



## Unpacking the Causes of Supply Chain Inefficiencies in the South African Mining Sector: Evidence from Qualitative Inquiry

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### Abstract

Supply chain inefficiencies remain a major challenge affecting operational performance and competitiveness in resource-intensive industries, particularly within the mining sector. The purpose of this study was to explore and identify the underlying causes of inefficiency in supply chain processes in the South African mining sector. Understanding these inefficiencies is important because supply chains play a critical role in coordinating procurement, production, logistics, and distribution activities that sustain mining operations and contribute significantly to national economic development.

The study adopted an interpretivist qualitative research design using a deductive exploratory approach. Data were collected from 31 supply chain professionals, including managers from 16 mining organisations and practitioners from related downstream sectors, through semi-structured interviews. The data were analysed using thematic analysis supported by ATLAS.ti software, guided by an integrated theoretical framework incorporating Transaction Cost Economics, the Resource-Based View, Dynamic Capabilities Theory, Systems Theory, and the Bullwhip Effect Theory.

The findings revealed that supply chain inefficiencies in the South African mining sector arise from a complex interaction of organisational, operational, institutional, and environmental factors. Key causes include strategic and operational planning deficits, communication and coordination breakdowns, human capital and leadership challenges, technological and systemic deficiencies, financial and resource constraints, and inventory and quality control problems. Additional contributing factors include supplier and vendor management challenges, infrastructure and logistics limitations, external market volatility, operational disruptions, governance failures and corruption, social and community tensions, internal resistance to organisational change, and regulatory compliance pressures.

The study concludes that supply chain inefficiency in the mining sector is systemic rather than isolated, resulting from the interaction between internal organisational capabilities and external environmental conditions. By integrating multiple theoretical perspectives, the study contributes to the literature by providing a comprehensive framework for understanding the structural drivers of inefficiency in mining supply chains within developing economies.

The findings have important managerial implications, suggesting that mining organisations should adopt integrated supply chain management strategies that strengthen planning capabilities, enhance communication and collaboration, invest in technological modernisation, develop human capital, improve governance structures, and foster stronger stakeholder engagement to improve supply chain performance and competitiveness.

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### 1. Introduction

Supply chain (SC) efficiency has become a central determinant of competitiveness and sustainability in modern industries, particularly in resource-intensive sectors such as mining. The mining sector remains one of the most important pillars of global and African economic systems, contributing significantly to national income, employment creation and international trade (Lumadi and Nyasha, 2024) <sup>[38]</sup>. In Africa, the sector accounts for a substantial share of economic activity due to the continent's vast mineral resources, which represent nearly 30% of the world's reserves (Leighton, 2024) <sup>[34]</sup>. Within this context, South Africa plays a particularly strategic role, ranking among the world's leading producers of several key commodities including platinum, chrome, manganese, coal and gold (Anthony, 2018; Hirlekar, Kolte and Vasa, 2025) <sup>[4, 27]</sup>. Despite its global prominence, the effectiveness of the mining sector is heavily dependent on the efficiency of its supply chain processes, which

coordinate procurement, production, logistics, distribution and export activities across complex value chains (Navarrete-Cruz and Birkenberg, 2024) <sup>[46]</sup>.

Efficient supply chain processes are essential for ensuring operational continuity, cost efficiency and competitive advantage in global markets. In mining, supply chains coordinate numerous activities, including exploration, extraction, processing, transportation and marketing of mineral commodities (Handley, 2023; Navarrete-Cruz and Birkenberg, 2024) <sup>[25, 46]</sup>. When these processes function effectively, they support production stability, enable timely delivery of mineral products and contribute to national economic growth. Conversely, inefficiencies in supply chain processes may disrupt production, increase operational costs and weaken the sector's competitiveness in global markets (Nguyen, 2020; Nimeesha and Fachira, 2025) <sup>[50, 51]</sup>. Evidence from South Africa indicates that several commodities- including diamonds, gold and iron ore-have experienced declining production performance in recent years, highlighting the urgent need to examine operational constraints affecting the sector (Lumadi and Nyasha, 2024) <sup>[38]</sup>. Understanding the causes of supply chain inefficiencies in the mining sector is therefore of considerable importance not only for mining firms but also for policymakers concerned with economic growth, employment and export performance.

Scholarly research has increasingly emphasised the role of supply chain management (SCM) in improving operational efficiency across industries (Anggay and Hamiche, 2021) <sup>[3]</sup>. Several theoretical perspectives have been developed to explain inefficiencies in supply chain systems. Transaction Cost Economics (TCE) argues that inefficiencies may arise from coordination failures, high transaction costs and opportunistic behaviour among supply chain actors (Williamson, 1985) <sup>[67]</sup>. Resource-Based View (RBV) suggests that organisational performance depends on the effective deployment of internal resources and capabilities, implying that supply chain inefficiencies may stem from inadequate strategic resources or poor capability development (Barney, 1991) <sup>[8]</sup>. Similarly, Dynamic Capabilities Theory emphasises the ability of organisations to adapt and reconfigure their resources in response to environmental changes, particularly in volatile industries such as mining (Teece, Pisano and Shuen, 1997) <sup>[63]</sup>. From a broader perspective, Systems Theory conceptualises supply chains as interconnected systems whose efficiency depends on coordination among multiple subsystems such as procurement, logistics and production (Bertalanffy, 1968) <sup>[12]</sup>. Finally, Bullwhip Effect Theory explains how information distortions across supply chain stages may lead to demand fluctuations, overproduction or stock shortages, thereby causing operational inefficiencies (Lee, Padmanabhan and Whang, 1997) <sup>[33]</sup>. Collectively, these theories provide a multi-level explanation of supply chain inefficiencies by considering organisational resources, institutional relationships, dynamic capabilities and systemic coordination.

Although extensive research has examined supply chain efficiency in manufacturing and service sectors, empirical investigations focusing specifically on mining supply chains—particularly within developing economies—remain limited (Hu, Wang and Elshkaki, 2024; Osei *et al.*, 2023) <sup>[28, 52]</sup>. Existing studies often address supply chain disruptions in

isolated contexts such as logistics performance or procurement inefficiencies (Wincewicz-Bosy, Dymyt and Wasowska, 2021; Malebana, 2024) <sup>[68, 40]</sup>. However, these studies seldom integrate multiple theoretical perspectives to explain systemic causes of supply chain inefficiencies across the mining value chain. Moreover, few empirical studies have examined how organisational, operational and environmental factors jointly contribute to supply chain inefficiencies within the South African mining sector. Consequently, the literature lacks a comprehensive theoretical and empirical understanding of the mechanisms that generate inefficiencies across mining supply chain systems. This study addresses this gap by applying an integrated theoretical framework that combines Transaction Cost Economics, Resource-Based View, Dynamic Capabilities Theory, Systems Theory and the Bullwhip Effect Theory to examine the causes of supply chain inefficiencies in the South African mining sector. Against this background, the central research question guiding this study is: What are the causes of inefficiency in the supply chain processes in the South African mining sector? The objective of the study is therefore to explore the underlying organisational, operational and systemic factors contributing to supply chain inefficiencies in the mining sector. The study is conducted within the context of the South African mining industry, which operates in a highly competitive global market characterised by complex logistics networks, technological demands and regulatory frameworks (Leighton, 2024; Lumadi and Nyasha, 2024) <sup>[34, 38]</sup>. The analysis is conducted at multiple levels, including organisational processes within mining firms, inter-organisational relationships among supply chain actors and broader industry-level dynamics affecting supply chain performance. The constructs of interest include supply chain coordination, organisational capabilities, resource utilisation, information flows and operational efficiency within mining supply chain systems.

This study contributes to both theory and practice in several important ways. From a theoretical perspective, it advances supply chain management research by integrating multiple theoretical frameworks to explain inefficiencies in complex industrial supply chains. By linking unit-level theoretical constructs—such as transaction costs, resource capabilities and demand information flows—to broader programmatic theories of supply chain performance, the study contributes to a more comprehensive understanding of inefficiency in industrial supply chains. From a practical perspective, the findings are expected to inform the development of any quality service framework that can guide improvements in mining supply chain processes. Such improvements are critical for enhancing operational efficiency, strengthening global competitiveness and supporting sustainable economic development within the South African mining sector. The remainder of this article is structured as follows. The next section reviews the relevant literature on supply chain inefficiencies and develops the theoretical framework underpinning the study. This is followed by a description of the research methodology used to investigate the causes of supply chain inefficiencies in the mining sector. The subsequent section presents and analyses the empirical findings of the study. Finally, the article concludes by discussing the theoretical and practical implications of the findings and offering recommendations for improving supply chain efficiency in the South African mining industry.

## 2. Review of Literature

### 2.1. Introduction

Supply chain management (SCM) has emerged as a critical component of organisational competitiveness, particularly in industries characterised by complex production networks and high capital intensity. Modern supply chains integrate multiple organisational activities such as procurement, production planning, transportation, inventory management and distribution in order to ensure the efficient flow of goods, information and financial resources across value chains (Yalcin and Daim, 2022) <sup>[69]</sup>. As globalisation intensifies competition and expands international trade, organisations increasingly rely on efficient supply chain processes to reduce operational costs and enhance responsiveness to market demands. However, despite technological advancements and improved logistics systems, supply chain inefficiencies remain prevalent across many sectors, particularly in resource-based industries such as mining (Zeng *et al.*, 2021) <sup>[74]</sup>. These inefficiencies may manifest in the form of delays, inventory imbalances, coordination failures and increased operational costs, which ultimately undermine organisational performance and competitiveness. Consequently, scholars have devoted considerable attention to understanding the structural and operational factors that cause inefficiencies within supply chain systems. Understanding these causes is particularly important in developing economies where infrastructural limitations, regulatory complexities and organisational constraints often exacerbate supply chain challenges (Yaping and Bossman, 2021; Radebe and Chipangamate, 2024) <sup>[70, 56]</sup>.

Within the mining industry, supply chains are particularly complex due to the geographical dispersion of extraction sites, the need for specialised infrastructure and the involvement of multiple stakeholders across the production network. Mining supply chains typically involve several interconnected stages including exploration, extraction, processing, transportation and export of mineral commodities (Zeng *et al.*, 2021) <sup>[74]</sup>. Because these activities occur across different locations and organisational entities, efficient coordination among supply chain actors becomes essential for ensuring operational continuity and cost efficiency. Nevertheless, the mining industry continues to experience numerous operational disruptions arising from logistics constraints, technological limitations and governance challenges (Kerfati, Azzamouri and Azzamouri, 2025) <sup>[30]</sup>. In developing economies such as South Africa, these challenges are further intensified by infrastructural bottlenecks, policy uncertainties and fluctuating global commodity markets (Ngcobo, Mafini and Okoumba, 2022; Radebe and Chipangamate, 2024) <sup>[48, 56]</sup>. As a result, inefficiencies within mining supply chains can significantly affect production performance, export competitiveness and national economic growth. Against this background, it becomes necessary to examine the specific causes of supply chain inefficiencies within the mining sector. This literature review therefore explores existing scholarly contributions on supply chain inefficiencies, with particular emphasis on the factors that contribute to inefficiency in mining supply chain processes.

