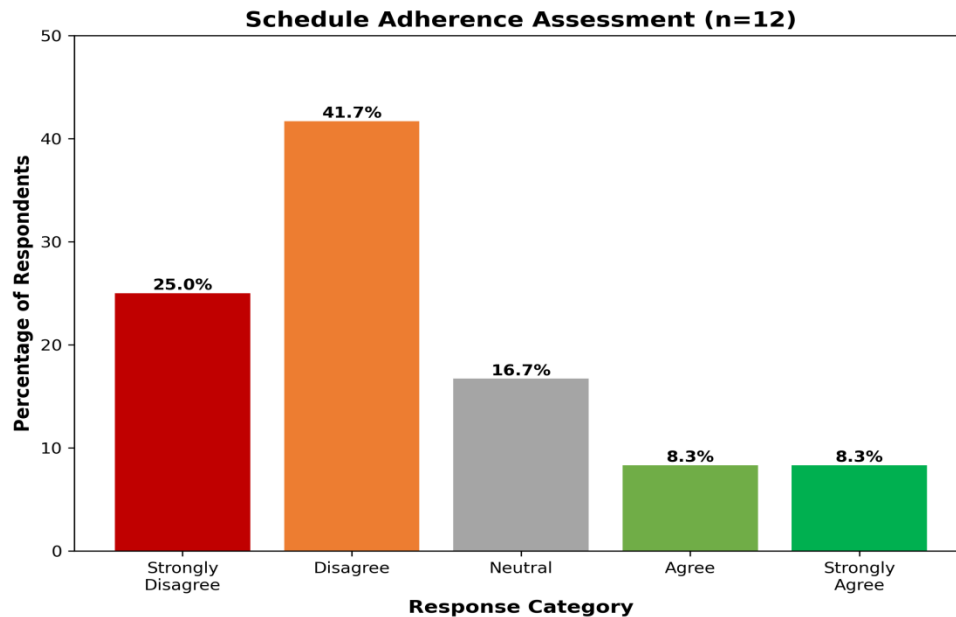


Figure 4.10 Schedule adherence patterns, Source: Field Data(2026)



4.7.4 Coordination and vessel utilization

Coordination between scheduling office and vessel crew received a moderate positive rating by the respondents as shown by 66.7% level of agreement (mean=3.58). Loading and unloading operations were rated satisfactory by 58.3% who felt that these operations were organized more efficiently while on the other hand, 41.7 % disagreed or did not know (mean = 3.17), indicating room for improvement in turnaround time optimization. According to 58.3% of respondents, route planning considers the current lake conditions, including water levels and weather (mean = 3.67). The crew deployment planning was also graded positively since 58.3 % agreed that deployment is planned in accordance with the operational requirements (mean = 3.67). The qualitative responses collected highlighted critical challenges that included poor time management and non-adherence to sailing times. Participants suggested rigorous compliance with the stipulated sailing times by the regulatory authority with better management of departure times and clearer separation of duties.

4.8 Impact of human resource capacity in operational performance

This section seeks to examine the role of human resource capacity in enhancing operational efficiency, again, endeavoring to address the second objective. Human capital, encompassing staff

competencies, motivation and working conditions, is fundamental to organizational performance (Becker, 1964). Table 4.15 below presents the assessment of human resource capacity from respondents' feedback.

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Received adequate training for role	0	0	8.3	58.3	33.3	4.25
Training provided regularly (annually)	25	33.3	16.7	25	0	2.42
Crew complement sufficient	16.7	25	8.3	25	25	3.17
Staff motivation levels high	8.3	50	8.3	8.3	25	2.92
Staff turnover low	0	8.3	0	33.3	58.3	4.42
Crew members have certifications	0	16.7	25	41.7	16.7	3.58
Clear career development path	16.7	25	33.3	25	0	2.67
Working conditions satisfactory	8.3	41.7	16.7	25	8.3	2.83
Confident in ability to perform duties	0	0	0	16.7	83.3	4.83
Communication between management & staff effective	0	8.3	41.7	50	0	3.42

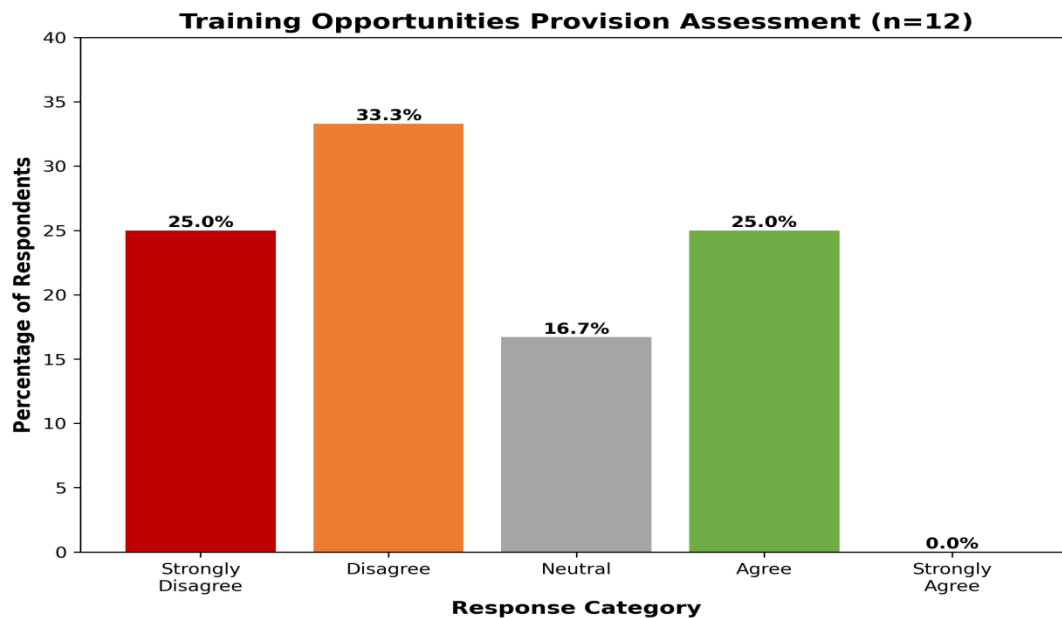
Table 4.15 Human resource capacity assessment, (n=12), Source: Field Data (2026)

NB:SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

4.8.1 Training and competency development

While the demographic profile indicated a workforce that was aging and experienced, a major shortcoming was training provision. A mere 25.0% agreed that such opportunities are provided on a periodic basis (at least annually), while 58.3% disagreed (mean = 2.42). The fact that this has one of the lowest mean scores in the study suggests systematic underinvestment in human capital development. Interestingly, 91.6% of the respondents agreed that they received sufficient training for the current position (mean = 4.25) while 100.0% also agreed that they are confident to discharge their duties well (mean = 4.83). The seeming contradiction can be explained by referring to the fact that staff competence is likely to stem from experience on the job over many years rather than training based on formal courses. But without scheduling regular training, existing personnel cannot be easily adapted to new technology, safety and operational best practices. With respect to the certifications and competencies, 58.4% agreed that all crew members have the required certifications. On the contrary, 41.7% disagreed or remained neutral (mean = 3.58), suggesting gaps in formal credentialing as shown below in Figure 4.11.

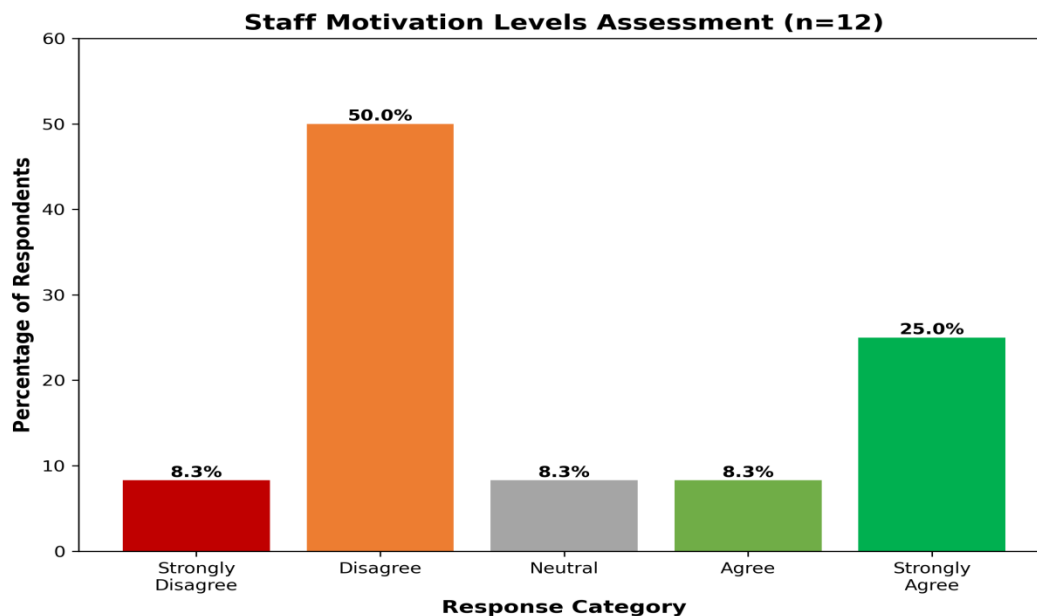
Figure 3 Training opportunities provision assessment, Source: Field Data (2026)



4.8.2 Staff complement and motivation

The levels of staff motivation were poorly rated. Only 33.3% agreed that the level of motivation in the marine operations unit is high while 58.3% disagreed (Mean=2.92). The lack of motivation is a major concern, as motivation in employees is vital for discretionary effort, innovation and service quality. (Herzberg, 1968). The adequacy of crew complement received different assessments where 50.0% agreed that the crew complement is sufficient to operate the vessels safely and efficiently while 41.7% disagreed (mean = 3.17). A critical operational constraint cited on a qualitative basis is manpower shortage, especially loaders. Discontent was recorded in the area of career development. On marine operations staff, only 25.0% agreed that a clear career development path exists, while 41.7% disagreed (mean = 2.67). The lack of a visible career progression matrix is likely contributing to a low motivation and as such limiting the organization's talent pool for younger employees. On a positive note however, staff turnover was reported as low with 91.6% agreeing turnover is low (mean = 4.42). This fits with the long service record provided earlier in the demographics section and indicates the job security that comes with holding permanent employment. Figure 4.12 below presents the staff's rating of motivation levels.

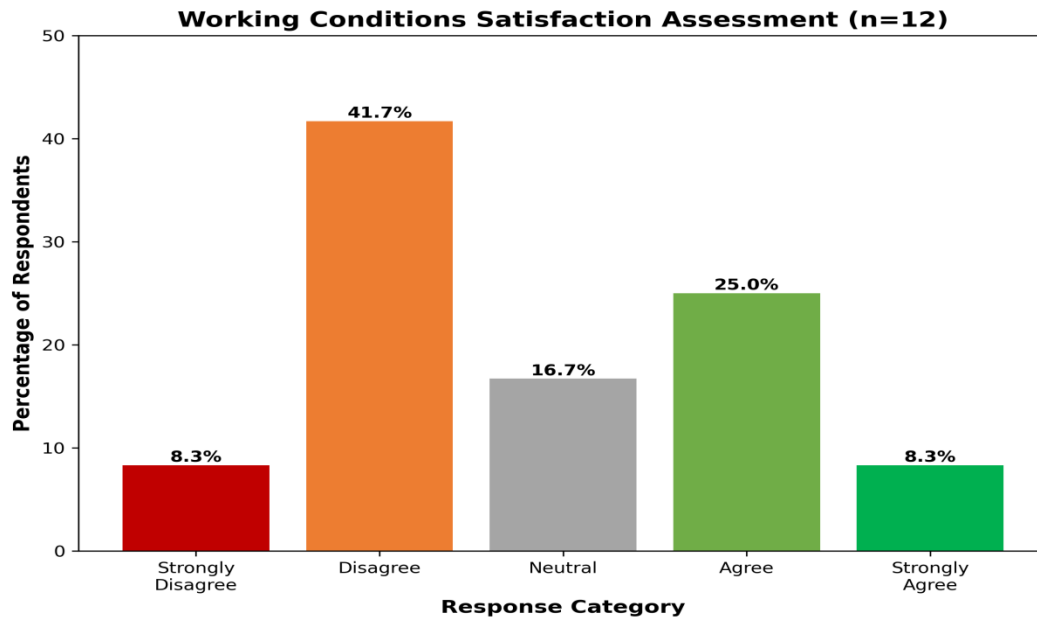
Figure 4.12 Staff motivation levels assessment, Source: Field Data (2026)



4.8.3 Working conditions and communication

The working conditions largely received negative assessments. 33.3% of respondents agreed that the working conditions (accommodation, remuneration, leave) were satisfactory whereas 50.0% disagreed with this assertion (mean = 2.83). The qualitative responses attributed the diminished morale among workers to poor welfare of staff members. Such complaints included a poor payment regime, inadequate protective clothing and food and irregular payment of allowances. Communication of management with staff operational team received moderate ratings where 50.0% agreed that it is effective, while 41.7% are neutral (mean = 3.42). This neutrality indicates the formal existence of communication channels that are not quality or responsive. These quantitative findings were strongly supported by qualitative data. The most frequently cited critical challenges were low morale among staff, poor staff welfare and suboptimal working conditions. The recommendations suggested improvements which include prompt payments of allowances, provision of protective clothing and adequate foodstuffs when sailing, increased staff complement and improved remuneration packages. The respondents' assessment of working conditions is illustrated in Figure 4.13 below.

Figure 4 Working conditions satisfaction assessment, Source: Field Data (2026)



4.9 Impact of resource availability on efficiency of marine operations

This section seeks to investigate the effect of resource availability on marine operations efficiency. Adequate resources namely fuel, spare parts, financial allocations, infrastructure and equipment are prerequisites for sustained operational performance (Slack, Brandon-Jones and Johnston, 2016). Table 4.16 presents the assessment of resource availability.

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Fuel available in sufficient quantities	58.3	16.7	16.7	8.3	0	1.75
Fuel procurement efficient & timely	58.3	25	16.7	0	0	1.58
All vessels operational & available	50	16.7	8.3	25	0	2.08
Spare parts readily available	41.7	33.3	16.7	8.3	0	1.92
Procurement cycle efficient	41.7	25	25	8.3	0	2
Docking/harbor facilities adequate	0	16.7	33.3	33.3	16.7	3.5
Navigation/communication equipment functional	0	0	8.3	33.3	58.3	4.5
Financial resources sufficient	16.7	58.3	8.3	0	16.7	2.42
Operational tools available & serviceable	16.7	25	33.3	25	0	2.67
Resource shortages caused cancellations/delays	0	16.7	16.7	41.7	25	3.75

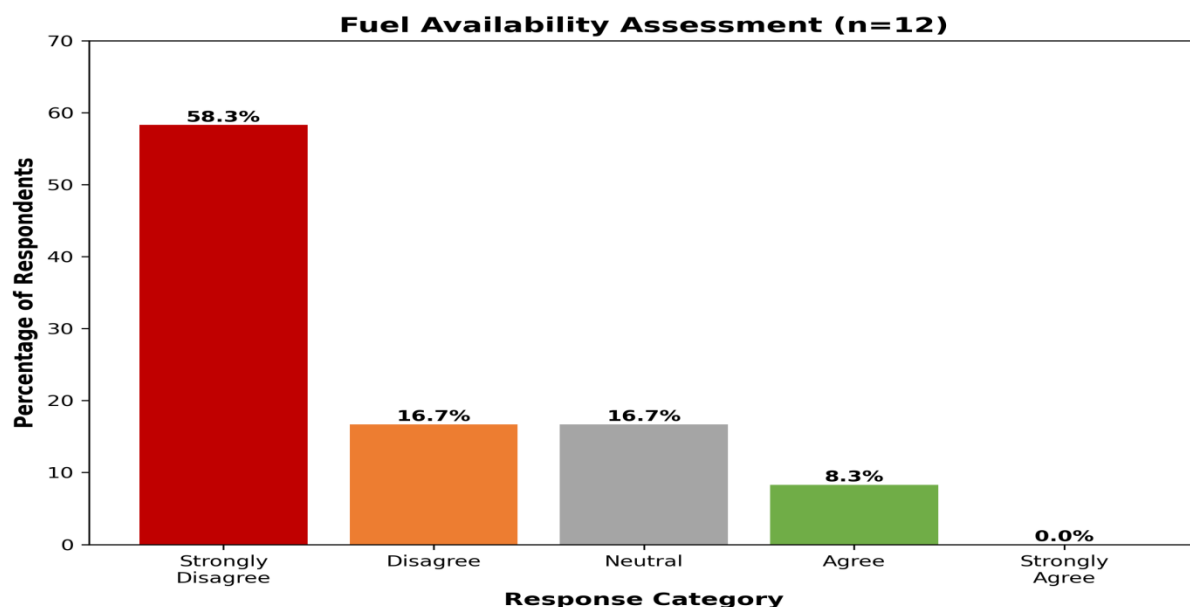
Table 4.16 Resource availability assessment, (n=12), Source: Field Data (2026)

Note: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

4.9.1 Fuel and spare parts availability

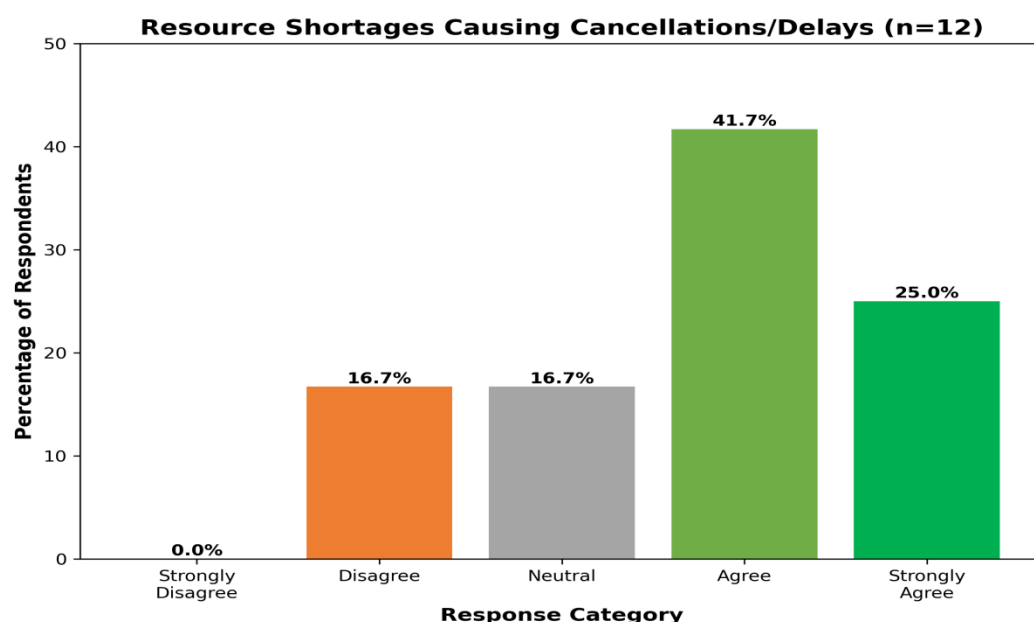
The unavailability of fuel for the operations was the most critical resource constraint. 75.0% of respondents strongly disagreed/disagreed that fuel is available in adequate quantities when needed for a scheduled trip (mean = 1.75) making this the least rated variable in the study. In the same way, 83.3% disagreed that fuel procurement processes are efficient and timely (mean = 1.58). The basic spare parts needed for boat repairs were not readily available as agreed to by 75.0 % (mean = 1.92). The finding complements the results in the maintenance section previously discussed, demonstrating procurement and supply chain failure at system level. 66.7% of respondents agreed that resource shortages have led to trip cancellations or late arrivals in the last one year (mean = 3.75). This leads to inefficient operations, operational hitches and revenue losses. Responses in the qualitative part of the questionnaires pointed towards erratic fuel supply as the first critical challenge impacting operations. Unanimously, the respondents suggested establishing bulk fuel supply arrangements with local fuel stations in Kariba, ensuring advance fuel deliveries from Harare, ploughing back a certain percentage of operational revenue into fuel procurement and maintaining strategic fuel reserves. Respondents rated the availability of the fuel as shown in Figure 4.14.

