

Critical Success Factors and Barriers in Applying Supply Chain Risk Management: A Case Study of the South African Railway Industry

T. Mangquku, B. B. S. Makhanya and JHC Pretorius

Postgraduate School of Engineering Management

University of Johannesburg

Johannesburg, South Africa

802049372@uj.ac.za, Bmakhanya@uj.ac.za, jhcpretorius@uj.ac.za

Abstract

This study explores the application of Supply Chain Risk Management (SCRM) in the South African railway industry. It aims to identify the critical success factors and barriers affecting the effective implementation of SCRM. A qualitative approach, grounded in the interpretivist paradigm, was employed to capture the lived experiences of ten senior supply chain professionals within the industry. Data were collected through semi-structured interviews and analyzed thematically. Key success factors identified include the enhancement of internal systems, participatory change management, and leadership commitment. Barriers include inadequate information sharing, external environmental pressures, communication gaps, and globalization complexities. The study recommends improved communication, adaptability to economic conditions, and proactive environmental risk management to strengthen SCRM practices.

Keywords

Supply Chain Risk Management, Supply Chain, Supply Chain Management, Critical Success Factors, Barriers.

1. Introduction

The evolution of Supply Chain Management in the globalised economic environment, which is interconnected, has transformed it from its traditional supply and demand system into a sophisticated and strategic business function (Balog, 2019). This transformation encompasses a comprehensive spectrum of operations, ranging from the conceptualisation of a product to its production, purchasing, and distribution to customers. As Rogers, Srivastava and Shah (2018) explain, Supply Chain Management plays a key role in the operations of modern business organisations, as it ensures the efficient delivery of products and services to the end users, within a dynamic environment of multiple players in operations at various stages of the supply chain. However, Sawik (2020) argue that due to the complexity and global nature of supply chain activities, there is increasing exposure to a variety of risks, such as unfavourable policies and regulations, unpredictable politics, weather, or poor infrastructure conditions, causing disruptions in the seamless flow of the products and services. The result has been the need for designing and implementing dynamic Supply Chain Risk Management (SCRM) practices, which become part of the sustainability and successful operations of businesses that are engaged in activities within the supply chains (Simba *et al.*, 2017).

The best practices of the SCRM must involve identifying, analysing, assessing, and mitigating potential risks for the disruption of the supply chain operations (Căescu and Dumitru (2016). Furthermore, they pointed out that in a volatile dynamic business environment, an organisation's ability to predict and manage risks in its supply chain is a determinant factor of the success or failure of its goals. As Chopra and Meindl (2017) posited, an effective SCRM could minimize disruptions and their negative implications, ranging from delivery delays, price and cost fluctuations

to loss of business. A resilient SCRM could also result in quick recovery and maintain key operations of the business during periods of adversity. However, despite the acknowledgment of the critical role played by SCRM, there are gaps in its application in certain areas, such as in the South African railway sector, and such gaps remain unexplored in the context of a country such as South Africa.

This study was conducted with the railway company in South Africa, referred to as BCP Holdings in this paper, to honor the nondisclosure agreement with the company and ethical requirements with the University of Johannesburg. Among the major players representing South Africa's transport and logistics network in the railway industry, is BCP Holdings. The role played by BCP Holdings is critical as it facilitates the movement of commodities that are bulk, containerized freight, and passengers, both within the country and beyond it. However, the South African railway industry has been declining in recent years, BCP Holding has consistently demonstrated underperformance, with the 2020/2021 financial year posing as the most challenging (BCP Holdings, 2021). Inefficiency in procurement and Supply Chain Management has been identified as among the key contributors to the underperformance, and this has highlighted the urgency in the understanding of SCRM and its application within the South African Railway industry, with a view of having enhanced organisational performance and ensuring that BCP Holdings have sustainable operations.

The global and interconnectedness of supply chains, which is continuously growing, underscores the importance of this research, with COVID-19 pandemic further demonstrating challenges of a global supply chain, political tensions, and natural disasters such as storms and earthquakes (Kuteyi and Winkler, 2022). Such exogenic factors have led to the exposure of vulnerabilities in the supply chains, pushing for urgency in the adoption of SCRM practices that are resilient and adaptive. In addition, in South Africa, a country that is developing, and where challenges posed by constraints associated with infrastructure and the economy are prevalent, the application of the best practices in the implementation of SCRM could provide a competitive advantage that could enable the BCP Holdings maintain efficiency in its operations, meeting the demands of its customers, and safeguarding their position in the industry.