### 2.2. Empirical Literature Review

#### 2.2.1. Supply Chain Complexity and Structural Inefficiencies

Supply chain complexity has been widely recognised as a major contributor to inefficiencies within industrial

operations. Complex supply chains typically involve multiple stakeholders, geographically dispersed operations and interdependent logistical activities that must be carefully coordinated to ensure efficient production and distribution processes (Zeng *et al.*, 2021) <sup>[74]</sup>. When coordination among these actors becomes fragmented, delays and operational bottlenecks often emerge, ultimately reducing supply chain efficiency (Kerfati, Azzamouri and Azzamouri, 2025) <sup>[30]</sup>. Scholars have argued that the mining industry is particularly vulnerable to these structural challenges because of its reliance on remote extraction sites, heavy equipment and extensive transportation networks (Radebe and Chipangamate, 2024) <sup>[56]</sup>. For example, the transportation of minerals from mines to processing facilities and export terminals often involves rail systems, ports and road networks that must function synchronously. Any disruption within one component of this logistics network can create cascading inefficiencies throughout the supply chain (Arabi and Gholamian, 2023) <sup>[5]</sup>.

Furthermore, the complexity of mining supply chains is intensified by the need to coordinate various operational processes simultaneously. According to Haonan *et al.* (2021) <sup>[26]</sup>, mining supply chains involve sophisticated scheduling and blending processes in which raw materials from different extraction sites must be combined to meet specific quality standards. These operations require advanced planning systems and efficient information flows to ensure that production schedules align with transportation and distribution activities. However, when information systems are poorly integrated, organisations often experience scheduling conflicts, inventory imbalances and delayed deliveries (Mukha, 2025) <sup>[45]</sup>. Such inefficiencies will obviously lead to increased operational costs and reduced customer satisfaction. Consequently, managing supply chain complexity remains a significant challenge for mining firms seeking to improve operational performance. Addressing structural inefficiencies therefore requires improved coordination mechanisms and integrated logistics systems capable of synchronising activities across the entire mining value chain.

#### 2.2.2. Logistics and Infrastructure Constraints in Mining Supply Chains

Infrastructure limitations represent another significant cause of inefficiency in mining supply chains, particularly in developing economies. Effective supply chain operations obviously depend heavily on reliable transportation networks that enable the movement of raw materials and finished products across long distances. However, inadequate infrastructure often creates significant bottlenecks that disrupt supply chain processes. Yaping and Bossman (2021) <sup>[70]</sup> found that mining operations in developing countries frequently encounter logistical challenges such as poor road networks, port congestion and unreliable transportation systems. These infrastructural deficiencies increase transportation costs and lead to unpredictable delivery schedules, thereby reducing supply chain efficiency (Radebe and Chipangamate, 2024) <sup>[56]</sup>.

Similarly, transportation infrastructure plays a critical role in determining the competitiveness of mining industries operating in global markets. The mining sector typically relies on bulk transportation systems such as railways and ports to export mineral commodities to international markets. When these systems experience congestion or capacity

constraints, mining firms often struggle to meet export commitments and maintain stable production levels. Arabi and Gholamian (2023) <sup>[5]</sup> further emphasise that transportation costs constitute one of the most significant cost components in mining supply chains. Consequently, inefficiencies within transportation networks can substantially affect the profitability of mining operations (Fattahi, Mosadegh and Hasani, 2021) <sup>[22]</sup>. These findings suggest that infrastructure development and logistics optimisation are essential for improving supply chain efficiency in mining industries. Without adequate infrastructure and reliable logistics networks, mining firms may continue to face persistent operational disruptions and increased supply chain costs.

### 2.2.3. Inventory Management and Production Scheduling Challenges

Inventory management represents another critical factor influencing supply chain efficiency within the mining sector. Efficient inventory systems enable organisations to balance supply and demand while minimising storage costs and avoiding production disruptions. However, ineffective inventory control practices often and obviously result in either excess inventory or shortages of critical materials, both of which contribute to operational inefficiencies. Mawonde *et al.* (2024) <sup>[41]</sup> emphasise that mining firms frequently encounter difficulties in managing inventory levels due to fluctuating demand for mineral commodities and uncertainties in production processes. When inventory management systems are poorly implemented, firms may experience delays in accessing essential spare parts or raw materials required for mining operations (Zeng *et al.*, 2021) <sup>[74]</sup>.

In addition, production scheduling within mining supply chains is often complicated by the variability of resource availability and operational constraints. Thiruvady *et al.* (2024) <sup>[64]</sup> note that mining operations typically involve complex resource-constrained scheduling problems in which equipment availability, labour resources and transportation capacity must be carefully coordinated. When these resources are not allocated efficiently, production delays and operational bottlenecks can occur (Haonan *et al.*, 2021) <sup>[26]</sup>. Such inefficiencies may also lead to increased operational costs and reduced productivity within mining firms. Moreover, the uncertainty associated with resource availability further complicates scheduling decisions, making it difficult for managers to optimise production processes (Arief *et al.*, 2025) <sup>[6]</sup>. Therefore, implementing advanced inventory management systems and optimisation models is essential for improving operational efficiency in mining supply chains. These systems can enhance decision-making by providing accurate information about inventory levels, production schedules and resource allocation.

### 2.2.4. Supplier Relationships and Procurement Inefficiencies

Supplier relationships and procurement processes also play a crucial role in determining the efficiency of supply chain operations within the mining sector. Mining companies depend heavily on suppliers for essential equipment, spare parts, raw materials and specialised services required for extraction and processing activities. However, ineffective supplier selection processes and weak supplier relationships obviously significantly undermine supply chain performance.

Becerra and Diaz (2025) argue that supplier selection is a strategic decision that influences supply chain resilience, sustainability and operational efficiency. When firms fail to consider factors such as supplier reliability, environmental performance and risk management capabilities, supply chain disruptions may occur (Radebe and Chipangamate, 2024). Moreover, procurement inefficiencies may arise when organisations rely on a limited number of suppliers or when supplier evaluation processes are inadequately structured. Such situations increase the vulnerability of supply chains to supply disruptions, particularly during periods of market volatility or geopolitical uncertainty (Kerfati, Azzamouri and Azzamouri, 2025). Research also suggests that incorporating sustainability and resilience criteria into supplier selection can enhance supply chain stability and reduce operational risks (Becerra and Diaz, 2025). In addition, strong collaboration between supply chain partners can improve information sharing and coordination across the supply chain network. Nguyen, Mac and Hoang (2025) further highlight that supply chain collaboration has become increasingly important for improving operational performance and promoting sustainable supply chain practices. Therefore, strengthening supplier relationships and implementing robust procurement strategies are essential for reducing inefficiencies in mining supply chains.

### 2.2.5. Technological and Digital Transformation Challenges

Technological limitations and digital transformation challenges represent another major source of inefficiency within modern supply chains. Advances in digital technologies such as artificial intelligence, blockchain and Internet of Things have significantly transformed supply chain operations by enabling real-time information sharing and data-driven decision-making (Yalcin and Daim, 2022) <sup>[69]</sup>. However, many organisations in resource-intensive industries have been slow to adopt these technologies due to financial constraints, organisational resistance and limited technical expertise (Mukha, 2025) <sup>[45]</sup>. As a result, supply chain processes often remain fragmented and poorly coordinated, leading to inefficiencies in logistics and production planning (Nguyen, Mac and Hoang, 2025) <sup>[49]</sup>. Mukha (2025) <sup>[45]</sup> argues that digital technologies such as process mining can significantly improve supply chain transparency and operational performance by enabling organisations to analyse real-time operational data. However, implementing such technologies requires strong data governance systems and organisational capabilities. In many cases, organisations face challenges related to poor data quality, lack of integration between enterprise systems and limited digital skills among employees. These barriers often prevent firms from fully leveraging the benefits of digital transformation within their supply chains (Yalcin and Daim, 2022) <sup>[69]</sup>. Consequently, technological limitations continue to hinder the efficiency of supply chain operations in many industries. Addressing these challenges requires strategic investment in digital infrastructure, employee training and organisational change management.

### 2.2.6. Sustainability and Environmental Management Challenges

Sustainability concerns have become increasingly central to supply chain management, particularly in environmentally sensitive industries such as mining. Mining operations are

associated with significant environmental impacts, including waste generation, greenhouse gas emissions and land degradation (Fattahi, Mosadegh and Hasani, 2021) <sup>[21]</sup>. Consequently, organisations face growing pressure from regulators, communities and international markets to adopt sustainable supply chain practices. Ngcobo, Mafini and Okoumba (2022) <sup>[38]</sup> highlight that green supply chain management (GSCM) has emerged as a key strategy for enhancing both environmental performance and operational efficiency in the mining sector. By incorporating environmental considerations into procurement, production and logistics processes, organisations can reduce waste, optimise resource utilisation and support sustainable development objectives.

However, implementing sustainable supply chain practices presents significant challenges for mining firms. Ngcobo, Mabotja and Chinomona (2025) <sup>[40]</sup> emphasise that effective GSCM implementation requires strong organisational commitment, employee engagement and coordinated action among supply chain partners. In the absence of these capabilities, sustainability initiatives may fail to yield meaningful operational improvements. Additionally, transitioning to sustainable supply chain practices often entails substantial investments in new technologies, infrastructure and training, which can be financially challenging for some mining firms (Kerfati, Azzamouri and Azzamouri, 2025) <sup>[30]</sup>. As a result, the move toward sustainable supply chain management is inherently complex and may initially generate operational inefficiencies before long-term benefits are realised. Addressing these challenges requires strategic planning, robust organisational capabilities and collaborative engagement across the entire supply chain network.

### 2.3. Theoretical Framework

This study adopts an integrated theoretical framework that combines multiple complementary perspectives to explain supply chain inefficiencies in the mining sector. Transaction Cost Economics (TCE) provides insight into how coordination failures and governance challenges between supply chain actors can generate operational inefficiencies (Coase, 2012; Williamson, 1975; Williamson, 1985). TCE posits that organisations design governance structures to minimise transaction costs associated with negotiating, monitoring, and enforcing contractual agreements. When governance mechanisms are poorly aligned with the nature of transactions, opportunistic behaviour and coordination

breakdowns may occur, resulting in delays, higher operational costs, and disrupted supply chain performance. In mining, where firms rely heavily on logistics providers and equipment suppliers, such governance failures can significantly impede operations.

The Resource-Based View (RBV) complements TCE by emphasising the internal resources and capabilities that firms deploy to achieve competitive advantage (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993). Within supply chains, strategic resources may include advanced logistics infrastructure, skilled personnel, and digital information systems (Mukha, 2025). When these resources are underdeveloped or poorly utilised, inefficiencies can arise. RBV's static nature, however, limits its explanatory power in rapidly changing environments. To address this, Dynamic Capabilities Theory highlights the importance of an organisation's ability to adapt and reconfigure resources in response to environmental shifts, such as fluctuating commodity prices, regulatory changes, or technological innovations (Teece, Pisano and Shuen, 1997; Teece, 2007; Eisenhardt and Martin, 2017).