Figure 5 Fuel availability assessment, Source: Field Data (2026)



Equally, Figure 4.15 below shows ratings on how resource shortages caused trip cancellation.

Figure 4.15 Resource shortages impact assessment, Source: Field Data (2026)



4.9.2 Financial Resources and Procurement Efficiency

75.0% (mean of 2.42) of the respondents disagreed with the assertion that the allocated financial resources for marine operations are sufficient. The inadequacy manifests itself in various forms, including the inability to obtain timely fuel and spare parts, unavailability of petty cash to cover urgent minor purchases and delayed or inadequate payment of staff allowances. The efficacy of the procurement cycle for spare parts was rated poorly with 66.7% of the respondents disagreeing that it was efficient in timely delivery (mean = 2.00). Qualitative responses pointed out bureaucratic red tape, long procurement processes and inflexibility as systemic barriers to timely resource acquisition. Participants proposed an array of financial and procurement reforms including establishment of a petty cash facility for urgent purchases and decentralization of procurement authority for marine operations. It was also recommended that a percentage (say 10%) of operational revenue should be retained or ploughed back directly in the budget for marine operations. Finally, pre-negotiated service contracts with suppliers were recommended to avoid lengthy procurement procedures

4.9.3 Infrastructure and equipment adequacy

The evaluation of infrastructure and equipment yielded mixed perceptions. The docking and harbor facilities were rated moderate with 50.0% agreeing they were adequate, while 50.0% disagreed or were neutral (mean = 3.50). According to the findings, operational tools and equipment (ropes, anchors, loading gear) were rated as moderately available and serviceable as rated by 25.0% of respondents while on the contrary, 41.7% of respondents disagreed to the notion. (mean = 2.67). Availability of navigation and communication equipment on the vessels was well-rated as 91.7% of respondents agreed it is functional (mean = 4.50). This indicates that investment in safety-critical technology has been properly prioritized. Fleet availability was rated poorly with 66.7% disagreeing that all the vessels in the fleet are operational and available for deployment (mean = 2.08), supporting the earlier finding of lengthened downtime periods (as high as 6 months) and inadequate spare parts for timely repairs.

4.10 Moderating effects of external factors

This section examines the moderating effects of external contextual factors on the relationship between operational practices and efficiency. These factors include budget allocation and disbursement patterns, environmental conditions (weather and water levels) and regulatory frameworks. Table 4.17 below presents the assessment.

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
Budget allocated adequate	25	41.7	8.3	8.3	16.7	2.5
Budget disbursements timely	33.3	50	16.7	0	0	1.83
Govt policies support operations	0	0	16.7	50	33.3	4.17
Weather disrupts operations frequently	0	16.7	41.7	25	16.7	3.42
Water levels affect operations significantly	0	8.3	25	50	16.7	3.75
Regulatory framework facilitates operations	0	0	8.3	41.7	50	4.42
Compliance requirements reasonable	0	0	8.3	50	41.7	4.33
External institutional support adequate	0	0	33.3	58.3	8.3	3.75

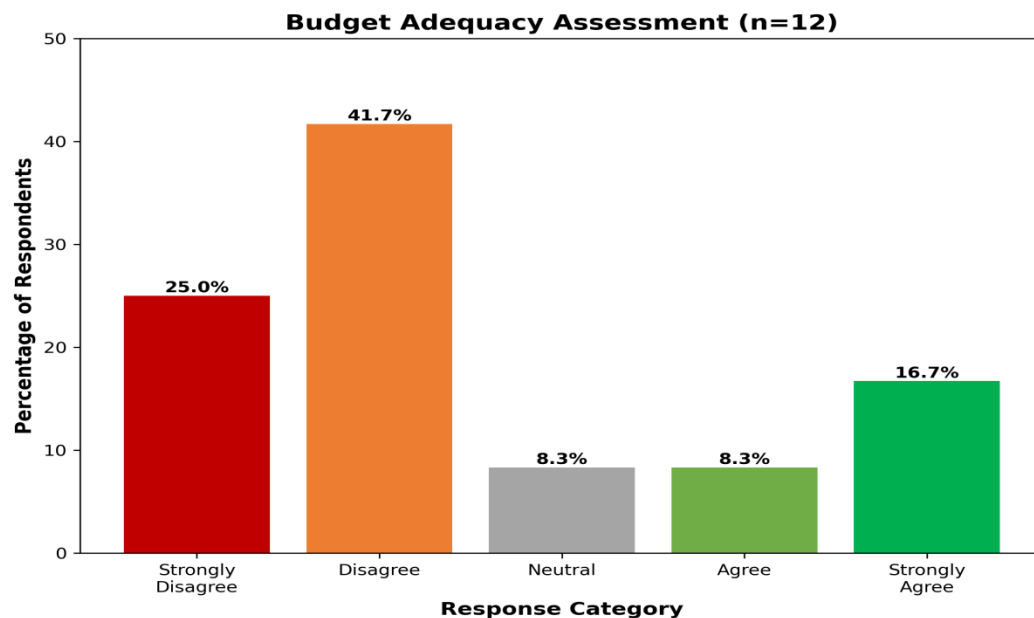
Table 4.17 Moderating variables assessment, (n=12), Source: Field Data (2026)

Note: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree

4.10.1 Budget Allocation and Disbursement

Both the adequacy of the budget and its timeous disbursement were rated very poorly. 25.0% of respondents agreed that the budget allocated for marine operations is adequate with 66.7% disagreeing (mean = 2.50). Most critically, with mean score (1.83), 83.3% disagreed that budget disbursements are timely and predictable, the second-lowest rating after fuel procurement. The finding confirms that the financial resource shortage identified in Section 4.9.2 above is widely attributable to systematic under-allocation and unpredictable disbursement. Inconsistent cash flows hinder planning and compel reliance on loans (as indicated in one of the open-ended questions on the questionnaires), and may lead to employee discontent as a result of allowance delays. Respondents rated the adequacy of budgets as shown in Figure 16.

Figure 4.16 Budget adequacy assessment, Source: Field Data (2026)



4.10.2 Environmental and Regulatory Factors

Environmental factors received moderate ratings. Weather conditions on Lake Kariba were reported to frequently disrupt scheduled operations by 41.7% of respondents, with 41.7% remaining neutral (mean = 3.42). Fluctuating water levels were perceived to significantly affect vessel operations by 66.7% of respondents (mean = 3.75). These environmental challenges are inherent to Lake Kariba's geography and climate, requiring adaptive operational strategies such as flexible scheduling and shallow-draft vessels for low-water periods. In contrast and on a rather

positive note, the regulatory environment received strongly positive assessments. An overwhelming 91.6% agreed that the regulatory framework (Inland Waters Control Department) facilitates efficient operations (mean = 4.42) and 91.6% agreed that regulatory inspections and compliance requirements are reasonable and achievable (mean = 4.33). Government policies were also viewed favorably, with 83.3% agreeing they support and facilitate efficient marine operations (mean = 4.17). External institutional support from the Ministry of Transport and local authorities was rated as adequate by 66.7% (mean = 3.75). This generally supportive external environment contrasts sharply with the internal operational and resource constraints identified earlier, suggesting that efficiency barriers are primarily organizational rather than external.

4.11 Qualitative Data Analysis - Thematic Analysis

This section systematically analyses qualitative data collected through open-ended questionnaire responses gathered from the 12 marine operation participants of RIDA, as well as key informant interview responses. Thematic Analysis, according to Braun and Clarke (2006) is an approach for identifying, analysing and reporting patterns (themes) within data with the dataset classification being flexible and accessible. Nomenclature systematically organizes and describes data in detail, while examining other aspects of the research topic.

The analysis was conducted using Braun and Clarke's (2006) six-phased framework which consists of (i) researchers becoming familiar with the data through constant reading of all the open-ended responses, (ii) systematic generation of initial codes, followed by (iii) collation of codes into potential themes, then (iv) reviewing the themes to ensure their internal coherence and external distinctiveness (v) defining and naming themes to capture the essence and finally (vi) the final analysis producing the thematic narrative presented in this section. The process was largely inductive and driven by data so that themes would come from the experiences of the participants rather than from pre-existing theories.

4.11.1 Overview of major themes

The seven major themes identified through the analysis of questionnaires and supported by key informant interviews, observations and operational records are: (1) Resource scarcity and supply chain disruptions, (2) organizational bureaucracy and systemic inflexibility, (3) human resource deficiencies and staff welfare crisis, (4) maintenance system inadequacies and vessel reliability

challenges, (5) operational discipline and scheduling non-adherence, (6) revenue reinvestment and financial autonomy imperatives and (7) safety management deficiencies. Table 4.18 below provides a summary of these themes, their prevalence in the data and their relationship to the research objectives.

Theme	Prevalence	Related Research Objective
1. Resource scarcity and supply chain disruptions	Mentioned by 100% of respondents (12/12)	Objective 2
2. Organizational bureaucracy and systemic inflexibility	Mentioned by 75% of respondents (9/12)	Objective 2
3. Human resource deficiencies and staff welfare crisis	Mentioned by 83% of respondents (10/12)	Objective 2
4. Maintenance system inadequacies and vessel reliability	Mentioned by 67% of respondents (8/12)	Objective 1: Impact of maintenance practices
5. Operational discipline and scheduling non-adherence	Mentioned by 58% of respondents (7/12)	Objectives 1& 2
6. Revenue reinvestment and financial autonomy	Mentioned by 50% of respondents (6/12)	Objectives 1&2
7. Safety Management Deficiencies		Objectives 1&2

Table 4.18 Summary of major themes from thematic analysis, Source: Thematic Analysis of Qualitative Data (2026)

4.11.1.1 Theme 1: Resource Scarcity and Supply Chain Disruptions

This was the most pervasive theme, mentioned by all 12 respondents (100% prevalence). It encompasses chronic shortages of critical operational inputs, particularly fuel and spare parts, which directly undermine service delivery and operational efficiency. The theme directly addresses the effect of resource availability on marine operations and triangulates with the quantitative findings presented in Section 4.9.1, where fuel availability received the lowest mean score (1.75) in the entire study.

4.11.1.1a Sub-theme: Erratic fuel supply as primary operational bottleneck

According to 10 of 12(83%) respondents, fuel scarcity was the most common operational bottleneck encountered in the operations. According to participants, unavailability of fuel is not a once-off disruption but a continuous structural constraint. Representative quotes included:

"Erratic fuel supply" (Deck Hand 1)

"Fuel shortages" (Deck Hand 2)

"Erratic supply of fuel, lubricants and staff allowances" (Administrative Staff)

"Fuel supply inconsistency and logistics bottlenecks" (Management)

The qualitative data revealed that fuel shortages are not attributable to budgetary constraints, as 100% of respondents agreed marine operations generate sufficient revenue (mean = 4.83), thus confirming revenue adequacy, but rather to supply chain inefficiencies, particularly the need to transport bulk fuel from Harare to Kariba. One participant explicitly described the coping mechanism: "borrowing fuel from stakeholders," indicating that operations continue, although through informal and unsustainable arrangements.

Erratic fuel supply was cited as a critical bottleneck in operational efficiency by 5 of the 6 interviewees as quoted: *"Usually fuel does not come in time and also it comes in inadequate quantities. At one point, the fuel arrived by swift at 11am when we were scheduled to depart at 8am."* (Management)

"When fuel is not available, the office usually borrows from stakeholders around Kariba, but returning the borrowed fuels is a big challenge which creates sour relations with stakeholders." (Management)

The observation notes confirmed this challenge: "Fuel for scheduled trips is sometimes borrowed from local stakeholders and in most cases is not available. Operational data records corroborated this observation by revealing fuel receiving vouchers indicating from where it was borrowed. Such emergency fuel which is sent from Harare is predominantly for 1 or 2 round-robin trips, and usually sent a few days prior to departure or even on the day of the trip."

4.11.1.1b Sub-theme: Spare parts unavailability and maintenance paralysis

The second most frequently cited resource constraint was spare parts unavailability, mentioned by 9 out of 12 respondents (75%). This sub-theme directly connects to Theme 4 (Maintenance System Inadequacies) and explains the extended vessel downtime documented quantitatively (up to 6 months). Representative quotes included:

"Unavailability of spares in the workshop stores" (Deck Hand 1)

"Unavailability of other boat spares as they are imported" (Maintenance Technician)

"Unavailability of critical spares in the workshop stores" (Vessel Operator)

Participants identified both the technical challenge (imported marine spares requiring international procurement) and the organizational challenge (procurement system inefficiency) as contributing factors. The quantitative data corroborate this perception as 75% of respondents disagreed that spare parts are available when required (mean = 1.83, Section 4.3.1).

Data collected from key informants corroborated this resource constraint. Respondent (SSP-01) corroborated this: *"The workshop stores is running on no major spares."* Respondent (Management) elaborated that "ideally, the boat should be serviced after every 250 hours, this scheduled service is not being done consistently due to unavailability of complete service kits. Mostly the filters are not being replaced but just being cleaned and re-used."

4.11.1.1c Proposed Solutions: Local procurement and inventory management

Respondents articulated specific and actionable recommendations to address resource scarcity, demonstrating operational expertise and strategic thinking. The most frequently recommended solutions included:

"An arrangement for bulk fuel supply should be made with local fuel supply stations so that fuel is collected from Kariba, thus minimizing delays of transporting fuel from Harare. This also eliminates the practice of borrowing fuel from stakeholders." (Administrative Staff 1)

"Maintaining backup stocks of ferry/boat consumables in the workshop stores to minimize ferry downtime." (Administrative Staff 1)

"Engaging local fuel supply garages to provide bulk fuel to eliminate delays attributed to unavailability of fuel timeously." (Administrative Staff 1)

These recommendations reveal operational staff's understanding that resource scarcity is primarily a logistics and inventory management problem rather than a budgetary affordability issue, aligning with the quantitative finding of strong revenue generation but poor resource availability.

4.11.1.2 Theme 2: Organizational bureaucracy and systemic inflexibility

This theme, mentioned by 9 out of 12 respondents (75%) in questionnaires, identifies organizational structures and processes as significant barriers to operational efficiency. It encompasses procurement delays, centralized decision-making inappropriate for remote operations and inflexibility in responding to urgent operational needs. This theme cross-cuts multiple research objectives but is particularly relevant to factors affecting operational efficiency under Objective 2 (maintenance practices) and (resource availability).

4.11.1.2a Sub-theme: Bureaucratic red tape in procurement

The centralized and bureaucratic nature of procurement processes was the widely mentioned organizational constraint, explicitly cited by 50% of the respondents. This was a recurring theme across all data sources. One of the greatest challenges, respondents indicated, was bureaucratic red tape in the procurement system. Representative quotes included:

"Bureaucratic red tape in the procurement system" (Administrative Staff 1)

"Organizational bureaucracy—the chain in procuring spares" (Maintenance Technician 2)

Participants described procurement delays not as occasional occurrences but as systemic features of the operational environment. One participant noted that procurement cycles are "inefficient" and lead to "slow spares procurement increasing expenses" (Management), directly linking bureaucracy to both operational downtime and cost escalation. The quantitative data corroborate this perception as 66.7% of respondents disagreed that procurement cycles are efficient (mean = 2.00, Section 4.6.2).

One Key Informant also noted, *"The procurement process is hindered by bureaucratic red tape which results in delays. Most service providers require payment in foreign currency whereas government policy emphasises payment in local currency."* (Management)

4.11.1.2b Sub-theme: Absence of petty cash and financial flexibility

Closely related to procurement inflexibility is the absence of petty cash provisions for urgent small purchases, mentioned by 4 respondents (33%). Representative quotes included:

"Unavailability of petty cash to purchase small items" (Maintenance Technician 1)

"Unavailability of floating cash—no cash to purchase small items" (Maintenance Technician 2)

*"Provision of petty cash and prompt payment of allowances helps to improve employee morale."
(Administrative Staff 1)*

This sub-theme reveals a mismatch between operational requirements for rapid response (e.g., purchasing an urgent small spare part to resume operations) and organizational financial control systems that centralize all purchasing authority, regardless of item value or urgency of the need.

4.11.1.2c Sub-theme: Need for decentralization and autonomy

Several respondents articulated the need for greater operational autonomy and decentralized decision-making authority. Representative quotes included:

"The marine operations must become a stand-alone unit to facilitate quick decision-making and procurement of requirements." (Maintenance Technician 1)

"Procurement of boat requirements must be done by staff from the user department to eliminate procurement and delivery of wrong items." (Crew Member)

4.11.1.3 Theme 3: Human resource deficiencies and staff welfare crisis

This theme, mentioned by 10 out of 12 questionnaire respondents (83%), encompasses inadequate staff complement, low motivation, poor working conditions and irregular payment of allowances. It directly addresses the role of human resource capacity in enhancing operational efficiency and triangulates with the quantitative findings in Section 4.5.2, where staff motivation received a mean score of only 2.92.

4.11.1.3a Sub-theme: Diminished staff morale and welfare neglect

Staff morale emerged as a critical concern, mentioned by 58% of questionnaire respondents. Representative quotes included:

"Diminished staff morale" (Deck Hand 1)

"Low staff morale" (Deck Hand 2)

*"There is need to capacitate staff with requisite resources (protective clothing, food, allowances)."
(Deck Hand 1)*

"Overlooking employee welfare" (Administrative Staff 1)

Key Informants also reinforced the concern of low staff morale. Respondent (MGT-01) reported that *"staff is dedicated and hard-working, but demotivated due to erratic fuel supply and payment of their duty allowances."* Respondent (MGT-03) highlighted that *"staff morale is very low". The salaries for captains under RIDA is far too low compared to that which other captains in the industry are getting.*" Respondent (MGT-04) warned that delayed allowance payments *"may lead them to steal proceeds of the operations."*

The qualitative data reveal that staff dissatisfaction stems not from the work itself as 100% of respondents expressed confidence in their ability to perform duties effectively (mean = 4.83, Section 4.2.9), but rather from perceived neglect of basic welfare provisions such as protective clothing, adequate food and timely payment of allowances.

4.11.1.3b Sub-theme: Inadequate staff complement

Staff shortage, particularly of loaders, was mentioned by 5 questionnaire respondents (42%). Representative quotes include:

"There is need to increase number of loaders." (Deck Hand 1)

"Staff shortage" (Administrative Staff)

This sub-theme corroborates the quantitative finding that crew complement adequacy received mixed assessments (mean = 3.17, Section 4.2.10), with 41.7% of respondents disagreeing that the complement is sufficient. Inadequate Staffing Levels was also identified through Key Informant Interviews. According to Respondent (MGT-03), staffing levels for vessel operators are at "50%," noting that *"ideally captains should be 4 or more for better efficiency, but currently each crew is served by one captain alone with no reliefer on-board."* Respondent (MGT-01) highlighted the absence of workshop operatives, while the observation confirmed that *"loading and offloading teams are understaffed."*

4.11.1.4 Theme 4: Maintenance system inadequacies and vessel reliability challenges

This theme, mentioned by 8 out of 12 questionnaire respondents (67%), outlines systemic deficiencies in maintenance practices and their direct impact on vessel reliability and operational continuity. It directly relates to the impact of maintenance practices on operational efficiency and

triangulates with findings in Section 4.7.1.1, where reactive maintenance dominance and spare parts shortages were quantitatively documented.