1.1 Problem Statement

For an organisation to achieve its strategic objectives, its ability is increasingly determined by how effective its SCRM practices are. In the context of BCP Holdings, operating in the South African railway industry environment, critical to risk mitigation is the implementation and practices associated with the SCRM, as ineffective SCRM practices could cause disruptions in the supply chain and the organisation's performance. However, there still exists gaps in the application of SCRM within the South African railway industry, which leads to the SCRM being inefficient, and making BCP Holdings vulnerable to various potential risks that include risks associated with supply, demand, and environment. The inability to meet the demand risks causes delays and failures in deliveries, thereby causing disruptions in the production and delivery of services and imbalances in the inventory, resulting in fluctuations of demands from customers (Prakash and Rathore, 2017). While environmental risks could have a negative impact on the timing and how supply chain activities are executed (Rajesh and Ravi, 2018). Within BCP Holdings, the ineffective SCRM framework has resulted in its underperformance, reporting a decline in its position, and losing its shareholder value. The underlying problem of the study is the nature of the application of the SCRM framework, rendering it ineffective, leaving BCP Holdings exposed to several risks, and this undermines the operational stability and its competitive edge in the railway industry. It is how the SCRM practices are carried out, through the identification of the barriers and best practices, with a view of suggesting strategies in the enhancement of SCRM to improve the performance of BCP Holdings, thereby mitigating risks associated with the supply chain.

1.2 Objectives

- To determine the critical success factors of the application of supply chain risk management in the South African Railway Industry
- To identify barriers in the application of supply chain risk management in the South African Railway Industry

2. Literature Review

Supply Chain Management has a focus on overseeing and optimisation of how goods, services, information, and raw materials flow within the supply chain. The goal is to ensure efficiency and the creation of value across the supply chain. SCM thereby enhances the coordination within the network of suppliers, manufacturers, and distributors with

a view of meeting the demands of customers effectively (Simba *et al.*, 2017). While the Supply Chain Risk Management (SCRM), being a subset of SCM, has a focus on the identification, assessment, and mitigation of risks that might cause disruption in the supply chain. This is composed of issues that are critical such as shortages in the supply chain, delays in transportation, and fluctuations in the market, with SCRM seeking to minimise the negative impact of such risks and maintain continuity in operations. However, Viegas and Macario (2010) argue that the effectiveness of SCM requires a proactive SCRM, capable of anticipating and addressing vulnerabilities while ensuring the resiliency of the supply chain against disruptions. Through the incorporation of risk assessment into the planning of the supply chain, organisations will have the capability of enhancing stability in operations, safeguarding against any potential risks, and achieving sustained efficiency. This approach is holistic, and it ensures the optimisation of the supply chain for performance while safeguarding it against potential threats.

2.1 Key Models of Supply Chain Management

Supply Chain Management (SCM) models are critical in the optimisation of the production and goods distribution across the various sectors, and this includes the railway sector, with one such model being the Continuous Flow Model, well placed for industries that have stable demand such as the Toyota's automotive supply chains, which emphasizes consistency in production and delivery as critical aspects (Zhou and Lei, 2020). However, in the railways sector, any disruptions could have a significant negative impact on the operations, and this necessitates investments. According to Phillips (2023), for companies such as Union Pacific Railroad, which is in the railway sector in the USA, the reliance is on the continuous flow in maintaining a steady movement of goods across various supply chain networks. While the Continuous Flow Model emphasises the need for stability, the other model is the Agile Supply Chain, addressing variability in high demand, as in the case of Zara, a market leader in the fashion sector, which has the ability to adjust production based on real-time demand (Sawik, 2020). However, this is parallel to what is in the railway industry as business organisation such as the Canadian National Railway, which is making use of an agile model in managing the spikes because of seasonal demands. As Seifbarghy and Gilkalayeh (2018) explained, such flexibility allows them to make swift responses to any disruptions in the supply chains, such as industrial actions or natural disasters. In the lean Supply Chain model, efficiency is critical, as demonstrated by Dell's systems of build-to-order, where the company's lean strategy is aimed at the minimisation of waste and the maximisation of efficiency. This practice is also reflected in the railway industry by Dani and Deep (2019), although relying on the management of the inventory just-in-time, could introduce vulnerabilities, especially in the case of unexpected disruptions.