Beyond organisational resources and capabilities, supply chain performance is shaped by systemic interdependencies among actors. Systems Theory conceptualises supply chains as interconnected networks where the performance of one component affects the entire system (Bertalanffy, 1968; Ackoff, 1971; Boulding, 1956). Weak coordination or fragmented information flows within the network can lead to operational inefficiencies (Zeng *et al.*, 2021). Complementing this, the Bullwhip Effect Theory explains how small fluctuations in demand can amplify upstream through the supply chain, causing excessive inventory or production shortages (Forrester, 1961; Lee, Padmanabhan and Whang, 1997).

Collectively, these theoretical perspectives offer a multi-level framework for analysing supply chain inefficiencies in the South African mining sector, integrating institutional, organisational, operational, and systemic factors. This approach provides a robust foundation for understanding the underlying causes of inefficiency and for designing interventions to improve supply chain performance.

### 2.4. Conceptual Framework

The conceptual framework for this study is derived from the integrated theoretical perspectives discussed above and focuses on the relationships between key factors influencing supply chain efficiency. The figure illustrates this relationship.

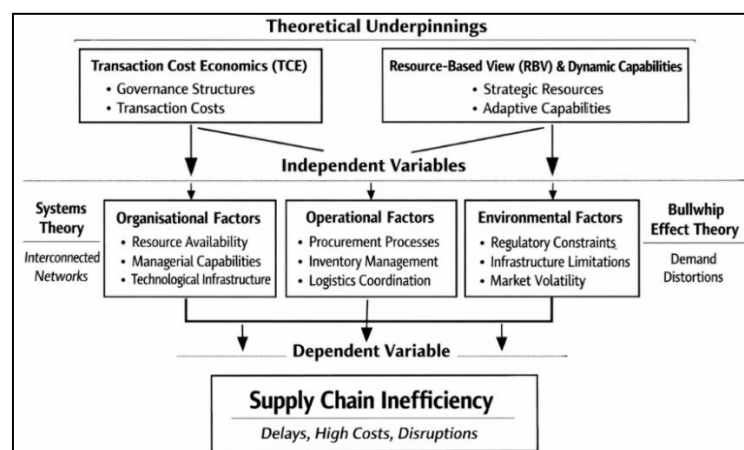


Fig 1: Conceptual Framework

Figure 1 presents a conceptual framework for analysing supply chain inefficiencies in the South African mining sector. At the top of the diagram are the two main theoretical underpinnings, namely Transaction Cost Economics (TCE) (Williamson, 1975; Williamson, 1985) <sup>[66, 67]</sup> and the Resource-Based View (RBV) (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) <sup>[65, 8, 53]</sup> combined with Dynamic Capabilities (Teece *et al.*, 1997; Teece, 2007; Eisenhardt and Martin, 2017) <sup>[63, 62, 20]</sup>. TCE contributes components such as governance structures and transaction costs, while RBV and Dynamic Capabilities contribute strategic resources and adaptive capabilities. These theories feed into the independent variables, which are grouped into organisational factors, operational factors, and environmental factors. The framework conceptualises supply chain inefficiency as the dependent variable, while organisational, operational and environmental factors constitute the independent variables influencing supply chain performance. Organisational factors include resource availability, managerial capabilities and technological infrastructure within mining firms (Mukha, 2025) <sup>[45]</sup>. Operational factors include procurement processes, inventory management systems and logistics coordination mechanisms (Mawonde *et al.*, 2024; Becerra and Diaz, 2025) <sup>[41, 10]</sup>. Environmental factors encompass external influences such as infrastructure constraints, regulatory policies and market volatility that affect supply chain operations (Yaping and Bossman, 2021; Radebe and Chipangamate, 2024) <sup>[70, 56]</sup>. The framework also acknowledges supporting perspectives from Systems Theory (Bertalanffy, 1968; Boulding, 1956; Ackoff, 1971) <sup>[12, 13, 1]</sup> (interconnected networks) and the Bullwhip Effect Theory (Lee *et al.*, 1997; Lee *et al.*, 1997) <sup>[32, 33]</sup> (demand distortions). Arrows illustrate how these independent variables influence the dependent variable, which is supply chain inefficiency, manifested through delays, high operational costs, and disruptions. By examining these relationships within the context of the South African mining sector, this study seeks to provide empirical insights into the underlying causes of supply chain inefficiencies and contribute to the development of strategies for improving supply chain performance.

## 2.5. Synthesis of Literature and Identified Gap

The reviewed literature highlights several factors that contribute to inefficiencies within supply chain processes across industries. Key causes identified in previous studies include supply chain complexity, infrastructure limitations, inventory management challenges, procurement inefficiencies, technological constraints and sustainability pressures (Zeng *et al.*, 2021; Yaping and Bossman, 2021; Mawonde *et al.*, 2024; Becerra and Diaz, 2025; Mukha, 2025; Ngcobo, Mafini and Okoumba, 2022) <sup>[74, 70, 41, 10, 45, 48]</sup>. These factors often interact with one another, creating systemic inefficiencies that affect operational performance and organisational competitiveness. For instance, inadequate infrastructure may exacerbate logistical delays, while weak information systems may hinder effective coordination among supply chain partners (Radebe and Chipangamate, 2024) <sup>[56]</sup>. Furthermore, the literature emphasises the importance of organisational capabilities, technological innovation and collaborative relationships in improving supply chain efficiency (Nguyen, Mac and Hoang, 2025) <sup>[49]</sup>. These findings suggest that supply chain inefficiencies cannot be attributed to a single factor but rather emerge from complex interactions among organisational, technological

and environmental variables.

A cross-study comparison of the reviewed literature reveals that while scholars broadly agree on the existence of structural inefficiencies in supply chains, they emphasise different explanatory mechanisms depending on the analytical perspective adopted. For example, studies focusing on operational logistics highlight infrastructure and transportation constraints as primary causes of inefficiency (Yaping and Bossman, 2021; Arabi and Gholamian, 2023) <sup>[70, 5]</sup>. In contrast, research grounded in organisational and managerial perspectives emphasises internal process inefficiencies such as poor inventory management systems, ineffective supplier relationships and limited organisational capabilities (Mawonde *et al.*, 2024; Becerra and Diaz, 2025) <sup>[41, 10]</sup>. Similarly, technology-oriented studies stress the importance of digital transformation and integrated information systems for improving supply chain visibility and coordination (Mukha, 2025; Yalcin and Daim, 2022) <sup>[45, 69]</sup>. From a sustainability perspective, scholars argue that environmental management and green supply chain practices introduce additional operational complexities but may simultaneously enhance long-term supply chain resilience and efficiency (Ngcobo, Mafini and Okoumba, 2022; Ngcobo, Mabotja and Chinomona, 2025) <sup>[48, 47]</sup>. This divergence of perspectives suggests that supply chain inefficiencies in mining are multidimensional phenomena influenced by both internal organisational dynamics and external environmental conditions.

The literature also reveals important theoretical implications when examined through the lens of established supply chain and organisational theories. From the perspective of Transaction Cost Economics, inefficiencies may arise when governance structures and contractual relationships between supply chain actors fail to minimise transaction costs associated with coordination, monitoring and information exchange (Williamson, 1975; Williamson, 1985) <sup>[66, 67]</sup>. In mining supply chains, where firms depend on multiple logistics providers, contractors and equipment suppliers, weak governance mechanisms may increase coordination costs and create operational delays. The Resource-Based View provides an alternative explanation by emphasising the role of firm-specific capabilities, suggesting that supply chain inefficiencies may emerge when organisations lack strategic resources such as advanced logistics infrastructure, skilled human capital and digital information systems required for efficient supply chain management (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) <sup>[65, 8, 53]</sup>. Complementing this perspective, Dynamic Capabilities Theory highlights the importance of organisational adaptability in responding to rapidly changing market conditions, technological disruptions and regulatory requirements that characterise the mining sector (Teece *et al.*, 1997; Teece, 2007; Eisenhardt and Martin, 2017) <sup>[63, 62, 20]</sup>.

Systems Theory further reinforces the argument that mining supply chains should be understood as interconnected networks rather than isolated operational functions (Bertalanffy, 1968; Boulding, 1956; Ackoff, 1971) <sup>[12, 13, 1]</sup>. According to this perspective, inefficiencies within one component of the supply chain—such as transportation infrastructure, inventory management or supplier coordination—can propagate across the entire network and create systemic performance problems. This systemic interdependence explains why isolated operational improvements often fail to produce significant efficiency

gains unless coordination across the entire supply chain network is simultaneously improved. Finally, Bullwhip Effect Theory provides additional insight into how information distortions and demand variability across supply chain stages may amplify operational inefficiencies (Lee *et al.*, 1997; Lee *et al.*, 1997) <sup>[32, 33]</sup>. In mining supply chains, fluctuations in global commodity demand and inaccurate demand forecasting may lead to excessive inventory accumulation, production instability and logistical bottlenecks. Together, these theoretical perspectives demonstrate that supply chain inefficiencies are not merely operational problems but are deeply embedded within broader organisational, institutional and systemic dynamics. Despite the extensive research on supply chain management, several gaps remain in the existing literature. First, much of the empirical research has focused on manufacturing and service industries, while comparatively fewer studies have examined supply chain inefficiencies within the mining sector (Hu, Wang and Elshkaki, 2024; Osei *et al.*, 2023) <sup>[28, 52]</sup>. Second, existing studies often analyse individual aspects of supply chain performance, such as logistics or procurement, without adopting a holistic perspective that considers the interconnected nature of mining supply chains (Zeng *et al.*, 2021) <sup>[74]</sup>. Third, there is limited empirical research that integrates multiple theoretical perspectives to explain the systemic causes of supply chain inefficiencies in mining industries, particularly in developing economies such as South Africa (Radebe and Chipangamate, 2024) <sup>[56]</sup>. In addition, most empirical studies in the mining sector have focused on specific operational components such as logistics optimisation, inventory control systems or sustainable supply chain practices, often treating these elements as independent determinants of supply chain performance. While these studies provide valuable insights, they rarely examine how organisational capabilities, governance structures, technological systems and external environmental constraints interact simultaneously to influence supply chain efficiency. As a result, the existing literature lacks an integrated analytical framework capable of explaining the multidimensional nature of supply chain inefficiencies within complex industrial contexts such as mining. Furthermore, there is a limited body of research that empirically investigates supply chain inefficiencies within the context of the South African mining sector, despite its strategic importance to the national economy and its exposure to infrastructural constraints, regulatory uncertainties and global commodity market volatility. Addressing this empirical gap is particularly important because supply chain challenges in emerging economies often differ significantly from those observed in developed industrial contexts. Consequently, there is a need for comprehensive research that examines the organisational, operational and systemic factors contributing to supply chain inefficiencies within the South African mining sector. Such research should adopt an integrated theoretical perspective capable of capturing the complex interactions between organisational resources, governance structures, technological capabilities and external environmental conditions that collectively shape supply chain performance. This study addresses this gap by exploring the causes of inefficiency in supply chain processes using an integrated theoretical framework and empirical insights from the mining industry.