4.11.1.4a Sub-theme: Reactive maintenance culture

All data sources converged on the finding that RIDA's maintenance approach is predominantly reactive. Several respondents explicitly identified the dominance of reactive over preventive maintenance as a critical operational weakness. Recommended solutions focused on preventive approaches:

"Scheduled maintenance program" (Administrative Staff)

"Implement preventative maintenance and stock critical spares on site." (Management)

"Preventive measures are needed to reduce breakdowns." (Maintenance Technician 2)

From Key Informant interviews, Respondent (MGT-03) stated unequivocally: "The main maintenance approach is rather reactive, the boat is usually attended to when it has a breakdown, but ordinarily, it is not maintained." The observation checklist confirmed the absence of any formal maintenance logbook, with breakdowns being "recorded on a desk calendar." Furthermore, Respondent (MGT-03) highlighted that: *"Currently, the maintenance system is poor. There is no proper maintenance management system in place. The main maintenance approach is rather reactive."*

These qualitative insights corroborate the quantitative finding that 58.3% of respondents agreed reactive maintenance dominates over preventive maintenance (mean = 4.00, Section 4.7.1.1).

4.11.1.4b Sub-theme: Heavy dependence on external service providers

Although 83.3% agreed that specialist external maintenance providers (e.g., KB Engineering) are engaged when needed (mean = 4.50), indicating effective use of external expertise for complex repairs, the high rating for external service provider engagement reflects RIDA's reliance on mostly one specialist service provider for most significant repairs. Of the 25 documented maintenance events, 72% were performed by external contractors. While the in-house maintenance artisan was consistently praised for competence "the Agency has a quite capable artisan but he is suffocated by financial constraints"—SSP-01, internal capacity is insufficient for major repairs, creating dependency on external providers and associated cost and time implications.

4.11.1.5 Theme 5: Operational discipline and scheduling non-adherence

This theme, mentioned by 7 out of 12 questionnaire respondents (58%), identifies behavioral and managerial deficiencies in operational execution, particularly poor time management and non-compliance with scheduled departure times. It directly addresses Research Objective 2 (evaluating the influence of operational scheduling on transport service efficiency) and triangulates with the quantitative finding of extremely poor schedule adherence (mean = 2.33, Section 4.7.3.2).

4.11.1.5a Sub-theme: Non-Adherence to sailing times

Several respondents explicitly identified departure time discipline as a critical operational weakness: *"Non-adherence to sailing times as required by the lake navigation authorities"* (Vessel Operator)

"There is need to improve on departure times so as to sail within the confines of the lake navigation stipulated timelines." (Crew Member)

"Improving on time management" (Vessel Operator)

The qualitative data revealed that schedule non-adherence was not primarily driven by external factors (breakdowns, weather) but rather by internal operational discipline deficiencies. This disconnect between planning excellence (mean = 4.67) and execution discipline suggests that efficiency gains are achievable through managerial and behavioral interventions rather than through additional resource investments.

4.11.1.6 Theme 6: Revenue reinvestment and financial autonomy imperatives

This cross-cutting theme, mentioned by 6 out of 12 respondents (50%), addresses the disconnect between revenue generation and resource availability. It uniquely identifies a novel operational dynamic: the coexistence of strong revenue generation with severe resource scarcity, attributable to organizational rather than financial constraints.

4.11.1.6a Sub-theme: Ploughing back operational revenue

The most frequently articulated recommendation was to reinvest a percentage of operational revenue directly into marine operations. Representative quotes included:

"Ploughing back 10% of the operational revenue realized to support the operations" (Administrative Staff 1)

"The business is a viable venture hence revenue generated through the operations should be re-invested to fund the operations" (Crew Member)

"The marine operations must become a stand-alone unit to facilitate quick decision-making and procurement of requirements." (Maintenance Technician 1)

These recommendations reveal operational staff's understanding of the revenue-efficiency paradox: marine operations generate strong revenue (100% agreement, mean = 4.83) but suffer from chronic resource shortages because revenue is not retained or reinvested locally. This constitutes a novel finding distinct from typical public-sector resource scarcity narratives.

4.11.1.7 Theme 7: Safety management deficiencies

The most critical safety finding is the near-complete absence of safety drills (mean=1.56) and the invalidity of safety/fitness certificates (mean=2.00). There was independent confirmation that "there is no safety management system in place" (MGT-02, MGT-03). The observation revealed expired fire extinguishers, absence of an evacuation/rescue boat, an expired certificate of survey/fitness, no public address system and passenger capacity being exceeded. Respondent (REG-01) emphasized that "the absence of the tender/rescue boat is of great concern... the matter is not being given the urgency it requires."

4.12 Overview of thematic analysis

The thematic analysis supplements the quantitative findings presented, adding further context to the descriptive statistics, frequency distributions and other quantitative findings. The analysis revealed seven themes, which align with the research aim and problem statement, to enhance operational efficiency of RIDA's marine operations. These themes indicate repeated connotations in the dataset and the operational challenges and opportunities that are identified by the frontline staff and management. Thematic analysis revealed seven key themes that characterize the operational challenges and opportunities of RIDA's marine operations. Three important lessons arise from the findings, beyond the data.

To begin with, the operational staff demonstrate high level of technical competence, organizational commitment and strategic awareness of efficiency barriers. The specificity and achievability of the recommendations suggests that solutions are there, are known and they can be implemented. This

implies that the key barriers lie in organizational authorization and policy rather than knowledge of the technology or inability to pay.

Furthermore, thematic analysis reveals a disconnection between operational performance (completing trips, making revenue) and operational sustainability. When staff achieve their targets through extraordinary adaptive capacity and informal work-arounds, this can hide or mask fragility within the system. This fragility has the potential to produce sudden catastrophic failure. Third, the analysis confirms that barriers to operational efficiency are mostly organizational and managerial, rather than external and environmental. According to the scores, it can be inferred that external conditions are not the binding constraints as the regulatory environment has supportive conditions (mean = 4.42) while the environmental challenges are manageable and revenue generation is sufficient (mean = 4.83). The principal obstacles to operational efficiency are internal organisational practices such as centralised financial control, bureaucratic procurement, absence of local revenue retention mechanisms and poor time management. The above pertinent insights will be useful in developing the framework in Chapter Five as they suggest that gains in efficiencies can be generated by organisational re-structuring and not resource mobilization.

4.13 Integrated Synthesis: addressing the research question 2

4.13.1 Research Question 2: What Factors Influence Operational Efficiency?

This section synthesizes the qualitative findings gathered from Section 4.11.1 to 4.12 to comprehensively answer the second research question which sought to provide answers to what factors influence operational efficiency of RIDA's marine services in Kariba.

4.13.1.1 Factor Identification

This section presents the factors that influence operational efficiency of RIDA's marine operations, based on analysis of qualitative data gathered. Fifteen distinct factors were identified and categorized across four domains: Tier 1 contains the most critical factors affecting operational efficiency, followed by Tier 2 with factors which significantly affect the operational efficiency. Tier 3 follows with factors considered to moderately affect operational efficiency and lastly, Tier 4 with positive factors identified, but which also influence operational efficiency. Table 4.19 below summarises these factors as grouped according to the tiers identified.

Tier	Critical Factors	Evidence Strength
TIER 1(Critical)	1. Fuel availability (mean 1.75, 100% cited)	very strong(Convergent across all 4 sources)
	2. Reactive maintenance (92% of interventions)	
	3. Revenue reinvestment failure (paradox)	
	4. Staff motivation crisis (mean 2.92, 83% cited)	
	5. Operational discipline failure (mean 2.33)	
TIER 2(Significant)	6. Spare parts unavailability	strong(3-4 sources)
	7. Centralized procurement/bureaucracy	
	8. Staff complement inadequacy	
	9. Training provision absence	
TIER 3(Moderate)	10. Vessel age/deterioration	moderate(2-3 sources)
	11. Financial disbursement unpredictability	
	12. Workshop capacity limitations	
TIER 4(Mixed/Positive)	13. Maintenance documentation absence	strong(Convergent)
	14. Staff competence (positive, mean 4.83)	
	15. Regulatory framework (mixed—supportive but lenient)	

Table 4.19 Factors influencing operational efficiency(hierarchical ranking), Source: Triangulated factor analysis(2026)

4.13.1.2 System Interactions of factors

The factors that influence operational efficiency as identified in section 4.13.1.1 above interact together to create compounding negative effects and self-reinforcing cycles which have been identified as follows:

Vicious Cycle 1: Maintenance-Breakdown-Resource Depletion: Reactive maintenance results in more breakdowns, more costs in repair, more depletion of resources, more deferred maintenance, more breakdown (repeat).

Vicious Cycle 2: is the revenue-efficiency paradox. It generates strong revenue but gets captured centrally. As a result, local resources are unavailable, which causes operational disruptions. This may result in service unreliability that may cause future revenue to decline.

Vicious Cycle 3: Demotivation-Discipline-Productivity: When morale is low, discipline is poor, and departure is late. This leads to complaints, pressure leading to further demotivation.

These systemic interactions demonstrate that addressing individual factors in isolation will produce limited gains. The operational efficiency framework must adopt a systems perspective, targeting multiple interacting factors simultaneously.

4.13.1.3 Critical Theoretical Insight

The majority of efficiency constraints stem from organizational governance failures rather than inherent operational challenges or resource unavailability as evidenced by: Fuel scarcity- Not caused by unaffordability (revenue 4.83) but centralized procurement logistics. Spare parts shortage- Not funds shortage but bureaucratic red tape and procurement chain inefficiency. Reactive maintenance- Not artisan incompetence but lack of resources and no formal maintenance system. Low motivation- Not unaffordable wages but erratic payment and overlooking welfare. Discipline failure- Not incompetence but tolerating late comers and abuse of influence. Thus, the proposed efficiency improvement framework to be modelled in Chapter Five must prioritize governance reforms (revenue ringfencing, procurement decentralization, accountability systems) over resource mobilization or technical capacity building.

4.14 Integrated discussion and synthesis across objectives

Having addressed the first two specific objectives, the following sections integrate and synthesise the findings across all objectives. They triangulate the evidence drawn from the questionnaires, key informant interviews, operational records and field observation, discuss the results in relation to the empirical literature reviewed in Chapter Two, reflect on the theoretical implications, recommend framework or model development and finally summarise the chapter.

4.14.1 Data Triangulation: Integration of Quantitative and Qualitative Findings Convergence, Divergence and Complementarity

This section presents the triangulation of the results based on four data sources: (i) structured questionnaires (n=12), (ii) semi-structured interviews (n=6), (iii) quantitative operational records (2020–2026), (iv) field observation (May 2026). The thematic analysis strongly corroborates and supplements the quantitative findings presented earlier in this chapter. The qualitative themes offer an explanation of the causal mechanisms underpinning the quantitative patterns, address apparent paradoxes and offer useful input for framework development. While quantitative data highlighted problems (e.g. low fuel availability scores), qualitative data explained causes (supply chain logistics). Quantitative data showed paradoxes (high revenue, low resources) while qualitative data solved the paradoxes (centralized capture of revenue meaning local reinvestment is not

possible). Thus, validity is strengthened when triangulation involves convergence, divergence and complementarity.

4.14.1.1 Convergence: Cross-source agreement

4.14.1.1a Reactive maintenance as primary weakness

Questionnaire: 58.3% agreed reactive maintenance dominates preventive maintenance (mean = 4.00); 75% disagreed spare parts are readily available (mean = 1.83)

Interviews: All 6 key Informant interviewed cited maintenance deficiencies in the operations. MGT-03: 'The boat is usually attended to when it has a breakdown, but ordinarily, it is not maintained.'

Records: 92.0% of maintenance interventions were breakdowns (23/25)

Observation: Maintenance records rated Very Poor (Rating 1), no formal maintenance logbook exists.

Triangulation Conclusion: unanimous convergence across all four sources validates reactive maintenance as the strongest finding.

4.14.1.1b Fuel Scarcity as most critical constraint

Questionnaire: Fuel availability had the lowest score in study (mean = 1.75); 75% of respondents disagreed that fuel is readily available.

Interviews: 100% of interviewees cited fuel scarcity. MGT-03: 'Fuel arrived at 11am when scheduled to depart at 8am.'

Records: Fuel supply log books show fuel is usually received through overnight swift services, rarely does bulk fuel come.

Observation: when fuel is not available for a scheduled trip, management tend to borrow locally from stakeholders, fuel records show entries of fuel loan from stakeholders

Triangulation Conclusion: All sources converge on fuel scarcity as the single most severe operational bottleneck.

4.14.1.1c Schedule adherence failure despite planning excellence

All four sources confirm paradox: Excellent planning (mean = 4.67) but catastrophic execution (mean = 2.33, lowest score).

Observation directly validated: 'Ferry did not depart @08.00hrs as scheduled' (Rating 1).

Regulator (REG-01) confirmed: 'Most of the time they depart late... I have been engaging them many times.'

Triangulation Conclusion: This identifies schedule failure as behavioral/ managerial rather than resource constraint and all sources converge on the finding.

4.14.2 Divergence: Cross-source contradictions

4.14.2.1 Vessel reliability perceptions vs objective records

Questionnaire: 75% agreed vessel reliability is satisfactory (mean = 4.25)

Quantitative Records: 25 breakdowns/73 months = 4.1/year; 2026 rate = 1.6/month (370% above average)

Triangulation Conclusion: Divergence reveals optimism bias, where staff have adapted to frequent breakdowns as normal, a phenomenon that may be termed the "normalisation of inefficiency," where operational staff who have worked under persistently constrained conditions for extended periods (41.7% with >10 years' service) recalibrate their performance expectations downward, assessing objectively deficient conditions as "satisfactory" or "normal." Objective records should be privileged.

Finding: Perceived reliability does not equal objective reliability.

4.14.3 Complementarity: mutual enrichment across sources

4.14.3.1 The Revenue-Efficiency dichotomy explained

Questionnaire: Identified paradox, revenue mean = 4.83 (highest), yet fuel = 1.75, financial = 2.42 (lowest)

Interviews: Explained the paradox, MGT-03: 'Failure to re-invest generated revenue destroys efficiency.' Revenue captured centrally, not reinvested locally.

Observation: Documented consequences showing poor amenities (waiting area Rating 1, signage Rating 1) despite viable business

Triangulation Conclusion: Complementarity enables novel finding: RIDA's inefficiency stems from organizational governance (centralized revenue capture) rather than operational unprofitability. Efficiency requires governance reform, not increased external funding. Table 4.20 below summarises the data triangulation across all sources.

Operational Dimension	Triangulation Type	Conclusion
Reactive maintenance dominance	CONVERGENCE	All 4 sources unanimously confirm
Fuel availability crisis	CONVERGENCE	Strongest convergent finding in study
Schedule adherence failure	CONVERGENCE	All sources confirm planning-execution disconnect
Vessel reliability	DIVERGENCE	Perceptions contradicted by breakdown records
Staff complement	DIVERGENCE	Questionnaire neutrality vs interview/observation evidence
Revenue-efficiency paradox	COMPLEMENTARITY	Different sources explain different facets

Table 4.20 Summary of data triangulation findings, Source: Integration of all data sources(2026)

The triangulation demonstrates that convergence validates core findings (fuel scarcity, reactive maintenance), divergence reveals perceptual biases requiring correction through objective data, and complementarity enables comprehensive understanding impossible through single-method research.

4.15 Discussion of Findings

This section synthesizes all the findings gathered from quantitative and qualitative data analysis in the preceding sections and situates them within the broader empirical literature reviewed in Chapter Two. The discussion is structured around three analytical themes: (i) findings that support and corroborate existing literature, (ii) findings that contradict or diverge from established patterns and (iii) novel findings that extend the literature and contribute original insights to the field of marine operations management.

4.15.1 Theoretical Positioning of Findings

The findings of this study engage productively with and in several instances challenge the body of theory and empirical scholarship reviewed in Chapter Two. The Resource-Based View (RBV) framework proposed by Barney (1991) posited that organisational performance is determined by the strategic deployment of firm-specific resources: tangible assets (vessels, fuel, spare parts), human capital (crew competencies, staffing levels) and organisational capabilities (maintenance systems, scheduling protocols). The present study affirms this foundational proposition but extends it in a theoretically significant direction: the principal resource constraints observed in RIDA's operations are not attributable to absolute resource scarcity but to governance failures in resource allocation and revenue reinvestment. This distinction between resource unavailability per se and governance-induced resource inaccessibility represents a refinement of RBV that has particular relevance in public-sector developing-economy contexts where budget capture, centralised procurement and bureaucratic inertia decouple revenue generation from operational resource availability.

Systems Theory (Von Bertalanffy, 1968) is powerfully validated by the interconnected failure modes documented across RIDA's operational subsystems. The one-way ANOVA result ($F(4, 30) = 0.099$, $p = .982$) is particularly telling: the near-perfect equality of mean deficiency scores across all five operational categories is precisely what systems theory would predict for an organisation in which a single systemic constraint centralised revenue capture and bureaucratic procurement propagates its effects uniformly across every subsystem. The three vicious cycles identified, namely the Maintenance-Breakdown-Resource Depletion Cycle, the Revenue-Efficiency Paradox Cycle and the Demotivation-Discipline-Productivity Cycle further exemplify the self-reinforcing feedback loops through which stressed systems deteriorate toward collapse rather than self-correcting.

Contingency Theory (Donaldson, 2001) receives qualified support: while environmental factors (Lake Kariba water level fluctuations and weather variability) do moderate operational efficiency, the study finds these contingencies are manageable rather than determinative. The positive assessments of the regulatory framework (mean = 4.42) and government policy alignment (mean = 4.17) are particularly notable given the wider literature's documentation of regulatory capture and enforcement inconsistency in sub-Saharan African maritime governance (Hoffmann and Kumar, 2010; UNCTAD, 2020). RIDA's Kariba operations thus present an unusual case: a public-sector inland waterway operator constrained not by external institutional hostility but by internal organisational governance failures, with significant implications for how efficiency interventions should be designed.

Lean Management principles (Womack and Jones, 2003) are strongly supported by the classification of operational dysfunctions into recognisable lean waste categories: waiting (vessels idling due to fuel unavailability mean = 1.75); defects (92% reactive maintenance rate producing repeated breakdowns); over-processing (bureaucratic multi-step procurement approval for routine operational items); and underutilisation (only one of three fleet vessels operational at any time). The aggregate effect of these waste categories is quantified by the operational records: RIDA experienced a first-ever five-month total operational suspension (April–August 2025) and a 2026 breakdown rate 370% above the historical average, consequences consistent with what lean theorists predict for organisations where waste has accumulated unchecked across multiple domains simultaneously.

Collectively, these findings affirm that the operational dynamics of state-run inland waterway transport in resource-constrained developing economies follow recognisable patterns documented in both the operations management and maritime economics literature. The maintenance-reliability linkage (Mokashi, Wang and Vermar, 2002), the resource-performance relationship (Slack, Brandon-Jones and Burgess, 2022), and the motivational consequences of hygiene factor deficiencies (Herzberg, 1968) all manifest in RIDA's operations in forms consistent with their theoretical predictions. The convergent evidence across four independent data sources questionnaires, interviews, operational records and field observation considerably strengthens the validity of these findings beyond what single-method studies could achieve.

4.15.2 Discussion of Findings contradicting existing literature

Two significant findings from this study diverge from patterns reported in the maritime operations literature:

- i. **High Trip Completion Despite Severe Constraints:** The finding that 100.0% of respondents agreed that ferries complete the planned number of trips each month (mean = 4.58) despite catastrophic fuel shortages, extended vessel downtime and poor schedule adherence contradicts the expected relationship between resource availability and operational output documented by Slack, Brandon-Jones and Johnston (2016). This paradox can be explained by three factors: (i) operational staff's extraordinary adaptive capacity and resilience in overcoming constraints through informal workarounds (e.g., borrowing fuel from stakeholders), (ii) the possibility that planned trips are scaled down to match resource availability rather than representing demand-driven targets and (iii) strong organizational commitment driven by the public service mandate to connect remote communities even under adverse conditions.
- ii. **Strong regulatory support in a developing economy context:** The overwhelmingly positive assessments of the regulatory framework (mean = 4.42) and government policy support (mean = 4.17) contrast with literature on maritime operations in sub-Saharan Africa, which often documents regulatory capture, corruption, inconsistent enforcement and policy instability (Hoffmann and Kumar, 2010; UNCTAD, 2020). This study's finding suggests that Zimbabwe's Inland Waters Control Department provides effective and supportive regulation rather than burdensome compliance requirements. This may reflect the unique inland waters context, where safety and environmental oversight are more straightforward than in ocean-going maritime transport.