Addressing such risks, Rajesh and Ravi (2018) argued that the incorporation of buffer inventories, and developing contingent plans that are robust is critical, arguing that the incorporation of the models, with risk management strategies that are effective could allow industries such as railways to maintain efficiency in operations, cost reductions, and ensuring the supply chain is resilient. For instance, although Union Pacific adopted a continuous flow model, its integration with agile and lean practices, ensures that there is stability, adaptability, and the safeguard of the supply chain against any potential risks.

2.2 An Overview of Approaches to Supply Chain Risk Management in the Railway Sector

The critical role of SCRM lies in ensuring that the supply chains are resilient and efficient through the identification, assessment, and mitigation of potential risks. SCRM is also essential in the management of disruptions and ensuring that operations are not negatively impacted in any way. This puts a spotlight on the railways industry, an integral industry in global logistics and transportation, which is facing a variety of risks, making a study on SCRM and railways imperative (Neumann, 2021). Considering its role as a key player in South Africa's economy, especially in the mining and agriculture sector, besides the transportation of goods. According to Simba, Niewman, and Agigi (2017), South African Railways (BCP) has faced a significant number of challenges, including a deteriorating infrastructure, and operations that are inefficient, further pointing out that in 2015 there was a derailment involving a freight train that was carrying manganese. This incident underscored the need for having a SCRM that is robust and resilient, with BCP embarking on huge investments in the modernisation of the rail infrastructure and the deployment of advanced systems for monitoring, so as to avert such incidents in the future chain (Mvubu and Naude, 2020).

SCRM in this context involves managing geopolitical risks, securing funding, and ensuring timely project completion. The Standard Gauge Railway (SGR) project illustrates the importance of a Strategic Risk Management Model, which emphasises long-term planning and coordination to address complex, large-scale infrastructure projects (Christopher

and Holweg, 2017). In the African continent, the railway industry is playing a key role in the development of the country's economy and regional integration, with Nel, de Goede and Niemann (2018) citing the East African Railways Corporation, operating in countries such as Uganda, Kenya, and Tanzania, facing challenges that are related to dilapidated infrastructure, and unstable political environment. However, the emergence of the Standard Gauge Railway (SGR) project, which was funded through investments from China, is a representation of a significant advancement in the efforts to modernisation of the rail networks. The role of the SCRM, in this context, involves the management of risks related to geopolitics, securing funds, and ensuring that the project is completed timely. The East African Railway project is a good demonstration of the importance of a Strategic Risk Management Model, as it put emphasis on long-term planning and proper coordination in addressing projects that are complex and also in large-scale (Nel, de Goede and Niemann, 2018). Good practices in SCRM, such as modernisation of infrastructure, leveraging of technological advancements, and risk assessments that are proactive, play a key role in the maintenance of efficiency and reliability of the rail networks, while Dani and Deep (2019) argued for the Risk-Based and Strategic Risk Management Models as the options for effective SCRM practices, as they are critical in the mitigation of potential risks, and in maintaining seamless operations of the railway sector.

2.3 The Role of Rail Transportation in Supply Chains

The railway industry is relied upon by the logistics supply chain and third-party suppliers. It is also an effective substitution for the automobile industry and a key player in the economic development of developing countries. Through its close connection with supply chains, the railway industry is part of maintaining efficiency and fostering economic prosperity (Smartrail, 2020). Different models are being developed by different nations and socioeconomic blocks such as the European Union EU), to improve efficiency in the supply chain and the railway industry, to address risks and challenges that are related to the supply chain, within the context of the rail transport, with one such example being the EU's "smart rail" project.

The significance of the rail network can also be traced back to 1998, at a time when the term "supply chain" was not known or mentioned so much in academic writings (Gholamizadeh, Zarei, and Yazdi, 2022). The significant role of the rail network in its involvement with the transportation of coal from the mines to power plants was featured prominently in a study by Lapidus *et al.* (2019). Thereafter, other studies have been examining the features, possibilities, and challenges it presents, and this is attributed to the ever-increasing significance of railway transport services within the supply chain. According to services (Lapidus *et al.*, 2019) the interest of people in railroad transportation services can be categorised into three, with one area of interest being its low external costs, making rail transportation the most cost-effective option for freight services, and it's also eco-friendly. According to Marchet *et al.* (2018), within the shortest time possible, and with less intercity traffic congestion, rail transport offers much more capacity, thereby making this mode of transport a much more favourable mode in the shipment of bulk goods such as metal trash or solid mineral fuel.