### 3. Research Methodology

#### 3.1. Research Design and Philosophical Orientation

This study adopted an interpretivist qualitative research design to examine the causes of inefficiency in supply chain (SC) processes within the South African mining sector. A research design provides the strategic framework that guides the entire research process, including data collection, analysis and interpretation (Huntington-Klein, 2021; Reddy and Pulluru, 2024) <sup>[29, 58]</sup>. In this study, the research design was structured to align philosophical assumptions, theoretical perspectives and methodological procedures with the central research question: What are the causes of inefficiency in the supply chain processes in the South African mining sector? Supply chain practices in mining organisations are not merely technical processes but socially embedded activities shaped by organisational relationships, institutional constraints and operational contexts (Clarke, 2024; Piotrowicz, Ryciuk and Szymczak, 2023) <sup>[17, 54]</sup>. Consequently, understanding inefficiencies requires examining the experiences and interpretations of practitioners directly involved in supply chain activities. Drawing on Mouton's (1996) three-world framework (Mouton, 1996) <sup>[44]</sup>, the study ensured coherence between ontology, epistemology and methodological choices. This philosophical alignment enabled a systematic exploration of the organisational and systemic factors that influence supply chain inefficiency in the mining sector. The study was grounded in relativist ontology, interpretivist epistemology and reflexive axiology, which collectively informed the methodological orientation of the research. Relativist ontology assumes that organisational realities are socially constructed and may vary across contexts and stakeholder perspectives (Mbanaso, Abrahams and Okafor, 2023) <sup>[42]</sup>. In the context of mining supply chains, inefficiencies emerge through complex interactions among organisational actors, infrastructure systems and regulatory environments. Correspondingly, an interpretivist epistemology was adopted to emphasise knowledge generation through understanding the subjective experiences and interpretations of participants rather than through purely objective measurement (Bell, Harley and Bryman, 2022) <sup>[11]</sup>. Positivist approaches are often suitable for testing causal relationships, but they are less effective for investigating organisational processes embedded in complex institutional contexts. Interpretivism therefore provided an appropriate lens for examining how supply chain practitioners perceive and explain inefficiencies within mining supply chains (Piotrowicz *et al.*, 2023) <sup>[54]</sup>. From an axiological perspective, the researcher acknowledged the influence of professional knowledge in supply chain contexts while applying reflexive strategies to minimise bias during interpretation (Klakegg and Tvedt, 2024) <sup>[31]</sup>.

#### 3.2. Research Approach and Strategy

A qualitative deductive research approach was employed to guide the investigation of supply chain inefficiencies in the mining sector. Deductive reasoning involves starting with theoretical propositions and examining empirical evidence to assess their explanatory relevance (Casula, Rangarajan and Shields, 2021; Qerimi *et al.*, 2023) <sup>[14, 55]</sup>. In this study, theoretical insights derived from Transaction Cost Economics, Resource-Based View, Dynamic Capabilities Theory, Systems Theory and Bullwhip Effect Theory

informed the analytical lens used to interpret supply chain inefficiencies. These theories highlight how governance structures, organisational resources, coordination mechanisms and information flows influence supply chain performance (Williamson, 1985; Barney, 1991; Teece, Pisano and Shuen, 1997) <sup>[67, 8, 63]</sup>. The deductive approach therefore allowed the researcher to examine empirical observations within an established theoretical framework. In addition, this approach supported the systematic interpretation of organisational and operational factors affecting supply chain processes. By linking theory and empirical insights, the study contributes to the broader discourse on supply chain management within resource-based industries.

An exploratory research strategy was adopted because limited empirical evidence exists on the systemic causes of supply chain inefficiencies in the South African mining sector. Exploratory research aims to generate insights and deepen understanding of phenomena that are not yet fully understood (Badke, 2021) <sup>[7]</sup>. Mining supply chains operate within complex networks that include suppliers, logistics providers, regulatory institutions and international markets. As a result, inefficiencies may arise from multiple interacting factors that require contextual investigation. As such, the primary aim of the study was to uncover organisational and systemic constraints affecting supply chain performance. The exploratory strategy therefore allowed flexibility in examining emerging themes and patterns within the data. This methodological choice is consistent with previous supply chain studies that explore complex operational environments through qualitative inquiry (Wincewicz-Bosy *et al.*, 2021) <sup>[68]</sup>.

A cross-sectional time horizon was used to capture a snapshot of supply chain processes and their associated challenges within the mining sector. Cross-sectional research involves collecting data at a single point in time to analyse current conditions or relationships among variables (Maier, Thatcher, Grover and Dwivedi, 2023) <sup>[39]</sup>. In this study, data collection occurred over a two-month period during which participants shared their experiences and perceptions of supply chain operations. This approach enabled the researcher to capture contemporary insights into supply chain inefficiencies across multiple mining organisations. Cross-sectional designs are commonly used in organisational research where the objective is to examine existing practices rather than long-term changes. The time horizon therefore provided an appropriate methodological framework for exploring the current status of supply chain processes in the mining sector. Furthermore, the approach allowed the study to generate relevant insights for improving operational efficiency and competitiveness.

### 3.3. Sampling Strategy and Participants

The study population consisted of professionals involved in supply chain functions within mining organisations in South Africa. The target population specifically focused on senior managers responsible for procurement, logistics and materials management, as these individuals possess direct knowledge of supply chain operations and decision-making processes (Saunders *et al.*, 2019; Rahman, 2023) <sup>[60, 57]</sup>. Certainly, supply chain inefficiencies often emerge from operational coordination challenges, supplier relationships and infrastructure constraints, which are typically overseen by senior management.

Therefore, engaging experienced practitioners provided valuable insights into the organisational and systemic factors influencing supply chain performance. The study selected participants from mining organisations operating across key mineral sectors including platinum, chrome, coal, iron ore, diamond, gold, salt and manganese. These sectors collectively represent a significant portion of South Africa's mineral economy and contribute substantially to national economic development (Leighton, 2024; Hirlekar, Kolte and Vasa, 2025) <sup>[34, 27]</sup>. By focusing on diverse mineral sectors, the study captured a broad representation of supply chain practices within the industry.

A purposive non-probability sampling technique was used to identify information-rich participants capable of providing relevant insights into supply chain inefficiencies. Purposive sampling involves deliberately selecting participants based on their expertise, experience or knowledge of the research topic (Etikan and Bala, 2017) <sup>[21]</sup>. This approach is widely used in qualitative research where the objective is to obtain detailed contextual understanding rather than statistical generalisation. In the present study, sixteen mining organisations were selected as the primary units of analysis, representing different mineral sectors and geographical locations within South Africa. From each organisation, one supply chain manager was selected as the primary unit of observation due to their managerial responsibility for procurement and logistics operations. In addition, fifteen supply chain practitioners from other related downstream sectors were included to produce insights into supply chain practices across related industries. The final sample therefore consisted of 31 participants, enabling a robust qualitative exploration of supply chain inefficiencies within the mining sector.

### 3.4. Data Collection

Data were collected using semi-structured open-ended interview questionnaires, which allowed the researcher to obtain consistent yet flexible responses from participants. Semi-structured interviews are widely used in qualitative research because they provide a balance between structured guidance and open-ended exploration (Saunders *et al.*, 2019) <sup>[60]</sup>. In this study, the interview instrument focused on organisational, operational and environmental factors affecting supply chain processes. Participants were senior managers with at least five years of professional experience in supply chain-related roles, ensuring that responses reflected informed and practical insights. Prior to data collection, the objectives of the study were clearly explained to participants to ensure transparency and voluntary participation. Written consent was obtained from all respondents before the interviews were conducted. Interviews were arranged at times convenient to participants and were conducted primarily through scheduled engagements and electronic correspondence. This approach facilitated candid discussion while accommodating the professional commitments of senior practitioners.

### 3.5. Data Analysis

Qualitative data were analysed using Braun and Clarke's thematic analysis, supported by ATLAS.ti version 25 software (Clarke and Braun, 2017) <sup>[18]</sup>. Thematic analysis provides a systematic method for identifying patterns and themes within qualitative datasets (Christou, 2022) <sup>[16]</sup>. The

analysis followed six iterative stages: data familiarisation, initial coding, theme identification, theme review, theme definition and final reporting (Clarke and Braun, 2017; Salmona and Kaczynski, 2024) <sup>[18, 59]</sup>. During the coding process, relevant text segments were labelled to summarise the meaning of participant responses. Axial coding within ATLAS.ti was then used to group related codes and identify broader analytical patterns across the dataset (Lochmiller, 2021) <sup>[36]</sup>. These patterns were subsequently organised into themes that captured key dimensions of supply chain inefficiencies in the mining sector. The final themes were evaluated against the study's research question to ensure analytical coherence. The use of qualitative analysis software enhanced transparency, consistency and traceability throughout the analytical process.

### 3.6. Pilot Study and Trustworthiness

A pilot study involving five participants was conducted prior to the main data collection phase. Pilot testing is an important methodological step that helps identify ambiguities in research instruments and ensures that interview questions are clear and relevant (Seth, Gupta and Singh, 2022) <sup>[61]</sup>. Participants in the pilot study met the same criteria as those selected for the main study, thereby ensuring comparability. Feedback from the pilot study allowed the researcher to refine the wording and sequencing of questions to improve clarity. This process also helped ensure that the interview questions generated meaningful and detailed responses from participants. Minor adjustments were subsequently made to the questionnaire to enhance its effectiveness. Conducting the pilot study therefore strengthened the methodological rigour of the research.

The study further ensured methodological rigour through the application of trustworthiness criteria, including credibility, confirmability, transferability and dependability (Saunders *et al.*, 2019) <sup>[60]</sup>. Credibility was enhanced by engaging experienced supply chain managers who possess direct operational knowledge of mining supply chains. Confirmability was ensured through systematic documentation and coding of data to minimise researcher bias. Transferability was addressed by providing detailed contextual descriptions of the research setting and participants, enabling readers to assess the applicability of findings to similar contexts. Dependability was ensured through transparent reporting of methodological procedures and data analysis processes (Hammerton and Munafò, 2021) <sup>[24]</sup>. Together, these strategies strengthened the reliability and validity of the research findings.

### 3.7. Ethical Considerations

Ethical integrity was a central consideration throughout the research process. Ethical clearance for the study was obtained from the UNISA Research Ethics Committee prior to data collection. Participation in the study was voluntary, and informed consent was obtained from all participants after the purpose and procedures of the research were clearly explained (Millum and Bromwich, 2021) <sup>[43]</sup>. Participants were assured that their identities and organisational affiliations would remain confidential. All responses were reported in aggregated form to prevent identification of individuals or organisations. In addition, participants were informed that they could withdraw from the study at any time without consequence.

These ethical safeguards ensured compliance with institutional research standards and protected the rights and interests of all participants (Lokot, 2021) <sup>[37]</sup>.