These divergences are theoretically informative rather than simply anomalous. The unexpected strength of schedule completion despite resource scarcity challenges linear resource-performance models (Slack, Brandon-Jones and Johnston, 2016) and points toward the compensatory role of public service motivation (Perry and Wise, 1990), an organisational dynamic that operations management theory, developed primarily in commercial contexts, has not adequately theorised. Similarly, the positive regulatory assessment challenges the assumption embedded in much sub-Saharan African maritime literature that institutional context is uniformly constraining (UNCTAD, 2020), suggesting that contextual adaptation of existing theoretical frameworks is necessary for explanatory adequacy in inland waterway transport research.

4.15.3 Discussion of Novel findings and study contribution

This study makes several novel contributions to the literature by documenting operational dynamics specific to inland water public service transport in remote, resource-constrained settings:

- i. **The Revenue-Efficiency Paradox:** The most striking novel finding is the coexistence of high revenue generation (mean = 4.83) with severe operational inefficiencies across maintenance, scheduling, human resources and resource availability. This paradox indicates that RIDA's marine operations are financially viable at the operational level but are undermined by systemic organizational failures in budget allocation, procurement and resource management. This pattern has not been documented in prior maritime operations literature, which typically assumes that revenue constraints drive resource scarcity. Here, the causal relationship is reversed, wherein organizational inefficiencies in budget disbursement (mean = 1.83) and procurement (mean = 2.00) artificially create resource scarcity despite revenue adequacy. This suggests that efficiency gains can be achieved through organizational restructuring and financial autonomy rather than through revenue enhancement strategies.
- ii. **Fuel as the binding constraint:** While the literature recognizes fuel as a significant operational cost (Stopford, 2009), this study uniquely identifies fuel availability rather than fuel cost as the primary bottleneck. The finding that 75.0% of respondents strongly disagreed that fuel is available when needed (mean = 1.75), coupled with qualitative evidence of borrowing fuel from stakeholders and transporting fuel from Harare to Kariba reveals a procurement and logistics failure rather than a budgetary affordability issue. This insight shifts the policy focus from cost management to supply chain resilience and local procurement arrangements.
- iii. **Bureaucratic centralism versus operational agility:** The finding that RIDA's centralised procurement and financial management system fundamentally constrains operational agility at the district level contributes to understanding how governance structures shape public sector operational efficiency. While Danladi et al. (2024) identified "governance fragmentation" as an efficiency barrier, RIDA's case presents the inverse problem, excessive governance centralisation that prevents local operational managers from making timely procurement decisions. The unanimous recommendation across respondent

categories for some form of operational autonomy (petty cash, revenue retention, local procurement authority) identifies a structural governance reform not commonly featured in maritime efficiency frameworks focused on technical and managerial interventions

- iv. Training Paradox: The study describes a situation where staff members claim to be sufficiently competent (mean = 4.83) yet acknowledge they have not received enough formal training (mean = 2.42). Consequently, it appears that it is the practical experience gained over a long tenure and not technically induced training that enables a person to be competent. The essence of this finding is to question human resource development models which lay emphasis on formal training and certification. In a resource-constrained setting, mentorship, on-the-job learning and institutional memory may be equally important. However, such over-reliance will not augur well considering the ageing workforce profile and the poor succession planning matrix.
- v. The Public Service Mandate as a motivational compensator: Despite low formal motivation indicators (mean = 2.92) and poor working conditions (mean = 2.83), respondents demonstrated high commitment to service delivery, as evidenced by 100.0% trip completion and 83.4% agreement that output meets community transport demand (mean = 4.42). This suggests that public service motivation (Perry and Wise, 1990) compensates for hygiene factor deficiencies in public-sector operational contexts, a dynamic not typically examined in private-sector maritime operations literature.
- vi. Environmental adaptation strategies, as mentioned earlier speak on the environmental conditions affecting the lakes viz. water levels and weather. Evidence from the study gives empirical evidence of adaptive capacity. The result that 58.3% of the respondents agreed that route planning takes the lake condition into consideration (mean = 3.67) and operation continues taking place despite the variability of the environment suggests localized knowledge and flexible routing can counterbalance inherent environmental constraints. The suggested shallow-draft vessels for low-water periods are truly an operational innovation specific to inland water transport.
- vii. The Normalisation of Inefficiency Phenomenon: A notable finding not explicitly documented in the reviewed literature is the discrepancy between self-reported efficiency perceptions (composite questionnaire mean of 3.57, "moderate") and observed operational reality (observation mean of 2.71, "below satisfactory"). This suggests a phenomenon that

may be termed the normalisation of inefficiency, whereby operational staff who have worked under persistently constrained conditions for extended periods (44.4% with >10 years' service) recalibrate their performance expectations downward, assessing objectively deficient conditions as satisfactory or normal. This phenomenon has implications for both data collection methodology and organisational change management, as staff may resist improvements to practices they have normalised as adequate.

- viii. Organizational Vulnerability to Single Vessel Dependency. Although Calderón-Rivera et al. (2024) provides insights into fleet size and composition in the literature, RIDA's extreme case where not even two out of three fleet vessels are operational, poses a single-asset dependency scenario that is not foregrounded in frameworks. A single vessel failing in 2025 resulted in a five-month total operational shutdown, which illustrates that single vessel dependency creates catastrophic (rather than incremental) risk. This evidence expands the literature by showing that fleet redundancy is not just an efficiency booster, but also a fundamental service continuity requirement for public transport systems that operate in rural isolation with no alternative access.

These eight novel contributions collectively advance the empirical and theoretical literature on inland waterway transport efficiency in three interconnected ways. Empirically, they provide the first documented evidence of the operational dynamics of a state-run inland waterway transport system in landlocked sub-Saharan Africa, filling a geographical and institutional gap explicitly identified by Calderón-Rivera, Bartusevičienė and Ballini (2024) and Danladi et al. (2024). Theoretically, they extend the Resource-Based View by demonstrating that governance-induced resource inaccessibility is analytically distinct from resource unavailability, and extend Systems Theory by showing how a single upstream governance failure propagates uniformly across all operational subsystems. Methodologically, the normalisation of inefficiency finding cautions against exclusive reliance on self-reported assessments in survey-based research conducted in persistently constrained settings, where long-serving respondents may have recalibrated their performance expectations downward. These contributions establish the empirical and theoretical foundation for the evidence-based I-MARINESG framework developed in Chapter Five.

4.16 Theoretical Implications of study

The findings collectively validate the study's multi-theoretical framework. The Resource-Based View (Barney, 1991) is strongly supported by the finding that resource inadequacy (tangible resources: vessels, fuel, spare parts; human resources: staffing, skills; organisational resources: maintenance systems, safety protocols) fundamentally determines operational capacity. Systems Theory (Von Bertalanffy, 1968) is validated by the interconnected nature of efficiency determinants, particularly the cascading effects of fuel shortage across the entire operational system. Operations Management Theory (Slack et al., 2022) is supported by findings regarding scheduling, turnaround time and process efficiency. Contingency Theory (Donaldson, 2001) is confirmed by the moderating effects of environmental conditions and institutional arrangements. Lean Management principles (Womack and Jones, 2003) are supported by the identification of multiple waste categories including waiting time, defects, and over-processing.

However, the findings also suggest that existing theories, predominantly developed in commercial, developed-economy contexts, require contextual adaptation for application to rural, state-operated marine transport in resource-constrained developing countries. The normalisation of inefficiency finding, the single-vessel dependency risk profile and the fuel-as-lifeline dynamics represent context-specific phenomena that challenge generic theoretical prescriptions and call for locally grounded framework development, which this study undertakes through Objective 3.

Specifically, the study proposes three theoretical extensions warranting further scholarly attention. First, RBV must be extended beyond its original firm-level commercial focus to incorporate governance-induced resource constraints in public-sector contexts, where revenue generation and resource deployment are structurally decoupled by institutional arrangements rather than market dynamics. Second, Systems Theory's concept of cascading failure requires empirical grounding in public service transport contexts, where single-vessel dependency and centralised resource capture create binary failure modes complete operational suspension rather than incremental decline not adequately captured in frameworks developed for multi-asset commercial operations. Third, the training paradox documented in this study challenges human resource development theory's assumption that formal training certification is the primary driver of operational competence, pointing instead toward contextually grounded

models weighting institutional memory, mentorship and extended on-the-job learning alongside formal qualifications.

4.17 Specific Objective Three: Towards an evidence-based framework for improving operational efficiency

Building directly on the current efficiency level (Objective One) and the factors influencing it (Objective Two), this third analytical part addresses Specific Objective Three, which sought to inform the development of an evidence-based framework for improving operational efficiency. It sets out the requirements that a viable framework must satisfy, providing the empirical foundation for the framework to be formally developed in Chapter Five.

4.17.1 Research Question 3: What Framework can be implemented to improve the operational performance of RIDA's marine transport services?

While comprehensive framework development is in Chapter Five, data gathered from all respondents suggests 10 evidence-based requirements that a viable operational efficiency framework must satisfy:

Requirement 1: Multi-Domain Integration: Address all 4 domains (resource, governance, technical, behavioral) simultaneously

Requirement 2: Governance Reform Prioritization: Prioritize governance reform as foundational (revenue ringfencing, decentralization of autonomy, provision of petty cash)

Requirement 3: Vicious Cycle Disruption: Target strategic intervention points (preventive maintenance, revenue ringfencing, timely allowances)

Requirement 4: Leverage Existing Competence: Empower competent staff (mean 4.83) with resources rather than to replace them

Requirement 5: Quick-Win + Long-Term Balance: Administrative fixes (allowances, extinguishers) + structural reforms (governance)

Requirement 6: Data System Development: Establish trip logs, maintenance logbooks, fuel tracking for evidence-based management, additionally, add automation to data capturing and storage

Requirement 7: Regulatory Accountability: Strengthen enforcement (annual audits, public reporting) to compel compliance

Requirement 8: Cultural & Behavioral Change: Address tolerating late comers through accountability, not just procedures

Requirement 9: Stakeholder-Inclusive Design: Incorporate staff recommendations (bulk fuel, local procurement, petty cash)

Requirement 10: Sustainability & Scalability: Funding of operations through ringfenced revenue; scalable to KF 550, KF 552 when refurbished

Based on these requirements, the framework to be developed in Chapter Five will encompass Governance reform, resource assurance, preventive maintenance/maintenance transformation, HR revitalization, operational discipline, safety compliance, data automation & monitoring and stakeholder engagement.

4.18 Chapter Summary

This chapter has presented a comprehensive analysis of data collected from 12 respondents involved in RIDA's marine operations in Kariba, 6 key Informant interviewees (both from within and outside RIDA), operational data and on-site observations. The analysis was structured around the research objectives, examining maintenance practices, operational scheduling, human resource capacity and resource availability, alongside moderating external factors and overall operational efficiency indicators. The chapter presented a comprehensive mixed-methods analysis of operational efficiency in RIDA's marine transport operations, integrating quantitative statistical analysis (SPSS), qualitative thematic analysis, systematic triangulation, joint display integration, and evidence-based synthesis addressing the three research questions. The quantitative data analysis revealed (i) reactive maintenance dominance (92.0% unplanned interventions); (ii) operational intensity escalation with catastrophic suspensions (5-month zero-operation period); (iii) uniform operational deficiencies (ANOVA $F = 0.099$, $p = .982$); and (iv) weak resource consumption predictability ($r = .358$, $R^2 = .128$).

The discussion situated these findings within the literature, identifying strong support for maintenance-reliability linkages, resource-performance relationships and human resource

motivation theories. Contradictions emerged in the unexpectedly high trip completion rates despite resource scarcity and the positive regulatory environment in a developing economy context. Novel contributions included the revenue-efficiency paradox, identification of fuel availability (not cost) as the binding constraint, documentation of bureaucratic procurement as a maintenance barrier, the training paradox, public service motivation as a compensator for hygiene factor deficiencies, the normalization of inefficiency and evidence of environmental adaptation strategies. The most significant outcome of the study was the identification of organizational governance failures as the root cause of operational inefficiency, challenging conventional resource scarcity narratives. RIDA's operations are financially viable (100% revenue sufficiency) but undermined by centralized revenue capture, bureaucratic procurement, absent maintenance protocols and weak operational discipline, all governance rather than resource deficiencies.

The qualitative data reinforced quantitative findings, with erratic fuel supply, spare parts unavailability, poor staff welfare and bureaucratic procurement cited as the most critical challenges. Recommended improvements included bulk fuel arrangements with local suppliers, ploughing back operational revenue, establishing petty cash provisions, decentralizing procurement, enhancing staff welfare, increasing staff complement and improving time management.

The data triangulation demonstrated convergence on fuel scarcity and reactive maintenance as primary constraints, revealed divergence between vessel reliability perceptions and objective breakdown records and identified complementary insights explaining the Revenue-Efficiency Paradox.

The aim of the study, enhancing operational efficiency, has been maintained throughout, demonstrating that while RIDA's marine operations achieve high trip completion and revenue generation, substantial efficiency gains are achievable through addressing fuel supply logistics, procurement system reforms, preventive maintenance investment, schedule execution discipline, staff welfare improvements and organizational financial autonomy. The insights collectively provide a rich, contextualized understanding that complements and deepens the quantitative patterns, establishing a robust empirical foundation for the framework to be developed in Chapter Five, which will build upon these integrated findings addressing governance reform, resource assurance, preventive maintenance, human resource revitalization, operational discipline, safety

compliance, data systems and stakeholder engagement. The following chapter presents the findings of the study, conclusions based on empirical research and the recommendations proffered by the study, including the development of the framework for enhancing RIDA's marine operations in Kariba, Zimbabwe.

CHAPTER FIVE: STUDY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings, conclusions and recommendations on the development of a framework for enhancing efficiency in the marine operations of RIDA, in Kariba. This chapter draws together the empirical data analysed in Chapter Four and positions this data in context with the theoretical and conceptual frameworks established in Chapter Two, the methodology set out in Chapter Three and the literature reviewed on marine and inland waterway transport operations in Chapter 2.

The chapter is structured as follows: Section 5.2 provides a summary of the major findings organised objective by objective, corresponding to the three specific research objectives laid out in Chapter One. Section 5.3 outlines the conclusions drawn from the findings discussed in this section, informed by the available evidence, literature and multi-theoretical framework adopted for the study. Section 5.4 outlines recommendations based on a framework of improving operational efficiency, compliant with Zimbabwe's Heritage-Based Education 5.0 policy, presented as a model comprising of interrelated pillars. Section 5.6 proposes an implementation modality of the framework. Section 5.7 provides merits of the developed framework while section 5.8 provides recommendations for future research. The chapter then ends with a comprehensive reference list for the whole study.

While the primary aim of the study was to develop a framework for enhancing operational efficiency of the Agency, the research sought to achieve the following specific objectives: to assess the current operational efficiency of RIDA's marine services in Kariba, to determine the factors influencing the inefficiencies in RIDA's marine services operations and lastly to come up with an evidence-based framework for improving the operational efficiency of RIDA's marine transport operations. The research employed a pragmatic paradigm that was anchored on Robert Yin's (2018) embedded single case study design and a parallel convergent mixed methods approach. Data were collected using structured questionnaires (n=12), semi-structured key informant interviews (n=6), operational records analysis (2020 – 2026) and systematic field observation which generated an overall response rate of 90%.

5.2 Summary of Study Findings

This section presents a comprehensive summary of the study findings, organised according to the three specific research objectives. The findings draw on triangulated evidence from quantitative data (questionnaires and operational records), qualitative data (interviews and open-ended responses) and field observation, ensuring methodological rigor and empirical robustness.

5.2.1 Objective 1: To Assess the Current Level of Operational Efficiency of RIDA's Marine Services in Kariba

The study found that RIDA's marine operations currently operate at a moderate level of operational efficiency, estimated at approximately 55–65%, characterised by a paradoxical combination of strong service commitment and severe systemic constraints. This assessment was derived from the triangulation of multiple convergent indicators across all four data sources.

5.2.1.1 Trip Completion and Revenue Generation

The strongest positive findings related to trip completion and revenue generation. All respondents (100%) agreed that RIDA's ferries complete the planned number of trips each month (mean = 4.58), with the modal estimate being 16 trips per month. Furthermore, 100% of respondents agreed that marine operations generate sufficient revenue relative to operational costs (mean = 4.83), the highest mean score in the entire study. Similarly, 83.4% agreed that operational output meets the transport demands of communities served (mean = 4.42). These findings demonstrate that RIDA's marine transport service is financially viable and fulfils its public service mandate to connect remote lakeside communities.

5.2.1.2 Schedule Reliability and Timeliness

Although trip completion rates were very high, reliability and timeliness in scheduling emerged as critical weaknesses. A paltry 16.6% of respondents agreed that trip schedules were followed (mean = 2.33), the lowest mean of all variables measured. Only 25.0% of the respondents agreed that the scheduled ferry trips are completed on time (mean = 2.75) and only 33.3% agreed that the turnaround times of trips are efficient (mean = 2.75). Field observation confirmed this finding as the ferry departed late on the day of observation (Rating = 1, Very Poor). The regulator (REG-01) also stated that: "Most of the time they depart late... I have been engaging them many times," thus corroborating this finding.

5.2.1.3 Vessel Condition and Maintenance Performance

RIDA's ferries were rated at an average of 3.25 (Fair to Good) on a 5-point scale. Despite this, maintenance documentation from 2020 until May 2026 indicated that there were 25 documented maintenance interventions with 23 (92.0%) unplanned breakdowns and only 2 (8.0%) scheduled preventive maintenance. External service providers handled 72% of all the maintenance interventions, revealing heavy dependency on external contractors. The occurrence of 1.6 per month in 2026 is 370% above the norm. During the overhaul period (October–December 2023), the cumulative cost of maintenance over the period was USD 79,058.50 at a mean cost of breakdown of USD 7,187.14 (SD = 6,245.82). The maintenance costs escalated sharply for the period, highlighting the financial consequences of deferred preventive maintenance.

5.2.1.4 Safety Compliance

Safety Compliance was assessed as moderate (60-70 %) with some gaps identified. The field observation noted an expired certificate of fitness (last issued in January 2025), the lack of a rescue/tender boat, expiry and non-servicing of the fire extinguishers, absence of a public address system, crew operating without PPE and sailing trips exceeding the passenger capacity. Key informants MGT-02 and MGT-03 independently confirmed that “there is no safety management system.” Respondent REG-01 stated that “the lack of the tender/rescue boat is a big issue... it is not being treated with appropriate urgency.”

5.2.1.5 Overall Efficiency Assessment

The average observation rating for the 35-rated items was 3.00/5.00 (Fair) while 20% of the indicators were rated “Very Poor” (Rating = 1). The findings from the ANOVA test ($F(4, 30) = 0.099, p = .982$) suggest that the inefficiencies are equally spread across every operational category and not only concentrated in one specific area indicating that the inefficiencies stem from systemic weaknesses rather than localised ones. Management's own assessment estimated operations at ‘40% capacity’ (MGT-01), whereas the Regulator pointed to ‘80% compliance’ (REG-01). A key finding was the declining trend in efficiency wherein the breakdown rate for 2026 is 370% above the historical average as well there was a first-ever suspension of operations for 5 months (April to August 2025) coupled with a decline in employee morale. The study identified a phenomenon, termed the “normalisation of inefficiency”, whereby long-serving staff (41.7% having >10 years’ service) have recalibrated performance expectations downwards and assess objectively deficient conditions as satisfactory.