2.4 Challenges and Opportunities in Rail-Based Supply Chain Management

The global expansion of supply chains has contributed to the increase of the importance of the use of rail transportation, and this is due to the speed, safety, reliability, lower costs, and eco-friendly nature of this transport mode, in comparison to the road transport (Lapidus *et al.*, 2019; Neumann, 2021; Zhou and Lei, 2020). In addition, Carlier (2021) pointed out that a key priority of supply managers is ensuring that SCRM practices are adhered to in terms of their application as a way of decreasing potential risks. The global increase in rail traffic between 2018 and 2019 is also significant, as the case of the rail traffic proportion in comparison to the road and inland traffic. An example is that of the EU, where rail transport proportion is almost equal to that of road transport (Carlier, 2021).

The opportunities presented to the rail transportation industry, such as increasing its productivity, could be further explored through the enhancement of the SCRM, and this could save costs and improve its service timelines. According to Phillips (2023), the potential benefits of the rail industry, extend to the logistics service providers and customers. As Zhou and Lei (2020) point out, the potential benefits and opportunities of the rail networks are also demonstrated through value creation, efficiency, cost savings, and technological integration, thereby transforming the SCM and the rail network services Viegas and Macario (2010).

3. Methods

This study utilized a qualitative approach and the interpretivism paradigm to address the research problem. Recognizing the complex nature of reality, its subjective aspect, and its social construction, the aim was to understand the research problem by exploring the application of best supply chain risk management practices in the South African railway industry. This involved gaining insights into the lived experiences of the participants, their diverse perspectives, and interpretations of their reality within their natural settings. The target population of the study was drawn from the Supply Chain Management department of BCP Holdings in the railway industry and comprised of managers and senior employees, with the sample size of the study being 10 participants. The sample size was determined by the saturation of the collected data, in relation to the extent of the insightful information that was provided by the participants of the study. As Creswell and Poth (2018) point out, data saturation is the point at which data is collected and reflects the information that had been already collected, implying that there are no new insights about addressing the research problem. The selection of the sample size of the study was guided by purposive sampling, a non-probability sampling technique. This was based on the selection of managers and senior employees who have a minimum of two (2) years' experience within supply chain risk management and are actively working with supply chain risk management activities in their daily working lives. In non-probability sampling, not all individuals in the Supply Chain Management department of BCP Holdings had an equal chance of being in the sample size.

3.1. Data Collection

Data collection in a qualitative study is an integral part of the process, providing insights into the research problem through the lived experiences, views, and multifaceted perspectives of the participants. With a focus on the application of Supply Chain Risk Management in the South African Railway industry, the study adopted semi-structured interviews as the primary source of data, collecting data from the target population. This data collection technique provided an engaging platform between the researcher and individual research participants, with Creswell (2018) pointing out that it facilitates an engaging exchange of views and experiences among the participants. The checklist was used supplementally to avoid overlooking important aspects in the data collection process, as it provided a structured framework for data collection. According to Bryman, DOS Santos and Masenge (2014), a checklist can help mitigate interviewer bias by ensuring that all participants are asked the same set of questions or topics in the same manner.

4. Results and Discussion

4.1 Demographic Information Summary

The study involved 10 participants selected based on their seniority and experience in supply chain risk management within the railway industry. All participants had at least two years of relevant experience, ensuring a strong understanding of industry-specific processes.

4.1.1 Years of Service

The majority of participants (80%) had over 10 years of service in the railway sector, indicating a high level of institutional knowledge (Figure 1). This includes those with 11–15, 16–20, and over 20 years of experience. The remaining 20% had between 6–10 years of service.