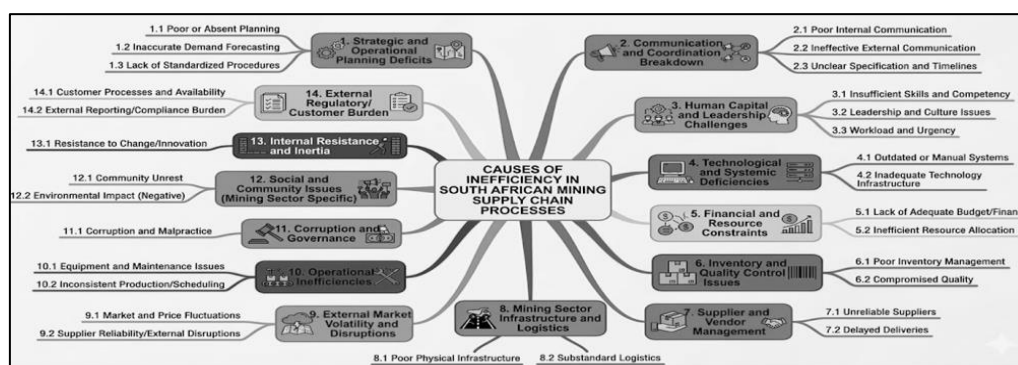
## 4. Presentation of Results

### 4.1. Introduction

The narratives show that the inefficiency in Supply Chain (SC) processes in the South African mining sector is influenced by multiple, interconnected factors. Building on the research problem presented in the introductory section, this section presents the empirical results aimed at comprehending the causes of inefficiency of SC processes in the South African mining sector. From the revised code list, patterns were identified through related codes. The findings from the semi-structured interviews are reported based on the research question and thematically organised. All 31 interviews were fully transcribed and analysed, and data saturation was achieved when no additional codes, themes, or subthemes were identified in later interviews.

### 4.2. Causes of the Inefficiency in the Supply Chain Processes in the South African Mining Sector

The narratives show that causes of SC inefficiency in South Africa's mining sector are multidimensional, spanning internal organisational weaknesses, external infrastructural challenges, and environmental constraints. The analysis of the research question, "*What are the Causes of Inefficiency in the Supply Chain Processes in South Africa in the Mining Sector?*" identified fourteen key themes and subthemes, offering a vivid account of the barriers to successful supply-chain processes. The obtained results point to the key areas of concern, as identified by the participants of the study. Figure 1 depicts themes and subthemes on the causes of Inefficiency in the Supply Chain Processes in South African Mining Sector



Source: Interview data

**Fig 2:** Theme and Subthemes on the causes of Inefficiency in the Supply Chain Processes in South African Mining Sector?

The themes, developed from qualitative data, suggest a complex network of challenges. To illustrate these relationships, Table 1 presents the network analysis from

ATLAS.ti, outlining how the 14 themes connect within the context of SC inefficiency in South Africa's mining sector.

**Table 1:** Network Analysis on the Causes of Inefficiency in the Supply Chain Processes in South African Mining Sector

| Theme A (Cause)                               | Linking Word                      | Theme B (Effect)                              | Context for Relationship                                                                      |
|-----------------------------------------------|-----------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1 Strategic and Operational Planning Deficits | Leads to                          | 10 Operational Inefficiencies                 | Poor planning is a direct cause of inefficiency.                                              |
| 1 Strategic and Operational Planning Deficits | Exacerbates                       | 3 Human Capital and Leadership Challenges     | Lack of direction can demotivate staff and expose leadership weaknesses.                      |
| 2 Communication and Coordination Breakdown    | Directly Impacts                  | 10 Operational Inefficiencies                 | Poor communication slows down processes and leads to errors.                                  |
| 2 Communication and Coordination Breakdown    | Often Co-exists with              | 13 Internal Resistance and Inertia            | Lack of clear communication can breed mistrust and resistance.                                |
| 3 Human Capital and Leadership Challenges     | Contributes to                    | 1 Strategic and Operational Planning Deficits | Ineffective leadership or lack of skilled personnel weakens planning.                         |
| 3 Human Capital and Leadership Challenges     | Is a Root Cause of                | 2 Inventory and Quality Control Issues        | Lack of trained staff and oversight directly affects quality and inventory management.        |
| 4 Technological and Systemic Deficiencies     | Causes/Amplifies                  | 10 Operational Inefficiencies                 | Outdated technology or faulty systems create bottlenecks and inefficiency.                    |
| 4 Technological and Systemic Deficiencies     | Makes Difficult                   | 2 Communication and Coordination Breakdown    | Systems that don't talk to each other hinder effective coordination.                          |
| 5 Financial and Resource Constraints          | Limits Investment in              | 4 Technological and Systemic Deficiencies     | Lack of funds prevents necessary tech upgrades.                                               |
| 5 Financial and Resource Constraints          | Worsens                           | 3 Human Capital and Leadership Challenges     | Inability to hire or retain top talent due to salary/resource limitations.                    |
| 6 Inventory and Quality Control Issues        | Are Affected by                   | 7 Supplier and Vendor Management              | Poor quality or delayed inventory is often traceable to suppliers.                            |
| 7 Supplier and Vendor Management              | Is Governed by                    | 11 Corruption and Governance                  | Corrupt practices often manifest in supplier/vendor selection and contracts.                  |
| 8 Mining Sector Infrastructure and Logistics  | Are a Major Constraint on         | 10 Operational Inefficiencies                 | Poor roads, energy supply, or logistics infrastructure directly impede operations.            |
| 9 External Market Volatility and Disruptions  | Necessitates Better               | 1 Strategic and Operational Planning Deficits | Planning must account for external shocks.                                                    |
| 9 External Market Volatility and Disruptions  | Exposes/Magnifies                 | 5 Financial and Resource Constraints          | Market shocks place immense pressure on already strained finances.                            |
| 10 Operational Inefficiencies                 | Are Exacerbated by                | 8 Mining Sector Infrastructure and Logistics  | Infrastructural bottlenecks amplify operational problems.                                     |
| 11 Corruption and Governance                  | Is a Root Cause of                | 5 Financial and Resource Constraints          | Corruption diverts resources and leads to financial mismanagement.                            |
| 11 Corruption and Governance                  | Undermines                        | 14 External Regulatory/Customer Burden        | Weak governance can lead to non-compliance, inviting stricter regulation.                     |
| 12 Social and Community Issues                | (Mining Sector Specific) Leads to | 10 Operational Inefficiencies                 | Community unrest, strikes, or conflict can shut down/disrupt operations.                      |
| 12 Social and Community Issues                | Are Partially Caused by           | 11 Corruption and Governance                  | Lack of accountability or inequitable resource distribution fuels social issues.              |
| 13 Internal Resistance and Inertia            | Hinders Success of                | 1 Strategic and Operational Planning Deficits | Resistance from employees/management makes implementing plans difficult.                      |
| 14 External Regulatory/Customer Burden        | Requires                          | 2 Communication and Coordination Breakdown    | Compliance with external rules requires coordinated efforts and clear internal communication. |

**Source:** Interview Data (adapted from Atlas ti Network diagram)

The narratives show that Operational Inefficiencies (10) act as the central effect, while Strategic and Operational Planning Deficits (1) and Human Capital and Leadership Challenges (3) are primary drivers. External factors, including market volatility (9) and infrastructural deficits (8), as well as governance issues (11), amplify these internal challenges. Communication and systemic technology failures also exacerbate operational inefficiency. The results indicate that inefficiency arises from a combination of systemic, structural, and contextual factors, as reported by participants. Next is thematic based analysis of

major themes and subthemes.

#### 4.2.1. Theme 1: Strategic and Operational Planning Deficits

The narratives show that the root cause of SC inefficiency is a lack of strategic and operational planning, which undermines overall supply chain performance. Participants consistently highlighted the absence of foresight and structured processes. Participant statements indicate a systemic absence of planning mechanisms that contribute directly to SC inefficiency in the mining sector.

#### 4.2.1.1. Subtheme 1.1: Poor or Absent Planning

The research results show that poor or absent planning forces reactive management, making SC processes vulnerable to disruptions. Participant 5 and Participant 28 mentioned "...Poor planning..." supported by Participant 21 and Participant 16 noting "...improper planning..." Participant 17, Participant 30, and Participant 31 identified "...lack of planning.." These statements highlight that the business operates without effective guidance, resulting in suboptimal SC performance.

#### 4.2.1.2. Subtheme 1.2: Inaccurate Demand Forecasting

The results show that inaccurate demand forecasting contributes to inventory inefficiency and financial strain. Participant 3 referred to "...Inaccurate demand forecasting..." Participant 21 mentioned "...Incorrectly forecasting future demand..." Participant 30 noted "...poor demand forecasting..." and Participant 23 cited "...poor Forecasting and Overstocking..." Thus, ineffective forecasting directly disrupts material availability, exacerbating the SC inefficiency.

#### 4.2.1.3. Subtheme 1.3: Lack of Standardised Procedures

The research results show that the absence of standardised procedures fosters inconsistency and poor decision-making across the supply chain. Participant 1 observed "...the uncertainty of clear guidelines on SC processes, where wrong decisions can be made as there may not be a framework, or systems in place..." while Participant 29 noted "...lack of Standard Operating Procedures..." and Participant 8 added "...unreviewed procedures and standards also impact on ineffective supply-chain processes..." Participant 16 highlighted non-compliance issues, echoed by Participant 29 as "...lack of policies." Therefore, the lack of universally implemented standard operating procedures results in inconsistent performance, contributing to SC inefficiency in the mining sector.

### 4.2.2. Theme 2: Communication and Coordination Breakdown

The narratives show that breakdowns in communication and coordination disrupt the timely flow of information, creating delays and errors throughout the SC. Internal silos and external communication failures compromise planning and execution, leading to inefficiency in the mining sector.

#### 4.2.2.1. Subtheme 2.1: Poor Internal Communication

The research results show that poor internal communication obstructs information flow, creating duplication, delays, and misaligned objectives. Participant 3, Participant 24, and Participant 28 cited "...poor communication..." Participant 7 and Participant 21 noted "...lack of Communication internally..." and Participant 13 described "...departments that work in a silo, that do not share information across the company..." Participant 30 summarized "...communication and collaboration issues..." while Participant 16 specifically reported "...Lack of Coordination and Communication..." As such results shows that ineffective internal communication emerges as a root cause of SC inefficiency in the mining sector.

#### 4.2.2.2. Subtheme 2.2: Ineffective External Communication

The narratives show that ineffective communication with external partners compromises coordination and timely delivery. Participant 9 stated "Poor communication between stakeholders," Participant 6 noted "...communication that is not clear, we struggle a lot with change in procedures and policies where we did not inform..." and Participant 27 highlighted "...lack of communication from own suppliers..." Participant 15 added "...communication, if there is breakdown in what is requested thus will affect the efficiency of our processes..." Weak external communication is therefore a major contributor to SC disruptions in the mining sector.

#### 4.2.2.3. Subtheme 2.3: Unclear Specification and Timelines

The research findings indicate that incomplete or unrealistic requests from production and end-user teams undermine procurement and delivery. Participant 17 noted "...unclear specifications from the plant," Participant 26 added "...most of the time this is caused by unclear specifications from the production plant..." and Participant 27 emphasized "...many times, the production team gives little time for us to get the equipment or material..." Therefore, the inability to specify and set reasonable timelines causes the SC to be in a constant state of panic and mistake.