5.2.2 Objective 2: To Identify the Key Factors Affecting Operational Efficiency in RIDA's Marine Operations

The study identified fifteen distinct factors affecting operational efficiency, categorised across four domains and ranked into four tiers of criticality based on evidence strength and prevalence. The most significant finding was that the majority of efficiency constraints stem from organisational governance failures rather than inherent operational challenges or resource unavailability.

5.2.2.1 Tier 1: Critical Factors (Very Strong Evidence, Convergent Across All Sources)

All four data sources provided convergent evidence on the five key factors identified as critical as follows.

- a) **Fuel Availability Crisis:** Overall mean score for fuel availability received the lowest ranking in the study (mean = 1.75). Majority of the respondents (75.0%) either strongly disagreed or just disagreed that fuel is available in adequate quantities, while about 83.3% of them disagreed that procurement of fuel is efficient and timely (mean = 1.58). Thematic analysis confirmed fuel scarcity as the most pervasive theme, mentioned by 100% of respondents. Qualitative evidence indicated that fuel shortages are not caused by a lack of financial resources as there is 100% agreement that revenue is sufficient but rather by supply chain inefficiencies, notably having to move bulk fuel from Harare to remote Kariba. It also came to light that operations often borrowed fuel from local stakeholders, an unsustainable coping mechanism that creates “sour relations with stakeholders” (Management) in the event of failure to reimburse the fuel.
- b) **Dominance of reactive maintenance:** Operational data suggested that between 2020 and 2026, out of the total of 25 maintenance activities recorded for operation of the equipment, 92% were unplanned breakdowns and only 8% were planned. Questionnaire data supported this finding, with 58.3% agreeing that corrective maintenance dominates preventive maintenance (mean = 4.00). All six key interview respondents mentioned maintenance deficiencies in their responses. The researcher’s field observation noted that there is no logbook for maintenance and breakdowns are recorded on a desk calendar. According to key informant MGT-03: “The main maintenance strategy is somewhat reactive. The boat is usually looked at for maintenance when it has a breakdown, but otherwise it is not maintained.”

- c) **Revenue Reinvestment Failure (Revenue-Efficiency Paradox):** The study's most distinct new finding was the simultaneous high level of revenue generation (mean=4.83, agreement=100%) coinciding with an acute shortage of fuel (mean=1.75), financial resources (mean=2.42) and spare parts (mean=1.92). Qualitative data explained this paradox, the revenue is captured centrally without revenue reinvestment in the marine operations. Respondent MGT-03 confirmed that if income that is generated is not re-invested, it destroys the efficiency. Staff unanimously recommended ploughing back 10% of the revenue generated from operations to be put in the marine operations budgets directly.
- d) **Staff Motivation Crisis:** Only 33.3% of respondents agreed that motivation levels are high (mean = 2.92), while 58.3% disagreed. Working conditions received negative assessments (mean = 2.83), with 50.0% disagreeing they are satisfactory. Qualitative data identified erratic payment of allowances, absence of protective clothing and adequate food and lack of career development paths (mean = 2.67) as drivers of low morale. Key informant MGT-04 warned that delayed allowance payments "may lead them to steal proceeds of the operations."
- e) **Operational Discipline Failure:** Despite excellent planning (mean = 4.67, 91.6% agreement), schedule adherence was catastrophic (mean = 2.33, 66.7% disagreement). Only 25.0% agreed that contingency plans exist for disruptions (mean = 2.58). The qualitative data revealed that non-adherence is driven by internal discipline deficiencies rather than external factors. Respondents cited "non-adherence to sailing times," "poor time management," and "tolerating late comers" as critical challenges.

5.2.2.2 Tier 2: Significant Factors (Strong Evidence, 3–4 Sources)

Five significant factors were identified: (a) spare parts unavailability (75% of respondents disagreed with availability, mean = 1.83); 75% of questionnaire respondents and 9/12 open-ended responses cited this challenge, with imported marine spares requiring international procurement); (b) centralised procurement and bureaucracy (66.7% disagreed procurement cycles are efficient, mean = 2.00 and 75% prevalence in thematic analysis); currency policy mismatch where service providers require foreign currency but government policy emphasises payment in local currency); (c) staff complement inadequacy (41.7% disagreed complement is sufficient, mean = 3.17; vessel operators at "50%" of required levels with no reliever captains on-board); (d) training provision

absence (58.3% disagreed training is provided regularly, mean = 2.42, one of the lowest scores); and (e) vessel age and deterioration (fleet availability rated poorly, mean = 2.08; only 1 of 3 ferries operational; post-refurbishment deterioration of +28.6% contradicting expected improvement).

5.2.2.3 Tier 3 and Tier 4 Factors

Tier 3 (moderate evidence) factors included financial disbursement unpredictability (83.3% disagreed budget disbursements are timely, mean = 1.83, second-lowest score), workshop capacity limitations (only 33.3% agreed workshop has adequate tools, mean = 3.00), and maintenance documentation absence (observation confirmed no formal logbook exists). Tier 4 factors represented mixed or positive influences: staff competence emerged as a strong positive factor (mean = 4.83, 100% confident in ability to perform duties), and the regulatory framework was assessed as supportive (mean = 4.42, 91.6% agreement) though potentially too lenient in enforcement.

5.2.2.4 Systemic Interactions: Vicious Cycles

The study identified three self-reinforcing vicious cycles: (1) the Maintenance-Breakdown-Resource Depletion Cycle (reactive maintenance → increased breakdowns → higher repair costs → resource depletion → deferred maintenance → further breakdowns); (2) the Revenue-Efficiency Paradox Cycle (strong revenue generation → revenue captured centrally → local resource unavailability → operational disruptions → service unreliability → potential future revenue decline); and (3) the Demotivation-Discipline-Productivity Cycle (low morale → poor discipline → late departures → complaints/pressure → further demotivation). These systemic interactions demonstrate that addressing individual factors in isolation will produce limited gains; interventions must adopt a systems perspective targeting multiple interacting factors simultaneously.

5.2.2.5 Quantitative Operational Analysis

Statistical analysis of operational records provided additional empirical depth. Fuel consumption analysis (September 2022 – April 2026, n=37 operational months) revealed mean monthly consumption of 1,768.86 liters (SD = 612.76), mean monthly trips of 13.08 (SD = 3.99), and mean fuel per trip of 146.77 liters (SD = 59.81). An independent t-test comparing 2023 and 2024 monthly fuel consumption revealed a statistically significant 93.5% increase ($t(20) = -8.616$, $p < .001$), reflecting resumption of full operations post-refurbishment without parallel improvements in fuel

procurement systems. Pearson correlation between monthly trips and fuel consumption was weak but significant ($r = .358$, $p = .030$, $R^2 = .128$), suggesting fuel consumption is driven by unmeasured factors including cargo/passenger load variation, route distances, weather conditions, and vessel technical condition—highlighting inadequate operational data capture systems.

5.2.3 Objective 3: To Develop an Evidence-Based Framework for Improving Operational Efficiency

The findings from Objectives 1 and 2 collectively provide a robust empirical foundation for framework development. The study identified ten evidence-based requirements that a viable operational efficiency framework must satisfy: (1) multi-domain integration addressing resource, governance, technical, and behavioral domains simultaneously; (2) governance reform prioritisation as the foundational intervention; (3) vicious cycle disruption through strategic intervention points; (4) leveraging existing staff competence rather than replacing staff; (5) balancing quick-wins with long-term structural reforms; (6) data system development for evidence-based management; (7) regulatory accountability strengthening; (8) cultural and behavioral change; (9) stakeholder-inclusive design incorporating staff recommendations; and (10) sustainability and scalability through ringfenced revenue. The framework is presented in Section 5.4.1.

5.3 Conclusions

This section presents the conclusions of the study, drawn from the empirical findings and situated within the theoretical framework and available literature. Conclusions are presented objective by objective, integrating evidence from all data sources with theoretical and scholarly perspectives.

5.3.1 Conclusion on Objective 1: Current Level of Operational Efficiency

The study concluded that RIDA's marine operations currently operate at a moderate but declining level of efficiency, characterised by a fundamental paradox: strong output delivery masking severe systemic fragility. While trip completion rates and revenue generation are high, these achievements are sustained through extraordinary adaptive capacity and informal workarounds by committed staff rather than through robust operational systems. This finding aligns with Perry and Wise's (1990) theory of public service motivation, which explains how intrinsic commitment to public service can compensate for deficiencies in hygiene factors, a dynamic empirically

confirmed in this study where 100% of staff expressed confidence in their abilities (mean = 4.83) despite poor working conditions (mean = 2.83) and low motivation (mean = 2.92).

From a Systems Theory perspective (Von Bertalanffy, 1968), RIDA's marine operations exhibit the characteristics of a stressed system where individual component failures cascade through interconnected subsystems. The uniformly distributed deficiencies confirmed by ANOVA ($F(4, 30) = 0.099$, $p = .982$) demonstrate that the system's weaknesses are pervasive rather than localised, validating the systems-level analytical approach adopted in this study. The normalisation of inefficiency phenomenon documented in this study represents a novel contribution to the literature, extending understanding of how long-serving staff in persistently constrained environments recalibrate performance expectations downward, a finding with implications for both organisational change management and survey-based research methodology in similar contexts.

The declining efficiency trajectory, evidenced by the 370% increase in 2026 breakdown rates, the unprecedented 5-month operational suspension in 2025 and worsening staff morale led to the conclusion that without urgent and comprehensive intervention, RIDA's marine operations face systemic collapse. This conclusion is consistent with Slack, Brandon-Jones and Burgess's (2022) operations management principle that systems operating beyond their design parameters deteriorate exponentially rather than linearly. The single-vessel dependency, where one vessel serves an entire marine unit, creates catastrophic rather than incremental risk, extending the literature on fleet management by highlighting that fleet redundancy is a fundamental service continuity requirement for rural public transport systems serving isolated communities with no alternative access (Calderón-Rivera, Bartusevičienė and Ballini, 2024).

5.3.2 Conclusion on Objective 2: Key Factors Affecting Operational Efficiency

The study concludes that the key factors affecting operational efficiency in RIDA's marine operations are predominantly organisational and governance-related rather than external or environmental. This conclusion is the study's most significant theoretical contribution, challenging the conventional resource scarcity narrative prevalent in developing-country public sector literature.

From the Resource-Based View perspective (Barney, 1991), the study confirms that resource inadequacy, tangible resources (vessels, fuel, spare parts), human resources (staffing, skills), and organisational resources (maintenance systems, safety protocols) fundamentally determines operational capacity. However, the study extends RBV by demonstrating that resource inadequacy in RIDA's case is not caused by resource unavailability in the absolute sense (given revenue sufficiency of mean = 4.83) but by governance failures in resource allocation, procurement and revenue reinvestment. This represents a governance-driven resource constraint rather than a pure resource deficit, a distinction with important theoretical and practical implications.

The Revenue-Efficiency Paradox constituted a novel finding not previously documented in maritime operations literature. Where the literature typically assumed that revenue constraints drive resource scarcity (Slack, Brandon-Jones and Johnston, 2016; World Bank, 2023), this study demonstrated a reversed causal relationship, organisational inefficiencies in budget disbursement (mean = 1.83) and procurement (mean = 2.00) artificially create resource scarcity despite revenue adequacy. This finding aligns with Danladi et al.'s (2024) identification of governance fragmentation as an efficiency barrier, but presents the inverse problem, excessive governance centralisation preventing local operational managers from making timely procurement decisions. The identification of fuel availability (rather than fuel cost) as the binding constraint represents another novel contribution. While Stopford (2009) recognises fuel as a significant operational cost in maritime transport, this study uniquely demonstrates that in RIDA's context, it is the logistics of fuel supply to a remote location, not its affordability, that paralyses operations. This shifts the policy focus from cost management to supply chain resilience and local procurement arrangements.

Contingency Theory (Donaldson, 2001) was validated by the moderating effects of environmental conditions on operational efficiency. Fluctuating water levels (66.7% agreement on significant impact, mean = 3.75) and weather disruptions (41.7% agreement, mean = 3.42) represent inherent Lake Kariba challenges requiring adaptive strategies. However, the predominantly positive assessments of the regulatory framework (mean = 4.42) and government policy support (mean = 4.17) contrast sharply with the internal constraints, confirming that efficiency barriers are primarily organisational rather than external, a finding that contradicts much of the literature on

maritime operations in sub-Saharan Africa, which typically documents regulatory capture, corruption and policy instability (Hoffmann and Kumar, 2010; UNCTAD, 2020).

The Training Paradox, whereby staff expressed high confidence in their abilities (mean = 4.83) despite inadequate formal training (mean = 2.42), challenged conventional human resource development models that prioritise formal training and certifications. Consistent with Herzberg's (1968) two-factor theory, the study concluded that staff competence derives primarily from experiential learning accumulated over long service tenure (75% with >7 years). However, this reliance on informal knowledge transfer becomes a strategic vulnerability given the aging workforce profile (91.7% aged 41+) and absence of succession planning, threatening institutional knowledge loss consistent with warnings by Wijnolst and Wergeland (2009) and BIMCO/ICS (2021) regarding global maritime workforce demographics.

Lean Management principles (Womack and Jones, 2003) were strongly supported by the identification of multiple waste categories, waiting time (vessels idling due to fuel shortages), defects (repeated breakdowns from reactive maintenance), over-processing (bureaucratic procurement for small items) and underutilisation of fleet (only 1 of 3 fleet vessels operational). The conclusion is that substantial efficiency gains are achievable through waste elimination strategies targeting these specific categories, consistent with lean operations management principles.

5.3.3 Conclusion on Objective 3: Framework Development

The conclusion drawn by the study was that for the framework to enhance the operational efficiency of RIDA's marine operations, it should be multidimensional, governance-centric and systems related instead of being focused on mere operational efficiency. This conclusion is based on the evidence that (a) all operational categories have a uniform distribution of deficiencies (ANOVA $p = .982$), (b) vicious cycles create self-reinforcing negative spirals requiring simultaneous multi-point interventions, (c) governance failure and not lack of resources is responsible for operational inefficiency and (d) staff have the capacity and commitment to achieve better performance if equipped with adequate resources and organisational support.

The framework should cement governance reform (revenue ringfencing, procurement decentralisation) as its foundational pillar, in line with the Resource-Based View's (Barney, 1991) emphasis on strategic management of resources and the finding of the study that resources exist but are mismanaged. According to Systems Theory (Von Bertalanffy, 1968) the framework must address all interacting domains of operations and not one at a time. Contextual adaptation to the environmental and institutional reality of Lake Kariba conditions is required by Donaldson's Contingency Theory (2001). Operations Management Theory by Slack, Brandon-Jones and Burgess (2022) provides the analysis of process optimisation and performance analysis. The objectives of Lean Management (Womack and Jones, 2003) and Total Quality Management (TQM) (Deming, 1986) reduce waste and continuously improve processes, products and services. The framework proposed in Section 5.4.1, which is compliant with Zimbabwe's Education 5.0, combines these theoretical foundations with the empirical evidence obtained to create a comprehensive, contextually adapted and easily implementable framework.

5.4 Recommendations

5.4.1 Study Recommendations: The I-MARINESG Operational Efficiency Enhancement Framework

In view of this study's findings and conclusions, the researcher developed the I-MARINESG Operational Efficiency Enhancement Framework, a comprehensive, Education 5.0-compliant working model aimed at enhancing the operational efficiency of RIDA's marine transport operations in Kariba. The framework is named I-MARINESG, an acronym representing its eight foundational pillars (Maintenance-M, Accountability and Governance-A, Resource Assurance-R, Innovation and Data systems-I, Nurturing human capital-N, Stakeholder Engagement-E, Safety and compliance-S and Governance and financial autonomy-G), with the "I" referring to the integrated nature of the model, while embedding the five pillars of the Heritage-Based Education(HBE) 5.0 policy namely Teaching, Research, Community Service, Innovation and Industrialisation.

The philosophy of Education 5.0 as espoused by Zimbabwe seeks to ensure that the outputs of higher education do not just produce knowledge for knowledge's sake, but produce solutions that will give rise to industrialisation and socio-economic transformation (Government of Zimbabwe,

2020). Thus, this framework is not just a checklist of ideas, but rather a structured and integrated model demonstrating how findings that emerge from research can be translated into practical innovative solutions in service to the community and operational improvements that enable industrialisation. Figure 5.1 below presents the I-MARINESG framework, followed by an explanation of each pillar and its relationship/application to Education 5.0.

Figure 5.1: The I-MARINESG Operational Efficiency Enhancement Framework for RIDA's marine operations in Kariba, Zimbabwe



Source: Researcher's Construct (2026)

Table 5.1 below summarises the linkages between the pillars of the proposed framework to the Education 5.0 pillars and how they are operationalized.

Education 5.0 Pillar	I-MARINESG framework Pillars Aligned	Manifestation in Framework
Teaching	Pillar 4: HR Revitalization (nurturing human capital)	Structured training programmes; competency certification; knowledge transfer from experienced to younger staff; operational discipline protocols
	Pillar 5: Operational Discipline(accountability and governance)	
Research	Pillar 7: Innovation Data & Systems	Operational data capture and analysis; evidence-based decision making; maintenance record systems; fuel consumption analytics; performance benchmarking
	Pillar 3: maintenance transformation	
Community Service	Pillar 8: Stakeholder Engagement	Reliable transport service to remote lakeside communities; passenger safety; fishing industry support; community connectivity enabling access to health, education, and markets
	Pillar 6: Safety & Compliance	
Innovation	Pillar 7: : Innovation Data & Systems	Digital maintenance management systems; automated trip logging; local fuel procurement arrangements; predictive maintenance adoption; shallow-draft vessel design for low-
	Pillar 2: Resource Assurance(Supply chain resilience)	
Industrialisation	Pillar 1: Governance Reform	Revenue ringfencing enabling self-sustaining operations; local procurement stimulating Kariba economy; service contract arrangements with local suppliers; fleet refurbishment generating marine engineering capacity
	Pillar 2: Resource Assurance	
	Pillar 3: Maintenance Transformation	

Table 5.1 Education 5.0 pillar mapping to proposed framework(I-MARINESG), Source: Researcher's Construct (2026)

5.4.2 Detailed Explanation of the I-MARINESG Framework Pillars

The I-MARINESG framework comprises eight interconnected pillars, each derived from the empirical findings of this study and aligned with Zimbabwe’s Education 5.0 philosophy. The acronym “I-MARINESG” captures the six primary pillars (Maintenance transformation, Accountability and governance, Resource assurance, Innovation and data systems, Nurturing human capital, and Engagement), supplemented by two cross-cutting pillars (Safety & Compliance, and Governance & Financial Autonomy), while the “I” demonstrates the integrated nature of the framework. As illustrated in Figure 5.1, the pillars are connected by directional arrows indicating enablement pathways and feedback loops, reflecting the Systems Theory foundation that underpins this study (Von Bertalanffy, 1968). Each pillar is explained below with its contribution to the overall solution, its Education 5.0 alignment and linkages to other pillars.

5.4.2.1 Governance & Financial Autonomy(G) (Foundation Pillar)

Explanation: This pillar represents the first-step intervention on which all others build on and rely. It addresses the root cause of operational inefficiency identified in the study as centralised revenue capture and bureaucratic governance preventing local resource availability despite strong revenue generation (revenue mean = 4.83 vs. financial resources mean = 2.42; budget disbursement mean = 1.83; 75% prevalence of bureaucracy theme). The pillar recommends (a) Revenue Ringfencing (retaining 10% of operational revenue and directly allocating it to the marine operations budgets,

(b) Procurement Decentralisation (delegation of authority for procurement of marine-specific items under a certain threshold to the Kariba marine operations unit), (c) Petty Cash Provision (revolving fund created for urgent small purchases) and (d) Marine Operations Unit Autonomy (the creation of a semi-autonomous operational unit with delegated powers for financial and procurement authority).