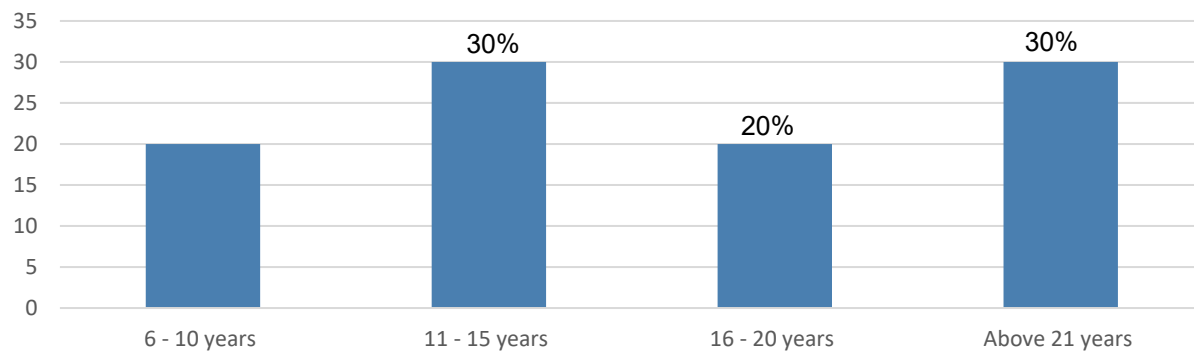


Figure 1. Distribution of participants by years of service in the railway industry

4.1.2 Level of Education

In terms of academic qualifications, 60% of participants held postgraduate degrees 10% with a postgraduate diploma or honours, and 50% with a master's degree (Figure 2). The remaining 40% held either a diploma (10%) or a bachelor's degree (30%), reflecting a strong theoretical foundation in supply chain concepts across the group.

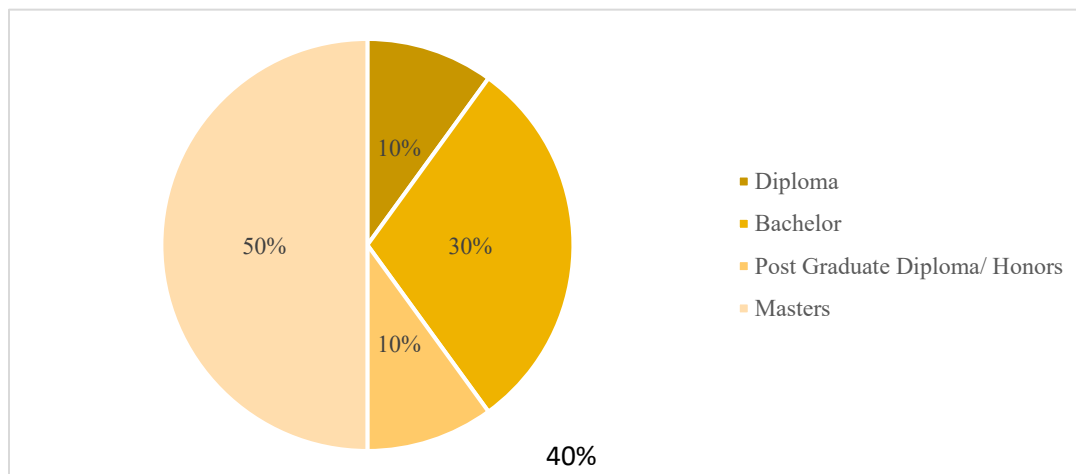


Figure 2. Level of education

4.2 Critical Success Factors

In addressing the critical success factors for the application of Supply Chain Risk Management (SCRM) within the South African railway industry, the findings indicate that there are areas of strength, while others have , and Shah (2018) explain, Supply Chain Management plays a crucial role in the operations of modern business organisations, as it ensures the efficient delivery of products and services to end-users within a dynamic environment of multiple players potential for improvement. Areas that need enhancement include internal processes and systems, as the data point to slow, complex systems and processes unable to adapt to the changing environment of the railways industry. As van Weele, Arjan and Rozemeijer (2022) explain, systems that are outdated could impact the productivity and efficiency of operations, besides exposing an organisation to more potential risks of disruptions. There also appears to be a

collaboration problem, in terms of the reluctance in the sharing of information with stakeholders, further undermining problem-solving and efficiency. While there appear to be some good change management practices, such as training of employees, inclusive change management is emerging as a critical success factor that needs improvement for the application of SCRM practices to be effective. Responses, as indicated in the data, suggest a more collaborative approach, with Viegas and Macario (2010) emphasising the involvement of employees in the process, and an approach to dealing with their concerns could result in a much better outcome of the SCRM practices in the railway industry.