### 4.2.3. Theme 3: Human Capital and Leadership Challenges

The narratives show that weaknesses in human capital, leadership, and organisational culture significantly undermine SC performance in the South African mining sector. Participants highlighted that limited skills, ineffective leadership, and high workloads constrain team effectiveness, contributing to systemic inefficiency in the mining sector.

#### 4.2.3.1. Subtheme 3.1: Insufficient Skills and Competency

The research results show that a shortage of skilled personnel directly reduces SC efficiency and service quality. Participant 3 noted "...skilled workforce shortage..." while Participant 11 stated "...labour that is not skilled to do the work..." and Participant 16 highlighted "...insufficient Skilled Personnel..." Participant 14 added "...lack of competent staff..." while Participant 25 observed "...Unqualified and demotivated Professionals..." Participant 23 reinforced the concern with "...staff Shortages..." These statements indicate that inadequate technical capacity and motivation are central causes of inefficiency in the mining sector.

#### 4.2.3.2. Subtheme 3.2: Leadership and Culture Issues

The narratives show that poor leadership and unethical culture contribute to SC inefficiency by discouraging compliance and promoting malpractice. Participant 12 highlighted "...unethical leaders also play a huge part in the ineffectiveness of these processes..." echoed by Participant 29 who stated "...poor organizational culture and leadership..." Participant 19 mentioned "...Po... politics... Labour," Participant 20 added "...informality (creation of informal business) and sleaze/malpractices..." and

Participant 31 noted "...lack of integrity and governance...." Hence, leadership behavior and organizational culture are fundamental determinants of SC inefficiency in the mining sector.

#### 4.2.3.3. Subtheme 3.3: Workload and Urgency

The research findings show that excessive workload and constant urgency force hasty decisions, undermining SC performance. Participant 4 reported "...workload that affects a personal efficiency in performance...." Participant 17 highlighted "...the pressure from our roles must be noted, we receive daily requirements that come with their own pressures....," and Participant 18 observed "...the lack of skill and urgency of the procurement department in the SC...." Therefore, high-pressure environments perpetuate reactive management and contribute to persistent inefficiency.

#### 4.2.4. Theme 4: Technological and Systemic Deficiencies

The narratives show that outdated or poorly integrated systems significantly limit SC efficiency by slowing processes and reducing visibility. Participants emphasized that technology gaps create bottlenecks and reactive operational modes.

##### 4.2.4.1. Subtheme 4.1: Outdated or Manual Systems

The research results show that manual and obsolete systems hinder SC operations and increase errors. Participant 8 highlighted "...manual operation is a delay that impacts the whole business....," Participant 3 noted "...inadequate technology....," and Participant 21 and Participant 24 stated "...outdated and ineffective technology...." Participant 30 summarized "...manual or outdated systems....," while Participant 25 mentioned "...Non-integrated System...." Thus, outdated systems are a significant barrier to modern SC efficiency.

##### 4.2.4.2. Subtheme 4.2: Inadequate Technology Infrastructure

The narratives show that weak technological infrastructure restricts data management, visibility, and SC oversight. Participant 16 stated "...Inadequate Technology and Systems....," Participant 22 cited "...Technological issues....," and Participant 24 emphasized "...outdated technology...." Participant 9 explained "...limited visibility across the SC...." As such, insufficient infrastructure results in restricted performance and operational inefficiency.

#### 4.2.5. Theme 5: Financial and Resource Constraints

The results show that insufficient finances and suboptimal resource allocation are major barriers to SC improvement and modernization. Participants identified that underfunding prevents investment in technology, infrastructure, and talent.

##### 4.2.5.1. Subtheme 5.1: Lack of Adequate Budget/Finance

The narratives show that financial constraints limit the capacity to maintain and improve SC processes. Participant 14 noted "...lack of finances plays a huge role in the failure of our processes....," Participant 31 added "...Financial constraints....," and Participant 28 highlighted "...Low budget...." Participant 3 mentioned "...economic volatility....," while Participant 20 emphasized "...financial strain in case of business facing cash flow problems."

Therefore, limited budgets prevent strategic investment, reinforcing SC inefficiency.

##### 4.2.5.2. Subtheme 5.2: Inefficient Resource Allocation

The narratives statements show that resources, even when available, are often misallocated, exacerbating SC inefficiency. Participant 16 stated "...Lack of resources....," Participant 28 added "...misuse of existing resources emerges as more critical," and Participant 23 observed "...ties up capital and storage resources unnecessarily...." Participant 16 also cited "...lack of Risk Management and Contingency Planning...." Therefore, suboptimal allocation contributes directly to operational delays and underperformance.

#### 4.2.6. Theme 6: Inventory and Quality Control Issues

The results show that weak inventory management and inconsistent quality control amplify operational risks and reduce SC reliability in the mining sector.

##### 4.2.6.1. Subtheme 6.1: Poor Inventory Management

The narratives show that inadequate inventory procedures result in inaccurate stock levels and limited visibility. Participant 16 cited "...inefficient Inventory Management....," Participant 28 noted "...poor stock control....," and Participant 21 observed "...lack of Visibility into historical purchases and inventory movements...". Thus, inventory mismanagement directly drives SC inefficiency.

##### 4.2.6.2. Subtheme 6.2: Compromised Quality

The verbatim quotes show that poor quality of materials increases rework, costs, and operational risks. Participant 12 highlighted "...quality of what we receive is already compromised....," Participant 27 added "...end up settling for low quality products just to ensure we deliver on time....," and Participant 24 summarized "...poor quality control mechanisms..." As such, compromised quality contributes to ongoing inefficiency in SC operations.

#### 4.2.7. Theme 7: Supplier and Vendor Management

The research findings show that unreliable suppliers and poor vendor management disrupt operations and supply continuity in the mining sector.

##### 4.2.7.1. Subtheme 7.1: Unreliable Suppliers

The narratives show that unstable suppliers create uncertainty and delays in SC operations. Participant 21 noted "...unreliable suppliers....," Participant 16 added "...supplier and Vendor Issues....," Participant 22 cited "...weak supplier relationships," and Participant 31 observed "...lack of vendor management...." Thus, supplier instability is a central contributor to operational inefficiency.

##### 4.2.7.2. Subtheme 7.2: Delayed Deliveries

The narratives show that late deliveries create supply disruptions, halting production and affecting financial outcomes. Participant 10 highlighted "...delayed deliveries which lead to supply interruptions....," Participant 27 cited "...late deliveries....," and Participant 20 noted "...delayed payments of suppliers and hindering local economic activity...." As such, delays in procurement and delivery significantly reinforce SC inefficiency.

#### **4.2.8. Theme 8: Mining Sector Infrastructure and Logistics**

The research results show that poor infrastructure and logistics significantly constrain SC efficiency in the mining sector.

##### **4.2.8.1. Subtheme 8.1: Poor Physical Infrastructure**

The verbatim quotes from participants show that inadequate roads, rail, and mine-site infrastructure create operational delays. Participant 9 highlighted "...poor infrastructure at mines especially during rainy season...", Participant 23 noted "...Poor Road conditions and remote mine locations often cause delays...", and Participant 20 added "...damaged roads and infrastructure..." Therefore, weak physical infrastructure imposes structural limits on SC efficiency.

##### **4.2.8.2. Subtheme 8.2: Substandard Logistics**

The research findings show that internal and contracted logistics often fail to meet performance requirements. Participant 30 emphasized "...inefficient transportation...", Participant 23 cited "...Substandard Transport Equipment...", and Participant 31 noted "...inefficient or lack of transportation..." As such, deficient logistics exacerbate delays and operational inefficiency.

#### **4.2.9. Theme 9: External Market Volatility and Disruptions**

The research findings show that market fluctuations and external disruptions introduce uncertainty, undermining SC performance in the mining sector.

##### **4.2.9.1. Subtheme 9.1: Market and Price Fluctuations**

The narratives show that commodity price volatility complicates budgeting and procurement. Participant 9 stated "...external factors such as strikes, fuel price and coal price fluctuations also contribute to inefficiencies...", Participant 30 cited "...market volatility...", and Participant 19 added "...changing and developing demand..." As such, price instability increases operational risk and limits SC efficiency.

##### **4.2.9.2. Subtheme 9.2: Supplier Reliability/External Disruptions**

The verbatim quotes show that external disruptions such as labor conflicts and climate events interrupt supply continuity. Participant 30 noted "supplier reliability issues", Participant 9 highlighted "strikes", and Participant 19 emphasized "climate-related disruptions". These uncontrollable external shocks significantly contribute to inefficiency.

#### **4.2.10. Theme 10: Operational Inefficiencies**

The research results show that day-to-day operational problems, including equipment failures and inconsistent production schedules, disrupt SC performance in the mining sector.

##### **4.2.10.1. Subtheme 10.1: Equipment and Maintenance Issues**

The interview participants show that inadequate maintenance leads to breakdowns and emergency procurement. Participant 12 noted "...equipment that are not maintained and processes that runs throughout without mechanical maintenance...", Participant 30 cited "...equipment and maintenance...", and Participant 23 highlighted "...order Processing Issues..." As such, equipment failure drives a reactive, inefficient SC cycle.

#### **4.2.10.2. Subtheme 10.2: Inconsistent Production/Scheduling**

The participants show that unpredictable production schedules disrupt SC coordination and inventory management. Participant 9 cited "...inconsistent production schedules from mines...", Participant 10 mentioned "...Production inefficiencies...", and Participant 22 referred to "...Insufficient production capacity or transportation..." Therefore, unpredictable production leads to misalignment and inefficiency.

#### **4.2.11. Theme 11: Corruption and Governance**

The participants show that corruption and poor governance systematically undermine SC efficiency and resource allocation. Participant 7 stated "...There is lot of corruption...", Participant 20 cited "...dishonesty/malpractices...", and Participant 31 added "...lack of integrity and governance..." Therefore, structural governance failures drive SC inefficiency and unreliability in the mining sector.

#### **4.2.12. Theme 12: Social and Community Issues**

The results show that social and community disruptions, including unrest and environmental impacts, significantly hinder SC continuity in the mining sector.

##### **4.2.12.1. Subtheme 12.1: Community Unrest**

The narratives show that tensions and disruptions around mine sites impede operations. Participant 23 noted "...community Unrest: Social tensions and disruptions around mining areas can delay operations and restrict access to sites..." This means that community issues are a non-operational but critical source of SC inefficiency.

##### **4.2.12.2. Subtheme 12.2: Environmental Impact (Negative)**

The narratives show that mining's environmental footprint intensifies community pressure and regulatory scrutiny. Participant 20 cited "...generating pollutions, noise and traffic...", and "...Land use and resources use (Deforestation and High water and electricity) ...." Therefore, environmental challenges introduce complexity and risks that limits SC efficiency.

#### **4.2.13. Theme 13: Internal Resistance and Inertia**

The research results show that resistance to change and reluctance to innovate impede SC process improvements. Participant 2 highlighted "...lack of innovation, processes that are not improved to meet the new requests and pressures of the market...", while Participant 6 reported "...change in production process were we not informed..." Therefore, cultural inertia reinforces stagnation and systemic SC inefficiency in the mining sector.

#### **4.2.14. Theme 14: External Regulatory/Customer Burden**

The narratives show that regulatory and customer requirements impose administrative burdens, extending lead times and slowing SC processes in the mining sector.