Contribution to Overall Solution: By decentralising financial control and ringfencing revenue, this pillar unlocks the financial resources that are generated but not reinvested. The effectiveness of other pillars depends on governance reform as all resources, maintenance, training and data systems require funding that is locally accessible. This pillar attacks the source of Vicious Cycle 2 (Revenue-Efficiency Paradox).

Education 5.0 Alignment – Industrialisation: This pillar directly serves the industrialisation agenda by transforming RIDA’s marine operations from a dependent, budget-subsidised entity into a self-sustaining operational unit capable of reinvesting its own revenue for continuous improvement, stimulating local economic activity in Kariba through local procurement and demonstrating a viable model for public-sector operational self-sufficiency replicable across Zimbabwe’s infrastructure agencies.

Linkages to Other Pillars: As shown by the directional arrows in Figure 5.1, Governance & Financial Autonomy is the foundation pillar. Specifically, it directly enables Resource Assurance (R) by providing the financial foundation for local fuel procurement and spare parts inventory. It also enables Maintenance Transformation (M) through funding for planned maintenance systems and workshop tooling. The Innovation & Data Systems (I) pillar depends on governance reform for investment in monitoring technologies. The link with Stakeholder Engagement (E) reflects external accountability mechanisms that reinforce governance discipline.

5.4.2.2 Resource Assurance & Supply Chain Resilience(R)

Explanation: This pillar addresses the most acute operational bottleneck, chronic fuel and spare parts unavailability caused by supply chain failures rather than budgetary affordability constraints (fuel availability mean = 1.75, the lowest score; fuel procurement mean = 1.58; spare parts mean = 1.92; 66.7% confirmed resource shortages caused cancellations/delays). The pillar recommends:

(a) Local Bulk Fuel Supply Agreements with Kariba town suppliers; (b) Strategic Fuel Reserves maintaining a minimum two-week buffer stock; (c) Critical spare parts inventory with minimum stock levels for high-frequency consumables; (d) pre-negotiated service contracts with specialist service providers and (e) Advance procurement planning using operational records for proactive forecasting.

Contribution to Overall Solution: Resource assurance breaks the dependency on centralised supply chains that cause chronic shortages. By ensuring local availability of fuel and spare parts, this pillar eliminates the most frequent proximate cause of service cancellations and delays, enabling the maintenance and operational discipline pillars to function as designed.

Education 5.0 Alignment – Innovation & Industrialisation: Innovative local procurement arrangements replace the failed centralised supply chain model. Local fuel supply agreements stimulate the Kariba economy (industrialisation) while fuel consumption analytics (innovation) enable evidence-based forecasting and waste reduction.

Linkages to Other Pillars: Resource Assurance speaks to Governance & Financial Autonomy (G), confirming that financial reform is its prerequisite. It directly enables Maintenance Transformation (M), since spare parts availability is the critical enabler for transitioning from reactive to preventive maintenance, thereby disrupting Vicious Cycle 1 (Maintenance-Breakdown-Resource Depletion). It also connects to Safety & Compliance (S) because safety equipment procurement depends on resource availability. The Innovation & Data Systems (I) pillar links with Resource Assurance through demand forecasting analytics.

5.4.2.3 Maintenance Transformation(M)

Explanation: This pillar targets the transformation from the documented reactive maintenance culture to a preventive and eventually predictive maintenance paradigm (92% of maintenance events were unplanned breakdowns; 72% external contractor dependency; 2026 breakdown rate 370% above historical average). Consistent with international best practice documented by Karatuğ, Arslanöglu and Soares (2023) and the ISM Code (IMO, 2018), the pillar recommends: (a) Planned Maintenance System (PMS) implementing manufacturer-recommended scheduled servicing at 250-hour intervals; (b) Maintenance logbook system replacing the current “desk calendar” approach; (c) Internal capacity building supplementing the existing skilled artisan with additional maintenance personnel; (d) Condition-based monitoring introducing oil analysis and

vibration checks and (e) Fleet rehabilitation program to return KF 550 and KF 552 to operational status.

Contribution to Overall Solution: Maintenance transformation directly addresses the single largest cost driver and most disruptive operational bottleneck. By shifting from reactive to preventive maintenance, RIDA can reduce breakdown frequency, lower per-event costs, decrease external contractor dependency, restore fleet availability and improve schedule reliability, collectively transforming operational capacity.

Education 5.0 Alignment – Research & Innovation and industrialisation: The maintenance transformation is grounded in research-based evidence (breakdown analysis, cost data) and introduces innovative maintenance management technologies. The systematic documentation of maintenance data creates a knowledge base supporting evidence-based decision-making and continuous improvement, core Education 5.0 research values.

Linkages to Other Pillars: Maintenance Transformation is enabled both by Governance (G) and Resource Assurance (R), confirming its dependency on financial autonomy and spare parts availability. It is an enabler of Safety & Compliance (S), as properly maintained vessels are the foundation of safe operations. It also connects with Nurturing Human Capital (N), since skilled personnel are needed to execute preventive maintenance while the maintenance programme itself serves as a training platform. Innovation & Data Systems (I) supports maintenance through condition monitoring and maintenance management information systems.

5.4.2.4 Accountability & Operational Discipline(A)

Explanation: The goal of this pillar is to address the disconnect discovered between planning and execution (the lowest score in operations is 2.33 for schedule adherence mean; planning mean is 4.67, the highest, while the contingency planning mean is 2.58; the discipline theme is the most commonly occurring at 58% in qualitative data). It acknowledges that improvements in efficiency can be attained through management and behavioural interventions rather than more resources. The pillar suggests: (a) Strict departure time accountability with documented compliance checks; (b) Contingency planning protocols for frequent disruptions; (c) Loading/unloading optimisation consisting of digital systems in loading, standardisation of turnaround operations; (d) Performance

monitoring dashboard for real-time supervisory oversight and (e) Separation of duties clarifying role responsibilities.

Contribution to Overall Solution: Operational discipline addresses the soft efficiency losses that persist even when resources are available. The study found that planning capacity exists (mean = 4.67) but execution discipline does not (mean = 2.33), indicating that behavioural and managerial reform can yield significant efficiency gains without additional capital expenditure. This pillar ensures that resource investments from other pillars translate into actual operational performance.

Education 5.0 Alignment – Teaching & Industrialisation: Operational discipline protocols represent teachable and replicable management practices. The scheduling excellence standards contribute to industrialisation by demonstrating that public-sector marine operations can achieve private-sector levels of reliability and time management.

Linkages to Other Pillars: Accountability & Operational Discipline is critically enabled by Nurturing Human Capital (N), since improved staff welfare and motivation create the conditions for discipline compliance, disrupting Vicious Cycle 3 (Demotivation-Discipline-Productivity). It also receives input from Innovation & Data Systems (I) through the performance monitoring dashboard that enables evidence-based accountability. This pillar also feeds into Stakeholder Engagement (E) through service level agreement compliance that builds community trust and regulatory confidence.

5.4.2.5 Innovation & Data Systems(I)

Explanation: This pillar addresses the pervasive absence of systematic data capture and evidence-based management (absence of formal maintenance logbook-breakdowns recorded on a desk calendar; weak fuel consumption predictability $R^2 = .128$; no formal trip logging system). Consistent with Tubis et al.'s (2025) digital maturity model for inland waterway transport, the pillar recommends: (a) Operational Data Management System implementing standardised trip logs, fuel records and maintenance logbooks; (b) Key Performance Indicator (KPI) Dashboard tracking departure compliance, breakdown frequency and fuel usage/efficiency; (c) Maintenance Management Information System (MMIS) as demonstrated effective by Damson, Mtui and Kileo

(2025) in Tanzania; (d) Automated Fuel Monitoring linked to trip activity and (e) Performance Reporting for management review.

Contribution to Overall Solution: Data systems serve as the cohesive element that unifies all other pillars into a functional management system. It is impossible to monitor, evaluate or improve the framework without systematic data capture. This pillar facilitates the transition of RIDA's marine operations management from intuitive and reactive to evidence-based and proactive programming. Moreover, it facilitates to leverage RIDA's resources, set operational goals, benchmark RIDA's internal performance and establish accountability.

Education 5.0 Alignment – Research & Innovation: This pillar is the most direct expression of the research and innovation mandates. Data systems enable evidence-based management (research), while digital technologies and automated monitoring represent innovation in public-sector marine operations management, potentially scalable to other RIDA operational contexts across Zimbabwe.

Linkages to Other Pillars: Innovation & Data Systems feeds into Maintenance Transformation (M) through the MMIS and condition monitoring systems. It supports Accountability (A) through the performance monitoring dashboard. It enhances Resource Assurance (R) through demand forecasting analytics. It enables Safety & Compliance (S) through incident reporting and risk assessment systems. It receives the investment funding from Governance (G) while Stakeholder Engagement (E) provides external data requirements and accountability expectations.

5.4.2.6 Nurturing Human Capital(N)

Explanation: This pillar addresses the human capital crisis documented across multiple data sources (staff motivation mean = 2.92; regular training mean = 2.42; working conditions mean = 2.83; career development mean = 2.67; aging workforce with 91.7% aged 41+ and 0% under 30). Drawing on Herzberg's (1968) two-factor theory and the Resource-Based View's emphasis on human resources as strategic assets (Barney, 1991), the pillar recommends: (a) Timely payment of staff allowances (b) provision of a staff welfare package including protective clothing, food provisions on board and decent accommodation; (c) implementation of structured training programs covering vessel operations, safety, maintenance and emergency response; (d) Succession

Planning and Youth Recruitment with mentorship programs (e) Career Development Pathways; and (f) improving crew complement thus addressing staffing shortages.

Contribution to Overall Solution: Through human capital, all other pillar interventions are transacted. The implementation of maintenance systems, the enforcement of safety protocols, the maintenance of operational discipline and the population of data systems, all depend on adequately staffed, skilled and competent crews. This pillar introduces conditions in the workforce to facilitate framework-wide success through hygiene factors (allowances, welfare) and motivators (training, career progression).

Education 5.0 Alignment – Teaching: This pillar directly embodies the teaching mandate through structured training programs, mentorship-based knowledge transfer, competency certification and the creation of learning pathways that transform experiential knowledge into transferable institutional capacity.

Linkages to Other Pillars: Nurturing Human Capital sends a critical message that improved staff welfare and motivation are prerequisites for discipline compliance, disrupting Vicious Cycle 3 (Demotivation-Discipline-Productivity). It feeds interacts with Safety & Compliance (S) through trained crews capable of implementing safety protocols. The pillar receives enabling input from Innovation & Data Systems (I) for competency tracking systems.

5.4.2.7 Engagement with Stakeholders & Community Service(E)

Explanation: According to this pillar, RIDA's marine operations are conducted within a stakeholder ecosystem (external institutional support mean = 3.75; regulatory support mean = 4.42; community transport demand met mean = 4.42; Government devolution agenda). Sustainable efficiency improvement demands systematic engagement with regulators, local governments, community representatives, fishing industry operators and development partners. The pillar suggested the establishment of a Stakeholder Advisory Committee made up of RIDA management, Inland Waters Control Department, Kariba Municipality, fishing industry representatives and community leaders. Also recommended is the establishment of Service Level Agreements that showcase the particular schedule commitments that have been made public and a Regulatory Partnership with a structured process to monitor compliance, establishment of Community

Feedback Mechanisms and engagements with Development Partners leveraging devolution and NDS2 frameworks.

Contribution to Overall Solution: Stakeholder engagement makes the entire framework accountable to the outside world, mobilizes resources and accords legitimacy to the concerned community. The study found that RIDA has a favourable regulatory environment (mean = 4.42), despite informal arrangements that risk a lack of enforcement. By formalising these relationships, the necessary external pressure and support structures are created to enable sustained internal reform. Community feedback will ensure that the efficiency gains translate into actual service delivery improvements.

Education 5.0 Alignment – Community Service: This pillar is the direct embodiment of the community service mandate. RIDA's marine operations serve as a lifeline for remote lakeside communities, connecting them to markets, healthcare, education and administrative services. Structured stakeholder engagement ensures that operational improvements translate into tangible community development outcomes aligned with Zimbabwe's Vision 2030 and NDS2 frameworks. Linkages to Other Pillars: Stakeholder Engagement receives input from Safety & Compliance (S) through public safety reporting. The pillar also interfaces with Nurturing Human Capital (N) through community-based recruitment and training partnerships.

5.4.2.8 Safety & Compliance(S)

Explanation: This pillar addresses the critical safety deficiencies documented through observation and confirmed by key informants (expired certificate of fitness; absence of rescue boat, expired fire extinguishers, no safety management system, crew without PPE, passenger capacity exceeded, absence of safety drills mean = 1.56; observation rating for safety certificates = 1, Very Poor). Aligning with the ISM Code (IMO, 2018), the pillar recommends: (a) Immediate Safety Remediation including certificate of survey/fitness renewal, rescue boat procurement, fire extinguisher replacement/servicing, and regular provision of crew PPE (b) Safety Management System Implementation with documented procedures and risk assessments (c) Passenger Capacity Enforcement (d) Annual Safety Audits with public reporting and (e) Emergency Response Protocols.

Contribution to Overall Solution: Safety compliance is both a moral imperative and a regulatory requirement that underpins the legitimacy of the entire operations. The study documented safety deficiencies so severe that they place passengers and crew at risk. Addressing these deficiencies is a non-negotiable prerequisite for any credible operational efficiency framework as efficiency without safety is not true efficiency but rather deferred catastrophe.

Education 5.0 Alignment – Community Service: Safety compliance is fundamentally a community service imperative. Ensuring the safety of passengers, many from remote, vulnerable communities with no alternative transport represents the most basic expression of the Agency’s community service mandate translated into operational practice.

Linkages to Other Pillars: Safety and compliance is a cross-cutting pillar. The vessel’s seaworthiness is ensured through the Maintenance Transformation (M) pillar, while Nurturing Human Capital (N) provides trained crew capable of executing safety protocols. Resource Assurance (R) allows procurement of safety equipment and Innovation & Data Systems (I) supports incident reporting and risk assessment. Safety interacts with Stakeholder Engagement (E) through public safety reporting and regulatory compliance through safety audit findings that feedback to Governance (G), informing governance priorities.

5.5 Pillar Interconnections and Systemic Integration

The pillars of the I-MARINESG framework are not independent but systemically connected. This is an outcome of the Systems Theory (Von Bertalanffy, 1968) and a finding of the study which shows that the identified deficiencies were uniformly distributed in the research sample across the four data sources (ANOVA $p = .982$). As shown by the main directional arrows in Figure 5.1, the key interconnections are:

- i. Resource Assurance (R) is enabled by Governance & Financial Autonomy (G). Revenue ringfencing will ensure local fuel procurement and increased spare parts inventory, breaking Vicious Cycle 2 (Revenue-Efficiency Paradox).
- ii. Resource Assurance (R) enables Maintenance Transformation (M), spare parts availability allows the operations to shift from reactive to preventive maintenance, which disrupts Vicious Cycle 1: (Maintenance-Breakdown-Resource Depletion)

- iii The Nurturing of Human Capital (N) enables Accountability (A) wherein improved staff welfare and motivation creates conditions for operational discipline compliance and the disruption of Vicious Cycle 3 (Demotivation-Discipline-Productivity).
- iv. Innovation and Data Systems (I) supports the other pillars with the evidence base needed for monitoring, evaluation and continual improvement.
- v. Stakeholder Engagement (E) provides external accountability, resource mobilisation and community legitimacy for the whole framework, with feedback o Governance.
- vi. The Safety & Compliance interface (S) with Maintenance (M), Human Capital (N) and Stakeholder Engagement (E) ensures that maintenance improvements, trained people and community service obligations collectively deliver safe operations.

5.6 Comparative Justification of the I MARINESG Framework Against Existing Models

5.6.1 This study's proposed I-MARINESG Operational Efficiency Enhancement Framework is strongly justified on both empirical and theoretical grounds, and it offers clear comparative advantages over existing operational efficiency enhancement models and approaches reviewed in Chapter Two. The model drew its intellectual foundation from the Resource-Based View (RBV), Systems Theory, Operations Management Theory, Contingency Theory, Lean Management Principles and Total Quality Management discussed in Chapter Two, while simultaneously responding to the empirical deficiencies identified in Chapter Four. The framework was designed in direct response to RIDA's empirically observed systemic pattern of inefficiency (ANOVA $p = .982$), the existence of self-reinforcing vicious cycles and the study's novel Revenue–Efficiency Paradox in which high revenue generation coexists with severe operational resource scarcity due to governance and reinvestment failures. These contextual realities necessitate an integrated model that extends beyond the scope of most existing solutions, which are frequently single-domain, technology-centric or maintenance-centric.

(a) Comparison with Maintenance-Centered Frameworks (PMS/CMMS/MMIS models)

The empirical literature reviewed in Chapter Two demonstrated that a dominant stream of operational efficiency improvement models in inland waterway transport is maintenance-centered. Abdulrahmani (2025) proposed a Maintenance Management System framework to increase ferry availability performance through planned maintenance scheduling, a computerised maintenance management system, spare parts inventory management, technical capacity development, and

performance monitoring using reliability metrics such as MTBF and MTTR. Damson, Mtui and Kileo (2025) similarly advanced an MMIS-driven framework, demonstrating that digitising maintenance scheduling and work-order control can significantly reduce unplanned downtime and improve vessel availability.

While these models are highly relevant and are incorporated within I-MARINESG's Maintenance Transformation (M) and Innovation & Data Systems (I) pillars, they are insufficient as stand-alone solutions for the RIDA context because RIDA's binding constraints are not limited to maintenance processes. This study demonstrates that even technically appropriate maintenance improvements cannot be sustained without addressing: (i) fuel procurement and local availability constraints (ii) governance and reinvestment failures driving the Revenue–Efficiency Paradox, (iii) behavioral and discipline failures causing schedule non-adherence despite strong planning and (iv) critical safety compliance deficiencies (e.g., absence of tender/rescue boat; absence of safety drills). Therefore, I-MARINESG's comparative advantage is that it embeds maintenance reform within a broader governance-resource-human-capital-safety-performance system, consistent with Systems Theory and RBV discussed in Chapter Two.

(b) Comparison with Digital Maturity and Advanced Technology Models (Digitalisation and autonomy architectures)

Chapter Two reviewed technology-forward models such as Tubis et al.'s (2025) Digital Maturity Model, which provides a staged pathway from basic digitisation to data-driven and ultimately intelligent/autonomous inland waterway operations, as well as Chen et al.'s (2025) autonomous inland waterway transportation system architecture. These models are valuable in demonstrating the long-term potential of digital transformation for efficiency, reliability and predictive maintenance capabilities.

However, I-MARINESG is comparatively stronger in contextual feasibility for a resource-constrained public-sector operator because it does not assume high digital readiness, extensive capital investment capacity or deep technical support infrastructure as prerequisites. Instead, I-MARINESG applies Tubis et al.'s (2025) logic selectively and pragmatically, it prioritises foundational governance and resource enablers (ringfencing revenue, decentralising procurement, establishing fuel resilience and spare parts buffers) before scaling digital sophistication. In this regard, I-MARINESG offers a sequenced and implementable pathway aligned with Contingency

Theory (Donaldson, 2001) by fitting solutions to RIDA's operational constraints and institutional environment rather than adopting a technology leap model that risks implementation failure.

(c) Comparison with Efficiency Assessment Models (DEA and KPI-centric approaches)

Chapter Two reviewed efficiency assessment approaches such as Data Envelopment Analysis (DEA) used in maritime and port operations (Agüero Tobar, González Araya and González Ramírez, 2023; Danladi et al., 2024). These models are powerful for benchmarking and comparative efficiency scoring across multiple units and they strengthen evidence-based evaluation.