4.2.1 Leadership

The involvement and commitment of leadership in various aspects of SCRM is perceived positively, according to the findings of the study, as per Figure 3, where 60% of the respondents rated it as “Good.” Although the remaining 30% (“Fair”) and 10% (“Poor”) are reflections on the need for more engagement in leadership roles. A suggestion by Singh and Singh (2019) is that leadership effectiveness can be enhanced through targeted training, responsive feedback mechanisms, and the cultivation of a culture centred on risk management.

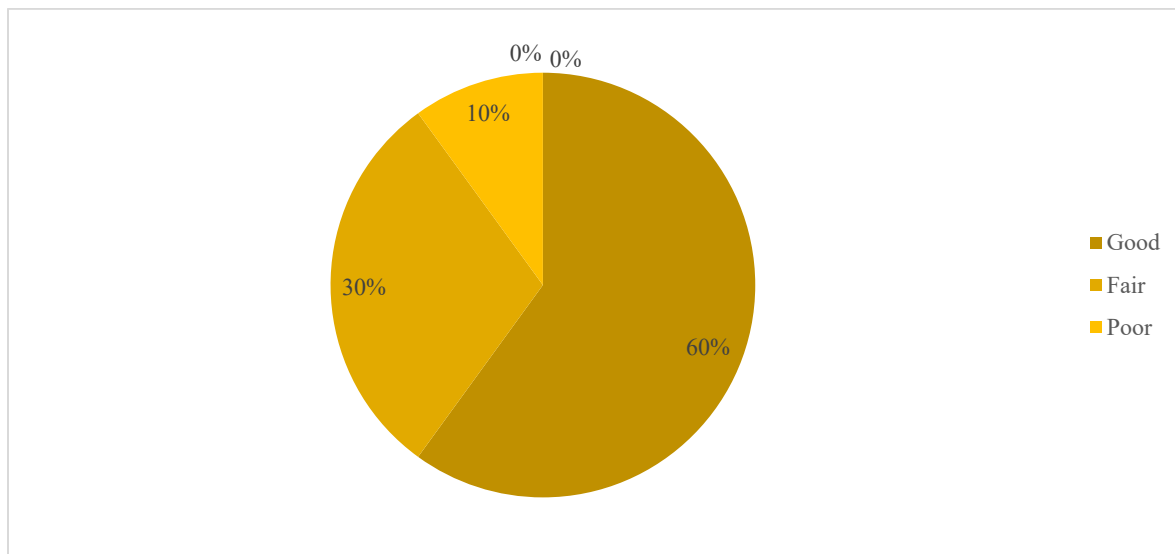


Figure 3. Leadership commitment

4.2.2. Skills and Knowledge

Regarding the participation of multi-stakeholders in SCRM, the study reveals strong support for the involvement of various stakeholders in discussions related to procurement, information sharing, and risk assessments. Nel, de Goede and Niemann (2022) emphasises the potential benefits of multi-stakeholder participation, which includes improved identification and mitigation of risks. And this has the potential to align all stakeholders with the SCRM goals. Organisational culture is also noted as playing a key role in the successful application of SCRM practices, as it is characterised by effective communication, adaptability, and accountability. As Chopra and Sodhi (2020) point out, the enhancement of SCRM practices depends on addressing both the positive and negative cultural traits. According to the findings of the study, there appears to be a generally positive view of the skills and knowledge of the workforce in the management of supply chain risks, where respondents rated it as “Good” stand at 60% of the respondents as per Figure 4, although the rating of “40%” as being as “Fair,” is an indication of the inadequacy of the current skills, and which requires an improvement for an effective SCRM application in the railway industry. This collaborates with Sawik (2020) who argued that investing in the training of the workforce empowers them to manage supply chain risks effectively.