##### **4.2.14.1. Subtheme 14.1: Customer Processes and Availability**

The participants show that complex customer processes and unavailability delay SC operations. Participant 4 stated "...the unavailability of the customer also has an effect in

effective SC processes, as we need to go through their processes and the quality checks, we meet their requirement..." As such, customer-related delays contribute directly to operational inefficiency.

#### 4.2.14.2. Subtheme 14.2: External Reporting/Compliance Burden

The narratives show that growing regulatory and reporting requirements increase administrative workload and compliance risks. Participant 16 cited "...Non-Compliance with Policies and Procedures..." reflecting internal and external demands. Compliance obligations thus add overhead, limiting overall SC efficiency in the mining sector.

### 5. Discussion of Findings

Strategic and operational planning deficits (Theme 1) emerge as a foundational cause of inefficiency in supply chain processes both generally and within the South African mining sector. The findings show that poor planning (Subtheme 1.1), inaccurate demand forecasting (Subtheme 1.2), and the lack of standardized procedures (Subtheme 1.3) create systemic disruptions that propagate across supply chain activities, ultimately leading to operational inefficiencies (Theme 10). Participants reported that reactive management practices caused by absent or inadequate planning prevent supply chains from operating proactively, which in turn results in delayed procurement, poor coordination, and suboptimal resource allocation. These findings align with prior empirical research that emphasises the importance of planning and forecasting in managing supply chain complexity (Zeng *et al.*, 2021)<sup>[74]</sup>; (Haonan *et al.*, 2021)<sup>[26]</sup>. For instance, Haonan *et al.* (2021)<sup>[26]</sup> argue that effective planning and scheduling mechanisms are essential for coordinating extraction, processing, and transportation in mining supply chains, while Zeng *et al.* (2021)<sup>[74]</sup> highlight how inaccurate forecasting contributes to inventory imbalances and operational delays. The findings are also consistent with the theoretical lens of the Bullwhip Effect Theory (Forrester, 1961)<sup>[23]</sup>; (Lee, Padmanabhan and Whang, 1997)<sup>[33]</sup>, which explains how poor demand forecasting amplifies variability across supply chain stages and generates inefficiencies. However, the current research extends this theory by showing that the bullwhip effect is not merely a result of demand distortion but is also embedded in structural planning failures within organisational processes, particularly in resource-dependent sectors such as mining. Therefore, the study suggests that SCM theory must more explicitly consider organisational planning capability as a structural antecedent of the bullwhip effect. These insights indicate that planning deficiencies are not simply operational weaknesses but systemic governance failures that destabilise supply chain performance in mining environments.

Communication and coordination breakdowns (Theme 2) constitute another critical cause of inefficiency in supply chain processes by disrupting the flow of information across organisational and inter-organisational boundaries. The findings reveal that poor internal communication (Subtheme 2.1), ineffective external communication (Subtheme 2.2), and unclear specifications and timelines (Subtheme 2.3) undermine coordination between departments, suppliers, and production teams. Participants noted that siloed departments and inconsistent information sharing often lead to duplication of work, procurement errors, and delays in material delivery. These findings support earlier studies which highlight that

fragmented communication systems increase supply chain complexity and operational disruptions (Kerfati, Azzamouri and Azzamouri, 2025)<sup>[30]</sup>; (Nguyen, Mac and Hoang, 2025)<sup>[49]</sup>. For example, Nguyen, Mac and Hoang (2025)<sup>[49]</sup> argue that collaboration and information sharing among supply chain actors are essential for improving operational efficiency, while Kerfati, Azzamouri and Azzamouri (2025)<sup>[30]</sup> demonstrate that coordination failures create cascading inefficiencies across supply chain networks. From a theoretical perspective, these findings strongly align with Systems Theory (Bertalanffy, 1968)<sup>[12]</sup>; (Ackoff, 1971)<sup>[1]</sup>, which conceptualises supply chains as interconnected systems where disruptions in one component affect the entire network. However, the present findings complicate this theoretical assumption by demonstrating that communication failures often originate from organisational culture and governance structures (Theme 3 and Theme 11) rather than purely technical system design. Consequently, the study extends Systems Theory by highlighting the socio-organisational mechanisms that shape communication flows within supply chains. This theoretical refinement suggests that improving supply chain integration requires not only technological systems but also cultural and governance reforms that encourage information transparency and collaboration.

Human capital and leadership challenges (Theme 3) represent a significant cause of supply chain inefficiency because organisational capabilities depend heavily on the skills, competencies, and ethical orientation of employees and managers. The findings demonstrate that insufficient skills and competency (Subtheme 3.1), leadership and cultural issues (Subtheme 3.2), and excessive workload pressures (Subtheme 3.3) undermine the effectiveness of supply chain operations. Participants emphasised that shortages of skilled personnel and weak leadership structures often lead to poor decision-making, ineffective planning (Theme 1), and compromised inventory management (Theme 6). These results are consistent with the Resource-Based View (RBV), which posits that organisational performance is largely determined by the availability and utilisation of valuable human and organisational resources (Barney, 1991)<sup>[8]</sup>; (Peteraf, 1993)<sup>[53]</sup>. Empirical studies also support this perspective; for example, Mukha (2025)<sup>[45]</sup> argues that supply chain efficiency depends significantly on the availability of skilled personnel capable of managing complex logistics and digital systems. Similarly, Mawonde *et al.* (2024)<sup>[41]</sup> highlight how inadequate managerial capabilities in mining operations can disrupt supply chain coordination and productivity. However, the present study extends RBV by demonstrating that human capital deficiencies are not merely resource shortages but are also intertwined with organisational culture, governance failures (Theme 11), and internal resistance to innovation (Theme 13). Thus, the findings suggest that the RBV's traditional focus on static resource possession may overlook the dynamic social processes through which resources are developed and utilised. The results therefore reinforce the importance of integrating RBV with Dynamic Capabilities Theory to better explain how organisations adapt their human capital to changing operational demands.

Technological and systemic deficiencies (Theme 4) constitute a major structural cause of supply chain inefficiency by limiting organisational visibility, data integration, and decision-making capabilities. The findings

show that outdated or manual systems (Subtheme 4.1) and inadequate technological infrastructure (Subtheme 4.2) slow down procurement processes, restrict information sharing, and create operational bottlenecks across supply chain activities. Participants noted that non-integrated information systems prevent real-time monitoring of inventory, procurement, and logistics operations, thereby exacerbating communication breakdowns (Theme 2) and operational inefficiencies (Theme 10). These findings are consistent with empirical research highlighting the importance of digital technologies in improving supply chain transparency and coordination (Yalcin and Daim, 2022)<sup>[69]</sup>; (Mukha, 2025)<sup>[45]</sup>. For instance, Yalcin and Daim (2022)<sup>[69]</sup> argue that digital transformation technologies such as artificial intelligence and blockchain significantly enhance supply chain integration and responsiveness. From a theoretical standpoint, these results are supported by the Resource-Based View, which emphasises the strategic value of technological resources in enhancing organisational competitiveness (Barney, 1991)<sup>[8]</sup>. However, the present study extends this theoretical perspective by demonstrating that technology alone does not guarantee supply chain efficiency; instead, technological effectiveness depends on complementary organisational capabilities such as skilled personnel (Theme 3) and financial investment (Theme 5). Consequently, the findings suggest that digital transformation should be conceptualised as a socio-technical capability rather than merely a technological resource. This insight challenges simplistic technological determinism in SCM literature and highlights the need for integrated technological and organisational capability development.

Financial and resource constraints (Theme 5) represent another critical cause of inefficiency in supply chain processes because they limit organisational capacity to invest in infrastructure, technology, and skilled personnel. The findings indicate that lack of adequate budgets (Subtheme 5.1) and inefficient resource allocation (Subtheme 5.2) restrict operational improvements and reinforce technological deficiencies (Theme 4) and human capital challenges (Theme 3). Participants noted that limited financial resources often force organisations to rely on outdated systems and insufficient staffing levels, thereby perpetuating operational inefficiencies. These findings are consistent with prior studies highlighting how financial constraints limit the ability of mining firms to modernise supply chain operations (Radebe and Chipangamate, 2024)<sup>[56]</sup>; (Fattahi, Mosadegh and Hasani, 2021)<sup>[22]</sup>. According to the Resource-Based View, financial resources are essential enablers of organisational capability development and operational efficiency (Wernerfelt, 1984)<sup>[65]</sup>; (Barney, 1991)<sup>[8]</sup>. However, the present study complicates this theoretical assumption by showing that inefficiency is not solely caused by resource scarcity but also by poor resource allocation and governance failures (Theme 11). Therefore, the findings suggest that resource management practices are as important as resource availability in determining supply chain performance. This insight contributes to SCM theory by emphasising the governance dimension of resource utilisation, which is often underexplored in RBV-oriented supply chain research.

Inventory and quality control issues (Theme 6) are identified as significant operational causes of supply chain inefficiency, particularly in resource-intensive industries such as mining. The findings demonstrate that poor inventory management

(Subtheme 6.1) and compromised product quality (Subtheme 6.2) create operational disruptions, increase costs, and reduce supply chain reliability. Participants noted that inaccurate inventory records and limited visibility into stock levels often result in overstocking, shortages of critical materials, and delays in production processes. These results are consistent with empirical research highlighting the importance of effective inventory management systems in maintaining supply chain stability (Mawonde *et al.*, 2024)<sup>[41]</sup>; (Zeng *et al.*, 2021)<sup>[74]</sup>. Furthermore, the findings align with Bullwhip Effect Theory, which explains how poor information visibility and inaccurate demand signals lead to excessive inventory fluctuations across supply chain stages (Lee, Padmanabhan and Whang, 1997)<sup>[33]</sup>. However, the present study extends this theory by demonstrating that inventory inefficiencies are frequently rooted in organisational factors such as poor planning (Theme 1), communication breakdowns (Theme 2), and technological limitations (Theme 4). Thus, inventory problems should not be viewed solely as operational issues but rather as symptoms of broader systemic weaknesses within supply chain governance. This insight reinforces the argument that supply chain inefficiency must be analysed from an integrated systems perspective rather than isolated functional silos.

Supplier and vendor management challenges (Theme 7) represent a crucial external dimension of supply chain inefficiency because mining firms depend heavily on suppliers for equipment, spare parts, and logistical services. The findings reveal that unreliable suppliers (Subtheme 7.1) and delayed deliveries (Subtheme 7.2) disrupt production schedules and contribute to operational instability (Theme 10). Participants emphasised that weak supplier relationships and inadequate vendor evaluation mechanisms often result in procurement delays and compromised product quality. These findings support previous empirical research which highlights the strategic importance of supplier selection and relationship management in supply chain performance (Becerra and Diaz, 2025)<sup>[10]</sup>; (Nguyen, Mac and Hoang, 2025)<sup>[49]</sup>. According to Transaction Cost Economics (Williamson, 1985)<sup>[67]</sup>, inefficient governance structures and poorly designed contracts can increase coordination costs and create opportunistic behaviour among supply chain partners. The present findings strongly support this theoretical perspective by showing that weak governance and supplier management practices increase the likelihood of supply disruptions. However, the study also extends TCE by demonstrating that governance failures are often intertwined with corruption (Theme 11) and internal organisational weaknesses (Theme 3). Consequently, the research suggests that supplier management inefficiencies are not purely transactional problems but also institutional and organisational challenges.