However, DEA and KPI systems alone are primarily diagnostic rather than fully prescriptive. They can show where inefficiency exists, but they do not inherently resolve why inefficiency persists in governance-constrained public systems, nor do they specify the multi-domain interventions required to disrupt vicious cycles. I-MARINESG incorporates performance monitoring and KPI dashboards under the Innovation and data systems(I) pillar and embeds them into operational accountability under the Accountability and governance (A) pillar, and it extends beyond measurement by providing structural interventions (governance reform, supply chain resilience, human capital revitalisation, safety system implementation) that translate measurement into sustained operational change.

(d) Comparison with Lean and Total Quality Management (TQM) as Generic Improvement Philosophies

Lean Management and TQM reviewed in Chapter Two (Womack and Jones, 2003; Deming, 1986) provide essential principles for waste elimination, continuous improvement and quality assurance, and these principles are reflected throughout I-MARINESG (e.g., eliminating waiting waste caused by fuel shortages, reducing defects waste caused by repeated breakdowns and standardising processes to improve timeliness and reliability). Similarly, safety and quality management expectations are reinforced by the ISM Code framework (IMO, 2018).

Nevertheless, Lean and TQM function primarily as guiding philosophies, not fully specified operational roadmaps for the specific institutional and governance constraints of a decentralised district marine service. I-MARINESG's comparative strength is that it operationalises Lean/TQM principles into concrete, context-specific pillars with defined interventions, explicitly linked to the empirical root causes identified in the study (governance failures, fuel logistics, reinvestment breakdown, reactive maintenance, weak discipline, demotivation and safety gaps).

(e) Unique Value Proposition of I-MARINESG: Governance-Centered, Systems-Integrated, and Cycle-Disruptive Design

The most significant comparative advantage of I-MARINESG is that it is explicitly governance-centered and cycle-disruptive, directly addressing the study's novel finding that operational inefficiency is driven more by governance and reinvestment failures than by absolute resource scarcity. Existing models in the reviewed literature typically assume that low-performance stems from resource constraints, weak maintenance systems or low technology adoption. By contrast, I-MARINESG is designed to break three empirically identified vicious cycles through targeted leverage points:

1. Maintenance–Breakdown–Resource Depletion Cycle is disrupted through Resource assurance and Maintenance transformation (resource buffers + planned maintenance systems).
2. Revenue–Efficiency Paradox Cycle is disrupted at source through Governance and financial autonomy (ringfencing revenue + procurement decentralisation + petty cash facility).
3. Demotivation–Discipline–Productivity Cycle is disrupted through Nurturing human capital and Accountability and operational discipline (welfare/training/succession + enforceable accountability mechanisms).

Furthermore, unlike many frameworks reviewed in Chapter Two that emphasise design without strong operational sequencing, I-MARINESG includes explicit implementation phasing (Section 5.7), improving practical feasibility and increasing the likelihood of sustainable adoption under public-sector constraints. In summary, I-MARINESG synthesises and extends existing approaches /maintenance frameworks (Abdulrahmani, 2025; Damson, Mtui and Kileo, 2025), digital maturity models (Tubis et al., 2025) and quality/lean philosophies (Deming, 1986; Womack and Jones, 2003) into a single coherent model whose scope, sequencing and governance logic are tailored to the RIDA Kariba marine operations context.

5.7 Implementation Phasing

The researcher proposed a phased approach in the implementation of the framework, by identifying and carefully arranging the activities from short term through medium term to long term in order to realize realistic gains and traceable improvements. This is illustrated in Table 5.2

below:

Phase	Timeframe	Priority Pillars	Key Actions
Phase 1: Quick Wins	0–3 months	Pillars 1, 4, 6	Establish petty cash fund; pay outstanding allowances; renew certificate of fitness; procure rescue boat and fire extinguishers; provide crew PPE
Phase 2: Foundation Building	3–12 months	Pillars 1, 2, 3, 7	Implement revenue ringfencing (10% retention); establish local bulk fuel agreements; introduce planned maintenance system and logbooks; deploy KPI dashboard
Phase 3: System Strengthening	12–24 months	Pillars 3, 4, 5, 7	Full preventive maintenance programme; structured annual training; departure accountability system; MMIS implementation; fleet rehabilitation planning
Phase 4: Sustainable Excellence	24–36 months	All Pillars	Condition-based monitoring; digital data systems; second vessel operational; stakeholder advisory committee active; continuous improvement culture embedded

Table 5.2 I-MARINESG Framework implementation phases, Researcher's Construct (2026)

5.8 Recommendations for Further Studies

While this study has provided comprehensive insights into operational efficiency challenges and proposed an evidence-based enhancement framework, several related aspects could not be investigated within the scope and limitations of this study. The following recommendations for further research are offered to complement and extend the findings of this study:

(a) Longitudinal impact assessment of the I-MARINESG Framework

This study developed the framework but did not implement or evaluate it empirically. A longitudinal study tracking the implementation of the I-MARINESG framework over 24–36 months would provide valuable evidence on implementation challenges, adaptation requirements and measurable efficiency gains. Such a study could employ a pre-test/post-test design comparing operational KPIs before and after framework implementation.

(b) Comparative analysis of inland waterway operations across Southern Africa

This study focused exclusively on RIDA's operations in Kariba. A comparative study examining inland waterway operations across Southern African countries (e.g., Zambia's Lake Kariba operations, Malawi's Lake Malawi ferry services, Tanzania's Lake Victoria operations) would enable cross-national comparison of efficiency determinants, governance models and best practices, potentially identifying transferable innovations.

(c) Economic impact analysis of marine transport disruptions on lakeside communities

This study documented the existence of service disruptions but did not quantify their economic impact on dependent communities. A dedicated economic impact study, potentially employing cost-benefit analysis or contingent valuation methodology, could quantify the economic losses incurred by fishing communities, traders and public service users when ferry services are cancelled or delayed, strengthening the economic justification for investment in marine operations improvement.

(d) Digital transformation readiness and technology adoption in RIDA's Operations

The study identified the absence of digital data systems as a significant gap but did not comprehensively assess digital readiness or technology adoption barriers. A study applying Tubis et al.'s (2025) digital maturity model to RIDA's operations could provide a detailed digital readiness assessment and phased digitalisation roadmap appropriate for the resource-constrained context.

(e) Customer satisfaction and service quality assessment

This study focused on operational staff and management perspectives. A complementary study examining customer (passenger and cargo user) satisfaction, service quality perceptions and willingness to pay for improved services would provide demand-side insights essential for service improvement and revenue optimisation.

(f) Environmental sustainability of RIDA's marine operations on Lake Kariba

This study deliberately excluded detailed environmental sustainability analysis beyond basic regulatory compliance. A dedicated environmental study examining fuel emissions, oil spill risks, waste management practices and ecological impacts of marine operations on Lake Kariba's fragile ecosystem would complement the operational efficiency focus of this study and align with global sustainability imperatives.

(g) Governance models for public-sector operational autonomy in Zimbabwe

The study's most significant finding that governance failures rather than resource scarcity drive operational inefficiency raises broader questions about public-sector governance in Zimbabwe. A comparative governance study examining different models of operational autonomy within Zimbabwe's parastatals and state enterprises could inform policy reforms applicable beyond RIDA to the broader public infrastructure sector.

(h) Fleet replacement and vessel design study for Lake Kariba Operations

The study identified single-vessel dependency as a critical systemic vulnerability but did not extend to fleet replacement planning or vessel design specifications. A technical study assessing optimal fleet composition, vessel design requirements (including shallow-draft vessels for low-water conditions) and fleet rehabilitation costs would provide the technical foundation for long-term fleet investment decisions.

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APPENDICES

APPENDIX A: INTERVIEW DATA TRANSCRIPTION CODES

Theme	Brief sample of coded text
SAFETY MANAGEMENT	Question: From your regulatory perspective, how would you assess the safety standards of RIDA's marine fleet and operations? ☐ “My main worry is on overloading of the boat especially with regards to passengers” ☐ “The operations do have the minimum safety equipment requirement such as life jackets, rafts, rings, ship-to-shore radio communication, navigation equipment. However, of great concern is the absence if the tender/rescue boat which should always be towed by the boat so that in the event of an emergency, passengers cab be quickly taken to a safe place. The acquisition of this boat has been on the cards for a long time”
FRAMEWORK DEVELOPMENT AND RECOMMENDATIONS	Question: What specific regulatory or policy interventions would you recommend to improve the operational efficiency and safety of RIDA's marine transport operations on Lake Kariba? ☐ “RIDA’s fleet is now very old and there is need to rehabilitate the boats” ☐ “The Agency is also encouraged to acquire a new fleet as a long term strategy” ☐ “In the current scenario, the Agency is encouraged to revive another boat to make them 2, so as to relive the KF 551 which is currently characterized by overloading of passengers”
MAINTENANCE PRACTICES AND FLEET CONDITION	Question: Based on your engagement with RIDA, how would you assess the current technical condition of RIDA's marine fleet (KF 550, KF 551, KF 552)? ☐ “Lack of finance is the biggest challenge, the district office is running the marine operations while operating on a shoestring budget” ☐ “Available budgets being provided are not adequate to cover operating costs” ☐ “Requests made are not honored” ☐ “Company requested to provide quotations for the supply of propeller shafts, propellers among other items but to date nothing has been done, and no replacements are in place” ☐ “The workshop stores is running on no major spares” ☐ “Safety is heavily compromised due to the absence of the tender boat”

APPENDIX B: INTERVIEW GUIDE FOR RIDA MANAGEMENT

TARGET RESPONDENT GROUP: RIDA Senior Management & Supervisory Staff

INTERVIEW PROTOCOL

Participant Code: MGT-____

Organisation: ____

Designation/Role: ____

Date: ____ / ____ / 2026

Time: Start ____ End ____

Venue: ____

Years in current role: ____

Years at RIDA: ____

Audio recording consent: Yes No

Opening Statement: "Good morning/afternoon. My name is Edwick Enia Chikaka, a Masters of Business Leadership student at Bindura University of Science Education. I am conducting research on enhancing the operational efficiency of marine transport operations at RIDA in Kariba. This interview will take approximately 30–45 minutes. Your responses are confidential and will be used solely for academic purposes. You may decline to answer any question or withdraw at any time. May I proceed?"

SECTION A: CURRENT OPERATIONAL EFFICIENCY (OE)

Q1.1. How would you describe the current state of RIDA's marine transport operations in Kariba?

Q1.2. In your assessment, how efficient are the current marine operations? What evidence supports your assessment?

Q1.3. What do you consider the most significant operational challenges facing RIDA's marine services?

Q1.4. Of the three ferries (KF 550 Chaminuka, KF 551 Mbuya Nehanda, KF 552 Nyaminyami), can you describe the current operational status of each?

SECTION B: MAINTENANCE PRACTICES (MP)

Q2.1. Describe the current maintenance management system for RIDA's vessels.

Q2.2. How effective is the current maintenance system in preventing breakdowns and ensuring vessel availability?

Q2.3. What are the main barriers to effective maintenance of RIDA's marine fleet?

SECTION C: OPERATIONAL SCHEDULING (OS)

Q3.1. How are ferry trip schedules developed and communicated to stakeholders?

Q3.2. What factors cause deviations from planned schedules, and how frequently do they occur?

Q3.3. How is cargo and passenger loading coordinated to optimise turnaround time?

SECTION D: HUMAN RESOURCE CAPACITY (HR)

Q4.1. How adequate is the current staffing complement for marine operations?

Q4.2. What training and capacity development programmes are in place for marine operations staff?

Q4.3. How would you assess staff morale and motivation in the marine operations unit?

SECTION E: SAFETY MANAGEMENT (SM)

Q5.1. Describe the safety management systems currently in place for RIDA's marine operations.

Q5.2. How compliant are RIDA's marine operations with the Inland Waters and Shipping Act and other regulatory requirements?

SECTION F: RESOURCE AVAILABILITY (RA)

Q6.1. How would you describe the adequacy of resources available for marine operations?

Q6.2. What procurement challenges affect the timely availability of operational resources?

SECTION G: MODERATING FACTORS (MF)

Q7.1. How do weather conditions and lake water level fluctuations affect marine operations?

Q7.2. How do government policies and the regulatory framework influence the efficiency of marine operations?

Q7.3. How does budget availability and financial management affect operational efficiency?

SECTION H: FRAMEWORK DEVELOPMENT (FD)

Q8.1. Based on your experience, what are the most critical interventions needed to enhance the operational efficiency of RIDA's marine services?

Q8.2. What would an ideal operational efficiency framework for RIDA's marine operations look like?

Q8.3. What lessons can be drawn from other organisations or sectors that RIDA could apply to improve marine operations?

Q8.4. What institutional or policy changes would support the implementation of an efficiency improvement framework?

Q8.5. Is there anything else you would like to add regarding RIDA's marine operations or how efficiency could be enhanced?

CLOSING STATEMENT

"Thank you very much for your time and insights. Your contributions are invaluable to this study. I may follow up for clarification if needed — would that be acceptable? If you wish to review or amend any of your responses, please do not hesitate to contact me. Once again, all responses will be treated with strict confidentiality."

APPENDIX C: INTERVIEW GUIDE FOR REGULATORS

TARGET RESPONDENT GROUP: Regulators (Zambezi River Authority, Inland Waters Control Department)

INTERVIEW PROTOCOL

Participant Code: REG-____

Organisation: ____

Designation/Role: ____

Date: ____ / ____ / 2026

Time: Start ____ End ____

Venue: ____

Audio recording consent: Yes No

Opening Statement: "Good morning/afternoon. My name is Edwick Enia Chikaka, a Masters of Business Leadership student at Bindura University of Science Education. I am conducting research on enhancing the operational efficiency of marine transport operations at RIDA in Kariba. This interview will take approximately 30–45 minutes. Your responses are confidential and will be used solely for academic purposes. You may decline to answer any question or withdraw at any time. May I proceed?"

SECTION A: REGULATORY FRAMEWORK AND COMPLIANCE (RC)

Q1.1. What is your organisation's role in relation to RIDA's marine transport operations on Lake Kariba?

Q1.2. How would you assess RIDA's compliance with the Inland Waters and Shipping Act [Chapter 13:06] and other applicable regulations?

Q1.3. What are the key regulatory challenges affecting marine transport operations on Lake Kariba?

Q1.4. How effective is the current vessel registration, inspection and certification process?

SECTION B: SAFETY MANAGEMENT (SM)

Q2.1. From your regulatory perspective, how would you assess the safety standards of RIDA's marine fleet and operations?

Q2.2. What safety incidents involving RIDA's vessels have been reported in recent years, and what were the root causes?

SECTION C: OPERATIONAL ENVIRONMENT / MODERATING FACTORS (MF)

Q3.1. How do environmental conditions on Lake Kariba (weather, water levels) affect marine transport operations and safety?

SECTION D: INTER-INSTITUTIONAL COORDINATION AND POLICY (IP)

Q4.1. How effective is the coordination between your organisation and RIDA regarding marine operations?

Q4.2. How do current government policies (e.g., NDS2, Vision 2030, devolution) influence marine transport development on Lake Kariba?

Q4.3. What is the Inland Waters Control Department/Zambezi River Authority's role in managing Lake Kariba conditions, and how does this affect RIDA's marine transport operations?

SECTION E: FRAMEWORK DEVELOPMENT AND RECOMMENDATIONS (FD)

Q5.1. What specific regulatory or policy interventions would you recommend to improve the operational efficiency and safety of RIDA's marine transport operations on Lake Kariba?

Q5.2. What role could your organisation play in supporting the development and implementation of an efficiency improvement framework for RIDA's marine operations?

Q5.3. Are there any best practices from other jurisdictions or operators that could be applied to improve marine transport operations on Lake Kariba by RIDA?

Q5.4. Is there anything else you would like to add?

CLOSING STATEMENT

"Thank you very much for your time and insights. Your contributions are invaluable to this study. I may follow up for clarification if needed — would that be acceptable? If you wish to review or amend any of your responses, please do not hesitate to contact me. Once again, all responses will be treated with strict confidentiality."

APPENDIX D: INTERVIEW GUIDE FOR SPECIALIST SERVICE PROVIDER

TARGET RESPONDENT GROUP: Specialist Service Provider (KB Engineering)

INTERVIEW PROTOCOL

Participant Code: SSP-____

Organisation: ____

Designation/Role: ____

Date: ____ / ____ / 2026

Time: Start ____ End ____

Years of engagement with RIDA: ____

Audio recording consent: Yes No

Opening Statement: "Good morning/afternoon. My name is Edwick Enia Chikaka, a Masters of Business Leadership student at Bindura University of Science Education. I am conducting research on enhancing the operational efficiency of marine transport operations at RIDA in Kariba. This interview will take approximately 30–45 minutes. Your responses are confidential and will be used solely for academic purposes. You may decline to answer any question or withdraw at any time. May I proceed?"

SECTION A: MAINTENANCE PRACTICES AND FLEET CONDITION (MP)

Q1.1. Based on your engagement with RIDA, how would you assess the current technical condition of RIDA's marine fleet (KF 550, KF 551, KF 552)?

Q1.2. What are the most common types of maintenance and repair work you have undertaken for RIDA's vessels?

Q1.3. How would you assess RIDA's current maintenance management practices from a technical perspective?

Q1.4. What are the main technical challenges affecting the reliability and availability of RIDA's vessels?

SECTION B: RESOURCE AVAILABILITY – SPARE PARTS AND SUPPLY CHAIN (RA)

Q2.1. How would you describe the availability and procurement process for spare parts needed for RIDA's vessels?

Q2.2. Are there specific components or systems that are particularly difficult to source for RIDA's vessel types?

SECTION C: OPERATIONAL EFFICIENCY IMPROVEMENT AND FRAMEWORK DEVELOPMENT (OE/FD)

Q3.1. What maintenance strategy would you recommend for RIDA's marine fleet to improve vessel availability and reduce breakdowns?

Q3.2. What investment priorities would you recommend for RIDA's marine fleet (short, medium and long term)?

Q3.3. What technical training would you recommend for RIDA's in-house maintenance staff?

Q3.4. Is there anything else you would like to add about improving RIDA's marine operations from a technical perspective?

CLOSING STATEMENT

"Thank you very much for your time and insights. Your contributions are invaluable to this study. I may follow up for clarification if needed — would that be acceptable? If you wish to review or amend any of your responses, please do not hesitate to contact me. Once again, all responses will be treated with strict confidentiality."

APPENDIX E: QUESTIONNAIRE

Dear Sir/Madam

My name is Edwick Enia Chikaka, a Masters student at the Bindura University of Science and Education, Graduate School of Business. As part of the partial fulfilment of completing the MSc in Business Leadership, I am conducting research titled: **Developing a framework for enhancing efficiency of marine operations in Rural Infrastructure Development Agency, Kariba**

I hereby kindly seek your assistance in completing the attached questionnaire. Where a free response is required, please kindly fill in the spaces provided. You are free to make additional contributions that you think may be of assistance to this research.

Please kindly note that participation is voluntary and the participant may withdraw at any given time. Confidentiality and anonymity will be adhered to unless prior consent is given. The responses and information provided will be greatly appreciated and will be used for academic purposes only.

Thank you
Signed

Edwick Enia Chikaka

Consent Agreement

I have read the above statement and understood its contents. I have been allowed to ask questions and discuss my concerns. I agree to voluntarily participate in the study as it has been explained and have the right to withdraw if I may find it necessary. However, I also understand that my identity will not be disclosed by the researcher or the University and all the information will be confidential.

Signature.....

Instructions to Respondents

1. Do not write your name anywhere on this questionnaire.
2. There are no right or wrong answers. Please respond based on your honest experience and observations.
3. Read each statement carefully and indicate your level of agreement by placing a tick (✓) in the appropriate column.
4. Please answer ALL questions. Incomplete questionnaires reduce the reliability of the study.
5. The questionnaire should take approximately 20–25 minutes to complete.
6. If you have any questions, please ask the researcher before proceeding.

SECTION A: DEMOGRAPHIC INFORMATION

Note: Demographic information helps classify responses by background characteristics without identifying individuals. This allows for analysis of whether different groups (by age, experience, role, etc.) perceive operational efficiency differently.

Please tick (✓) the appropriate box or fill in the blank for each item below. This information is used for statistical classification only and will not be used to identify you.

A1. Gender

- ☐ Male
- ☐ Female

A2. Age group

- ☐ 18–30 years
- ☐ 31–40 years
- ☐ 41–50 years
- ☐ 51–60 years
- ☐ Above 60 years

A3. Highest educational qualification

- ☐ Primary education
- ☐ Secondary education (O-Level)
- ☐ Advanced Level
- ☐ Diploma/Certificate
- ☐ Bachelor's Degree
- ☐ Postgraduate Degree

A4. Current designation/role

Vessel Operator/Captain: person in charge of navigating and operating the ferry. Deck hand: crew member who assists with vessel operations, mooring, and passenger handling. Maintenance Technician/artisan: person responsible for repairs and servicing.

- ☐ Vessel Operator/Captain
- ☐ Deck hand
- ☐ Crew member
- ☐ Maintenance Technician/artisan
- ☐ Administrative/Logistics Staff
- ☐ Dock/Loading Personnel
- ☐ Other (specify): _____

A5. Length of service at RIDA (Kariba marine operations)

- ☐ Less than 1 year
- ☐ 1–3 years
- ☐ 4–6 years
- ☐ 7–10 years
- ☐ More than 10 years

A6. Employment status

- ☐ Permanent
- ☐ Contract
- ☐ Temporary/Casual

SECTION B: CURRENT LEVEL OF OPERATIONAL EFFICIENCY (Dependent Variable)

Note: Operational efficiency refers to how well RIDA's marine services achieve their objectives using available resources. Key indicators include: number of completed trips, vessel reliability (uptime vs. downtime), on-time performance, and cost-effectiveness (revenue generated compared to operating costs).

This section assesses the current level of operational efficiency of RIDA's marine transport services in Kariba. Please indicate your level of agreement with each statement.

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	RIDA's ferries complete the planned number of trips each month.					
2	Vessel downtime (time out of service) is within acceptable limits.					
3	Vessel breakdowns are infrequent (less than once per month).					
4	Trip turnaround times (loading, travel, unloading, return) are efficient.					
5	Scheduled ferry trips are completed on time in most cases.					
6	The overall reliability of RIDA's marine transport services is satisfactory.					
7	The current operational output meets the transport demands of communities served.					
8	Marine operations generate sufficient revenue relative to operational costs.					

B9. In your estimation, how many ferry trips are completed per month on average? -----

A trip is a one-way journey from one point to another. For example, a ferry going from Point A to Point B and returning to Point A completes two trips.

B10. What is the average vessel downtime per month (in hours/days)? -----

Downtime is the period when a vessel is not operational due to maintenance, repairs, or breakdowns.

B11. How many vessel breakdowns have occurred in the past 12 months? -----

B12. What was the longest vessel down time period recorded in the last 12 months? -----

SECTION C: MAINTENANCE PRACTICES

Note: Preventive maintenance means scheduled, routine servicing to prevent breakdowns (e.g., regular engine checks, oil changes). Corrective/reactive maintenance means repairs done after something breaks. Vessel readiness refers to the state where a vessel is fully functional and available for scheduled operations.

This section examines maintenance practices of RIDA'S ferries in Kariba. Please indicate your level of agreement with each statement

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	Preventive (scheduled) maintenance of vessels is carried out regularly.					
2	There is a documented and followed maintenance schedule for all vessels.					
3	Breakdowns are responded to promptly (within 8 hours as per target).					
4	The maintenance workshop has adequate tools and equipment.					
5	Maintenance records are systematically kept and up to date.					
6	Maintenance artisans have the required skills and qualifications.					
7	Corrective (reactive) maintenance dominates over preventive maintenance.					
8	Specialist external maintenance providers (e.g., KB Engineering) are engaged when needed.					
9	Spare parts for vessel repairs are available when required.					
10	The current maintenance system ensures vessel readiness for scheduled operations.					

C11. How would you rate the overall condition of RIDA's ferries? (Circle one)

1 = Very Poor 2 = Poor 3 = Fair 4 = Good 5 = Excellent

SECTION D: OPERATIONAL SCHEDULING (Independent Variable 2)

Note: Operational scheduling involves planning when ferries depart, which routes they take, and how crews are assigned. Vessel utilisation measures how effectively ferries are being used (actual operating hours vs. available hours). Turnaround time is the total time from departure to return, including loading, travel, and unloading.

This section examines operational scheduling of the RIDA'S ferries in Kariba. Please indicate your level of agreement with each statement

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	Ferry trips are planned in advance with a clear schedule communicated to all stakeholders.					
2	Trip schedules are adhered to consistently (departures and arrivals on time).					
3	Route planning takes into account current lake conditions (e.g., water levels, weather).					
4	Loading and unloading operations are organised efficiently to minimise turnaround time.					
5	Crew deployment is planned to match operational requirements.					
6	There is effective coordination between the scheduling office and vessel crews.					
7	Contingency plans exist for schedule disruptions (e.g., breakdowns, weather).					
8	The current scheduling system optimises vessel utilisation.					

SECTION E: HUMAN RESOURCE CAPACITY

Note: Human resource capacity refers to whether RIDA has enough trained and motivated staff to operate vessels effectively. Crew complement is the number of crew members assigned to a vessel. Staff turnover measures how frequently employees leave the organization. High turnover can indicate dissatisfaction and disrupt operations.

*This section examines human resource capacity of RIDA's marine operations in Kariba.
Please indicate your level of agreement with each statement*

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	I have received adequate training for my current role in marine operations.					
2	Training opportunities are provided regularly (at least annually).					
3	The crew complement is sufficient to operate vessels safely and efficiently.					
4	Staff motivation levels in the marine operations unit are high.					
5	Staff turnover in marine operations is low.					
6	Crew members possess the required certifications and competencies.					
7	There is a clear career development path for marine operations staff.					
8	Working conditions (e.g., accommodation, remuneration, leave) are satisfactory.					
9	I feel confident in my ability to perform my duties effectively.					
10	Communication between management and operational staff is effective.					

SECTION F: SAFETY MANAGEMENT

Note: Safety management includes all systems, equipment, and procedures to protect passengers, crew, and cargo. A near-miss is an incident that could have caused harm but didn't. Safety drills are practice exercises for emergency situations. Approved capacity limits refer to the maximum number of passengers and cargo weight a vessel is legally certified to carry.

This section examines safety management of RIDA'S ferries in Kariba. Please indicate your level of agreement with each statement

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	Safety equipment (life jackets, fire extinguishers, first aid kits, evacuation boat) is available on all vessels.					
2	Safety equipment is regularly inspected and in good working condition.					
3	Standard safety procedures are documented and followed before each trip.					
4	Crew members are trained in emergency response and safety protocols.					
5	Safety drills are conducted regularly (at least quarterly).					
6	Safety incidents and near-misses are formally reported and documented.					
7	The vessels comply with the Inland Waters and Shipping Act [Chapter 13:06] requirements.					
8	Vessel safety certificates are current and valid.					
9	Passengers and cargo are loaded within approved capacity limits.					
10	Safety non-compliance has contributed to operational delays or shutdowns.*					

SECTION G: RESOURCE AVAILABILITY

Note: Resource availability refers to whether essential inputs are available when needed, including fuel, spare parts, operational equipment, and financial resources. The procurement cycle is the process and time required to order and receive supplies. Lead time is the time between ordering an item and receiving it.

This section examines resource availability in the operation of RIDA'S ferries in Kariba. Please indicate your level of agreement with each statement

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	Fuel is available in sufficient quantities when needed for scheduled trips.					
2	Fuel procurement processes are efficient and timely.					
3	All vessels in the fleet are operational and available for deployment.					
4	Spare parts for vessel maintenance and repairs are readily available.					
5	The procurement cycle for spare parts is efficient (within acceptable lead times).					
6	Docking and harbour facilities are adequate for operations.					
7	Navigation and communication equipment on vessels is functional.					
8	Financial resources allocated to marine operations are sufficient.					
9	Operational tools and equipment (ropes, anchors, loading gear) are available and serviceable.					
10	Resource shortages have caused trip cancellations or delays in the past 12 months.					

SECTION H: MODERATING VARIABLES

Note: Moderating variables are external factors that may strengthen or weaken the relationship between operational practices and efficiency. These include budget allocation and timing (budget disbursements), weather and water level conditions on Lake Kariba, and regulatory requirements from government bodies like the Inland Waters Control Department and Zimbabwe Revenue Authority.

This section captures perceptions of external/contextual factors that moderate the relationship between operational determinants and efficiency. Please indicate your level of agreement with each statement

SD-Strongly Disagree

D- disagree

N- neutral

A- Agree

SA- strongly agree

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
1	The budget allocated to marine operations is adequate to support efficient operations.					
2	Budget disbursements are timely and predictable.					
3	Government policies support and facilitate efficient marine operations.					
4	Weather conditions on Lake Kariba frequently disrupt scheduled operations.					
5	Fluctuating water levels on Lake Kariba significantly affect vessel operations					
6	The regulatory framework (Inland Waters Control Department, ZRA) facilitates efficient operations.					
7	Regulatory inspections and compliance requirements are reasonable and achievable.					
8	External institutional support (Ministry of Transport, local authorities) is adequate.					

SECTION I: OPEN-ENDED QUESTIONS

Note: These questions allow you to share insights based on your direct experience that may not be captured in the structured questions above. Please be specific and provide examples where possible. Critical challenges are obstacles that significantly hinder operations or prevent achievement of objectives.

Please provide brief responses in the spaces provided. These questions help capture additional insights not covered by the scaled items above.

I1. In your opinion, what are the **THREE** most critical challenges affecting the efficiency of RIDA's marine operations in Kariba?

I2. What specific improvements would you recommend to enhance the operational efficiency of RIDA's marine transport services?

I3. Are there any other observations or comments you would like to share regarding RIDA's marine operations?

— THANK YOU FOR YOUR PARTICIPATION —

APPENDIX F: FIELD OBSERVATION GUIDE/CHECKLIST

Target Respondent Group : RESEARCHER

Instructions on the checklist

Complete one checklist per observation session (e.g., per trip observed, per facility visit).

Observe naturally without disrupting operations. Obtain prior management permission.

Use the rating scale: 1 = Very Poor, 2 = Poor, 3 = Fair, 4 = Good, 5 = Excellent, or N/A = Not Applicable/Not Observed.

Record qualitative field notes in the comments column and the narrative section at the end.

Photograph evidence where permitted (with consent).

OBSERVATION RECORD

Observation Code: OBS-_____

Date: _____ / _____ / 2026

Time: Start _____ End _____

Location: _____

Activity observed: ☐ Ferry trip ☐ Loading/unloading ☐ Maintenance activity ☐ Docking facility ☐ Workshop ☐ Other: _____

Vessel observed (if applicable): ☐ KF 550 ☐ KF 551 ☐ KF 552 ☐ Other: _____

Weather conditions: _____

A. VESSEL CONDITION AND MAINTENANCE

No.	Observation Item	1	2	3	4	5	Comments
1	Overall physical condition of the vessel (hull, deck, superstructure)						
2	Engine room condition and cleanliness						
3	Evidence of regular maintenance (paint, greasing, rust treatment)						
4	Availability of maintenance tools and equipment in workshop						
5	Maintenance records/logbook available and up to date						
6	Spare parts storage area — organisation and stock levels						
7	Vessel cleanliness and operational readiness						

B. SAFETY EQUIPMENT AND COMPLIANCE

No.	Observation Item	1	2	3	4	5	Comments
1	Life jackets and evacuation boat available and accessible (sufficient for capacity)						
2	Fire extinguishers present, serviced and accessible						
3	First aid kit available and stocked						
4	Navigation lights functional						
5	Communication equipment (radio/phone) functional						

6	Safety signage displayed (capacity limits, emergency procedures)						
7	Safety briefing conducted before departure						
8	Vessel safety certificate displayed/available						
9	Passengers/cargo loaded within capacity limits						

C. OPERATIONAL SCHEDULING AND EFFICIENCY

No.	Observation Item	1	2	3	4	5	Comments
1	Departure on schedule (as per posted timetable)						
2	Loading/unloading process efficiency and organisation						
3	Crew coordination during operations						
4	Communication between shore and vessel staff						
5	Passenger/cargo manifest maintained						
6	Evidence of trip planning documentation						
7	Turnaround time efficiency at destination						

D. HUMAN RESOURCE AND CREW CAPACITY

No.	Observation Item	1	2	3	4	5	Comments
1	Crew complement appears adequate for the operation						
2	Crew wearing appropriate uniform/PPE						
3	Crew demonstrates competence in vessel handling						
4	Crew demonstrates knowledge of safety procedures						
5	Crew interaction with passengers (professionalism)						
6	Evidence of crew certifications/qualifications						

E. INFRASTRUCTURE AND FACILITIES

No.	Observation Item	1	2	3	4	5	Comments
1	Docking/jetty facilities condition and safety						
2	Fuel storage and handling facilities						
3	Passenger waiting area condition						
4	Workshop/maintenance facility condition						
5	Office/administrative area condition						
6	Signage and operational information displayed						

F. NARRATIVE FIELD NOTES

- 1) General observations about operational efficiency:
- 2) Notable practices (positive or negative):
- 3) Environmental/contextual factors observed:
- 4) Discrepancies between reported data and observed reality:
- 5) Researcher's reflections and preliminary interpretations:

APPENDIX G: OPERATIONAL DATA COLLECTION SHEET

OPERATIONAL DATA EXTRACTION SHEET

Research: Developing a Framework for Enhancing Efficiency of Marine Operations in RIDA, Kariba

Purpose

This data extraction sheet is used to systematically collect quantitative operational data from RIDA's internal records (trip logs, maintenance records, breakdown reports, fuel logs) for the period 2020–2025. This data supports the quantitative assessment of operational efficiency (Objective 1) and the identification of trends and patterns (Objective 2). Data will be entered into SPSS/Excel for descriptive and inferential statistical analysis.

SHEET A: TRIP LOG DATA (Monthly Summary)

Month/ Year	Trips Sched uled	Trips Compl eted	Trips Cance lled	Reason for Cancell ation	Avg. Turnar ound Time (hrs)	On- Time Depart ures (%)	Passen gers Carrie d	Carg o (tonn es)	Ves sel Use d

SHEET B: BREAKDOWN AND MAINTENANCE DATA

Date	Vessel	Type (Breakdown/Scheduled)	System Affected	Description	Response Time (hrs)	Repair Duration (hrs)	Parts Used	Cost (USD/ZWG)	Performed by (Internal/External)

SHEET C: FUEL CONSUMPTION DATA

Month/Year	Vessel	Fuel Received (litres)	Fuel Used (litres)	Trips Made	Fuel per Trip (litres)	Fuel Cost	Stock Balance	Supply Disruptions (Y/N)	Notes

SHEET D: VESSEL DOWNTIME TRACKER

Month/ Year	Ves sel	Days Operati onal	Days Down (Mainten ance)	Days Down (Breakd own)	Da ys Do wn (No Fue l)	Days Down (Weat her)	Days Dow n (Oth er)	Total Downt ime (days)	Availab ility Rate (%)

NB: No records were available for this data set

APPENDIX H: REQUEST FOR AUTHORITY TO CONDUCT STUDY



BINDURA UNIVERSITY OF SCIENCE EDUCATION

P Bag 1020
741 Chimurenga Rd, Off Trojan Road
Bindura, Zimbabwe

Direct Line: +263 66210 – 6284
Tel: +263 66210 – 7615, 7531/2, 7622/4
Cell: +263 772 749 583
gsb@buse.ac.zw
jmwenje@buse.ac.zw

GRADUATE SCHOOL OF BUSINESS

Where Great Minds Meet

19 March 2026

TO WHOM IT MAY CONCERN

REF: REQUEST TO CARRY OUT RESEARCH: EDWICK ENIA CHIKAKA B242447B:
MASTER OF BUSINESS LEADERSHIP, (MBL), PART 2.1 STUDENT

This letter serves to confirm that **Edwick Enia Chikaka Reg No. [B242447B]** is a Master of Business Leadership student in the Graduate School of Business at Bindura University of Science Education.

The student is in the final stage of study which requires her to carry out a research. Her dissertation is titled *“Developing a framework for enhancing efficiency of marine operations of the Rural Infrastructure Development Agency, Kariba.”*

We would be grateful if you could give her any assistance she may require.

For more details, please do not hesitate to contact us.

Yours faithfully,



Dr J. Mwenje
Director, Graduate School of Business

APPENDIX I: AUTHORITY TO CONDUCT STUDY

Fax: 708848
Telex: 24778
Telephone: 732695/9 796120/9,706301/5
Telegrams: "Interior Harare"
Private Bag 7756, Causeway, Zimbabwe
Harare



ZIMBABWE

Reference: DDF Per /
Office of the President and Cabinet
Rural Infrastructure Development Agency
Mukwati Building
Livingstone Avenue/4th Street
Harare, Zimbabwe

8 April 2026

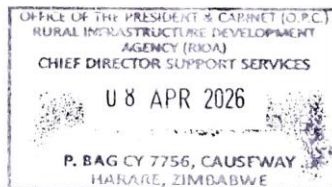
✓ Mrs E. Chikaka
Provincial Director- Mashonaland West Province

REQUEST FOR AUTHORITY TO CARRY OUT STUDY WITHIN THE RURAL INFRASTRUCTURE DEVELOPMENT AGENCY IN THE OFFICE OF THE PRESIDENT AND CABINET

Reference is made to your memorandum, dated 25 March 2026.

Please be advised that the Director General has approved your request to carry out a study at the Kariba Marine Operations in fulfilment of the requirements of your studies.

N. Chikokoko
Director Human Resources



**FOR: DIRECTOR GENERAL RURAL INFRASTRUCTURE
DEVELOPMENT AGENCY IN THE OFFICE OF THE PRESIDENT
AND CABINET**

Cc : Chief Director Support Services
Chief Director Operations

APPENDIX J: ETHICAL CLEARANCE

RESEARCH ETHICS COMMITTEE



P. Bag 1020
BINDURA, Zimbabwe
Email : rid@buse.ac.zw

BINDURA UNIVERSITY OF SCIENCE EDUCATION [BUSE]

9 June 2026

Edwick E Chikaka
Bindura University of Science Education
Graduate School of Business
P. Bag 1020
Bindura

Dear Edwick E Chikaka

**RE: INSTITUTIONAL RESEARCH COMMITTEE ETHICAL CLEARANCE-
APPROVAL NUMBER: BUSEREC/0160/2026**

Your application for research ethical clearance related to the topic '**Working Model for effectively operationalizing the Rural Infrastructure Development Agency(RIDA)'s Strategic Business Unit (SBU): The Case of Marine Operations in Kariba.**' has been approved and allocated approval Number: **BUSEREC/0160/2026**. You are to quote this approval number for all correspondences inclusive of consent forms and any other documents as and when appropriate. The approval period is as stated below:

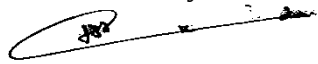
Type of Meeting	:	19 th Research Ethics Committee
Approval Date.	:	09/06/2026
Expiry date	:	08/06/2027

The project will automatically discontinue on the expiry date. You can apply for renewal three months before the expiry date. The renewal application should be accompanied by a progress report.

You are not expected to make any changes/adjustments to the protocol including the consent documents. Any trials involving drugs, devices and biologics require approval of the Medicines Control Authority of Zimbabwe before commencement. All problems to do with the safety of participants must be reported to BUSEREC within three (3) working days.

Upon termination of the study, a report has to be submitted to BUSEREC.

Yours sincerely

A handwritten signature in black ink, appearing to be 'J. J. J.', written over a horizontal line.

BUSEREC CHAIRPERSON

APPENDIX K: CURRENT EXTERNAL APPERANCE OF KF 551



APPENDIX L: TUNITIN REPORT



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