Infrastructure and logistics constraints (Theme 8) are identified as major structural causes of supply chain inefficiency within the South African mining sector. The findings show that poor physical infrastructure (Subtheme 8.1) and substandard logistics systems (Subtheme 8.2) significantly delay transportation, increase operational costs, and reduce supply chain reliability. Participants highlighted issues such as damaged roads, remote mine locations, and insufficient transportation capacity as key barriers to efficient supply chain operations. These results strongly align with previous research emphasising the importance of transportation infrastructure in mining supply chain

performance (Yaping and Bossman, 2021; Arabi and Gholamian, 2023). Systems Theory provides a useful theoretical explanation for these findings by suggesting that disruptions in one component of the supply chain system—such as transportation networks—can propagate across the entire supply chain network (Bertalanffy, 1968). However, the present findings also demonstrate that infrastructure constraints interact with internal organisational factors such as planning deficits (Theme 1) and financial limitations (Theme 5), thereby amplifying inefficiencies. This insight suggests that SCM theories should more explicitly account for the interaction between external infrastructure systems and internal organisational capabilities.

External market volatility and disruptions (Theme 9) constitute an environmental cause of supply chain inefficiency because they introduce uncertainty into procurement, production, and logistics planning. The findings reveal that commodity price fluctuations (Subtheme 9.1) and external disruptions such as strikes and climate events (Subtheme 9.2) create instability in supply chain operations. Participants noted that sudden changes in market conditions complicate budgeting decisions and disrupt long-term supply chain planning. These findings are consistent with previous studies highlighting the impact of global commodity market volatility on mining supply chains (Ngcobo, Mafini and Okoumba, 2022; Radebe and Chipangamate, 2024). From a theoretical perspective, Dynamic Capabilities Theory (Teece, Pisano and Shuen, 1997) provides a relevant explanation by emphasising the importance of organisational adaptability in responding to changing external environments. However, the current findings suggest that many mining firms lack the dynamic capabilities necessary to adapt to volatile market conditions. Consequently, the study contributes to SCM theory by highlighting how environmental uncertainty exposes weaknesses in organisational planning, governance, and technological capabilities.

Operational inefficiencies (Theme 10) represent the central manifestation of the various structural and organisational problems identified across the supply chain system. The findings demonstrate that equipment and maintenance issues (Subtheme 10.1) and inconsistent production scheduling (Subtheme 10.2) disrupt supply chain coordination and lead to frequent operational interruptions. Participants emphasised that inadequate maintenance practices often result in unexpected equipment breakdowns, which then require emergency procurement and reactive decision-making. These findings align with existing literature highlighting the operational complexity of mining supply chains and the importance of effective maintenance and scheduling systems (Thiruvady *et al.*, 2024). Systems Theory again provides a useful explanatory framework because it conceptualises operational inefficiencies as emergent outcomes of multiple interacting system components. However, the current research extends this theoretical perspective by demonstrating that operational inefficiencies are not isolated technical failures, but rather systemic outcomes of planning deficits, communication failures, technological limitations, and governance issues identified in earlier themes. This insight highlights the interconnected nature of supply chain inefficiencies in complex industrial systems.

Corruption and governance failures (Theme 11) represent a critical institutional cause of supply chain inefficiency because they undermine transparency, accountability, and

effective resource allocation. The findings reveal that corruption and malpractice distort procurement processes, encourage opportunistic behaviour, and reduce trust among supply chain actors. Participants indicated that corrupt practices often influence supplier selection and contract management, thereby reinforcing financial constraints (Theme 5) and supplier management problems (Theme 7). These findings strongly support the assumptions of Transaction Cost Economics, which emphasises the importance of governance structures in reducing opportunism and coordination costs within economic transactions (Williamson, 1985). However, the present study extends TCE by demonstrating that governance failures in supply chains may be deeply embedded within broader institutional contexts rather than merely contractual arrangements. Consequently, SCM theory must account for the institutional environment in which supply chain governance structures operate. This insight highlights the importance of institutional integrity and regulatory enforcement in maintaining efficient supply chain systems.

Social and community issues (Theme 12) represent a unique contextual cause of supply chain inefficiency within the mining sector because mining operations often occur in socially sensitive environments. The findings indicate that community unrest (Subtheme 12.1) and environmental concerns (Subtheme 12.2) disrupt mining activities and restrict access to operational sites. Participants reported that social conflicts and environmental concerns frequently lead to production delays and logistical disruptions. These findings are consistent with research on sustainable supply chain management in the mining sector, which emphasises the importance of stakeholder engagement and environmental responsibility (Ngcobo, Mafini and Okoumba, 2022). From a theoretical perspective, these results extend Systems Theory by demonstrating that supply chains are embedded within broader socio-environmental systems that influence operational performance. Consequently, the study challenges traditional SCM models that focus primarily on economic and operational factors while overlooking social dynamics.

Internal resistance and organisational inertia (Theme 13) represent behavioural causes of supply chain inefficiency because they prevent organisations from adapting to new technologies, processes, and market demands. The findings reveal that resistance to change and lack of innovation discourage the implementation of improved supply chain practices. Participants noted that employees and managers often resist process improvements due to organisational culture, uncertainty, or lack of incentives. These findings align with Dynamic Capabilities Theory, which emphasises the importance of organisational learning and adaptability in responding to changing environments (Teece, 2007). However, the present study highlights that dynamic capabilities may be constrained by cultural resistance within organisations. This insight suggests that SCM theories must pay greater attention to behavioural and cultural barriers that limit organisational transformation.

External regulatory and customer requirements (Theme 14) represent institutional causes of supply chain inefficiency because they increase administrative complexity and compliance costs. The findings show that customer processes (Subtheme 14.1) and regulatory reporting requirements (Subtheme 14.2) extend procurement lead times and increase operational workloads. Participants explained that

compliance obligations often require extensive documentation and approvals before procurement decisions can be implemented. These findings are partially supported by research on regulatory governance in supply chains, which highlights how regulatory frameworks can both improve accountability and increase operational complexity (Kerfati, Azzamouri and Azzamouri, 2025). From a theoretical perspective, Transaction Cost Economics again provides an explanatory framework by suggesting that regulatory compliance increases transaction costs within supply chain operations. However, the present findings extend this perspective by showing that regulatory burdens may interact with internal inefficiencies such as poor communication and planning.

Overall, the findings clearly answer the research question: “What are the Causes of Inefficiency in the Supply Chain Processes in South African Mining Sector?” by demonstrating that supply chain inefficiencies arise from a complex interaction of organisational, operational, institutional, and environmental factors. The study identifies fourteen interconnected themes, including planning deficits, communication breakdowns, human capital limitations, technological deficiencies, financial constraints, supplier management problems, infrastructure challenges, market volatility, governance failures, social disruptions, organisational inertia, and regulatory burdens. These findings confirm much of the existing literature on supply chain inefficiency while also extending theoretical understanding by demonstrating how these factors interact within a complex socio-technical system. Importantly, the study advances supply chain management theory by showing that inefficiencies cannot be adequately explained by single-factor models but instead emerge from dynamic interactions between organisational capabilities, governance structures, and external environmental conditions. Consequently, the research proposes a systems-oriented theoretical refinement of supply chain inefficiency, which integrates insights from Transaction Cost Economics, the Resource-Based View, Dynamic Capabilities Theory, Systems Theory, and the Bullwhip Effect Theory. This theoretical advancement highlights the need for future SCM research to move beyond linear models of supply chain processes and instead adopt multidimensional frameworks that capture the complex realities of modern industrial supply chains.

## 6. Conclusions and Recommendations

The findings of this study demonstrate that inefficiencies in supply chain processes within the South African mining sector arise from a complex interaction of organisational, operational, and environmental factors rather than from a single operational weakness. The results show that strategic and operational planning deficits (Theme 1), including poor planning, inaccurate demand forecasting, and lack of standardised procedures, form a foundational cause of inefficiency because they disrupt coordination across the supply chain and contribute directly to operational inefficiencies (Theme 10). Furthermore, communication and coordination breakdowns (Theme 2) between internal departments and external partners create information silos that delay procurement and logistics activities, while human capital and leadership challenges (Theme 3) weaken decision-making, governance, and organisational culture. Technological and systemic deficiencies (Theme 4) and financial and resource constraints (Theme 5) further

exacerbate these challenges by limiting investments in modern systems and skilled personnel, which subsequently undermines inventory management and quality control processes (Theme 6). In addition, supplier and vendor management challenges (Theme 7), infrastructure and logistics constraints specific to the mining sector (Theme 8), and external market volatility (Theme 9) introduce operational uncertainty that destabilises supply chain performance. Institutional and contextual factors such as corruption and governance failures (Theme 11), social and community disruptions (Theme 12), internal resistance to organisational change (Theme 13), and regulatory and customer compliance burdens (Theme 14) further amplify inefficiencies by increasing transaction costs, operational complexity, and organisational inertia. Collectively, these interconnected themes demonstrate that supply chain inefficiency in the South African mining sector is systemic in nature and emerges from the interaction between internal organisational capabilities and external environmental pressures, thereby confirming that improving supply chain performance requires a holistic and integrated management approach.

Based on the findings of this study, several recommendations can be proposed to improve supply chain efficiency in the South African mining sector. First, mining organisations should strengthen strategic and operational planning capabilities (Theme 1) by implementing formal forecasting systems, standardised operating procedures, and integrated planning mechanisms that improve coordination between procurement, production, and logistics functions. Second, organisations should enhance communication and collaboration mechanisms (Theme 2) by adopting integrated digital information systems and cross-departmental coordination structures that facilitate real-time information sharing across supply chain actors. Third, investment in human capital development (Theme 3) is essential; mining firms should prioritise continuous training, leadership development, and organisational culture transformation initiatives to strengthen managerial competence and ethical governance. Fourth, firms should accelerate digital transformation and technological modernisation (Theme 4) by replacing manual systems with integrated enterprise resource planning platforms that enhance visibility into inventory levels (Theme 6), supplier performance (Theme 7), and operational activities (Theme 10). Additionally, organisations should improve financial planning and resource allocation processes (Theme 5) to ensure adequate funding for infrastructure upgrades and operational improvements. Collaboration with logistics providers and government agencies is also necessary to address broader infrastructure and transportation challenges (Theme 8) that constrain mining supply chains. Furthermore, stronger governance and anti-corruption mechanisms (Theme 11) should be implemented to improve procurement transparency and accountability. Mining companies should also proactively engage with local communities and environmental stakeholders (Theme 12) in order to reduce social disruptions that affect operations. Finally, organisations should develop change management strategies that address internal resistance to innovation (Theme 13) and streamline regulatory compliance processes (Theme 14), thereby enabling supply chains to operate more efficiently in complex regulatory and market environments. Collectively, these recommendations emphasise the importance of integrated

organisational, technological, and institutional reforms to improve supply chain efficiency in the South African mining sector.

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