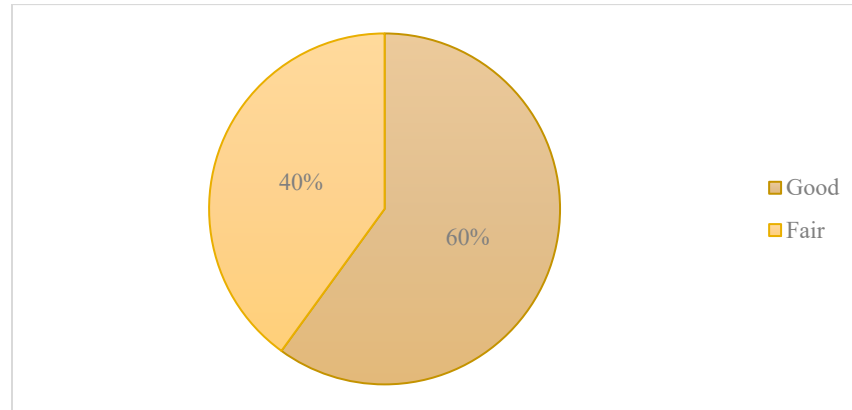


Figure 4. Skills and knowledge capacity

On the aspects of mission and vision in the promotion of a risk-aware culture, the findings point to a reasonable satisfaction with the alignment, where 40% rated the alignment as being “Good,” and 20% rated it as “Excellent,” Although a significant number of respondents, with the rating of 30% (“Fair”) and 10% as (“Poor”), pointing to the need for improvements. AbTalib and Abdul-Hamid (2015) suggest that having clarity on the mission and vision, integrating SCRM into strategic planning, and conducting regular evaluations could improve SCRM practices.

To conclude, although there are positive aspects to the application of SCRM practices in the railway industry, it is critical to address areas in need of improvements, the enhancement of internal processes and systems, the adoption of inclusive change management practices, ensuring strong commitment of leadership, the promotion of multistakeholder participation, cultivation of supporting organisational culture, and investing in the skills and knowledge of the workforce, through education and training.

4.1. Barriers to Effective Supply Chain Risk Management

The study's findings identify areas of potential challenge to effective SCRM practices within the South African railway industry. Effective SCRM practices are being hindered by ineffective communication, such as limited information sharing, inadequate transparency, and stakeholder training. There are also external factors acting as barriers to the effective practices of SCRM, with economic conditions, such as price fluctuations, inflation, and devaluation of the local currency, contributing to budget cuts and thereby having negative effects on resource allocations. Other factors are environmental and globalisation, with globalisation complexities, such as dependency on foreign suppliers, wars, and political upheavals, further increasing the vulnerabilities and potential disruptions in the supply chains within the industry. Chen *et al.* (2018) emphasise the need for robust risk management strategies that account for these external disruptions. Organisations should proactively identify potential risks and diversify suppliers.

Organisational culture significantly affects SCRM effectiveness. Participants noted barriers such as a lack of employee engagement, inconsistent support for risk management initiatives, and inflexible processes. Lin, Hjelle and Bergqvist (2020) highlight the need for a culture that prioritizes continuous learning and flexibility to enhance supply chain resilience. Embracing a culture of accountability and adaptability will support more effective risk management practices. Organisational culture is highlighted in the findings as affecting SCRM efficiency, with issues such as limited employee engagement, inconsistency in support for SCRM initiatives, and inflexible processes. Compliance with legal aspects related to the SCRM practices, as per Figure 5, indicates a positive response, where those rating legal compliance as “Good” stand at 80%, although the remaining 20% rating of “Poor” indicates the need for improvement

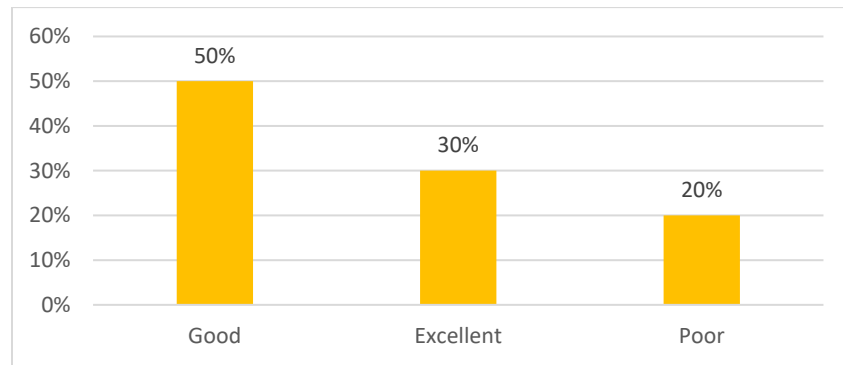


Figure 5. Legal frameworks and regulations

The support of leadership in addressing challenges in the application of SCRM practices is significant, with 60% rating it as “Good”, as per Figure 6, while the remaining 40” of the respondents are within the “Fair” and “Poor” categories suggesting a need for the leadership to engage, train and foster a culture of risk management.

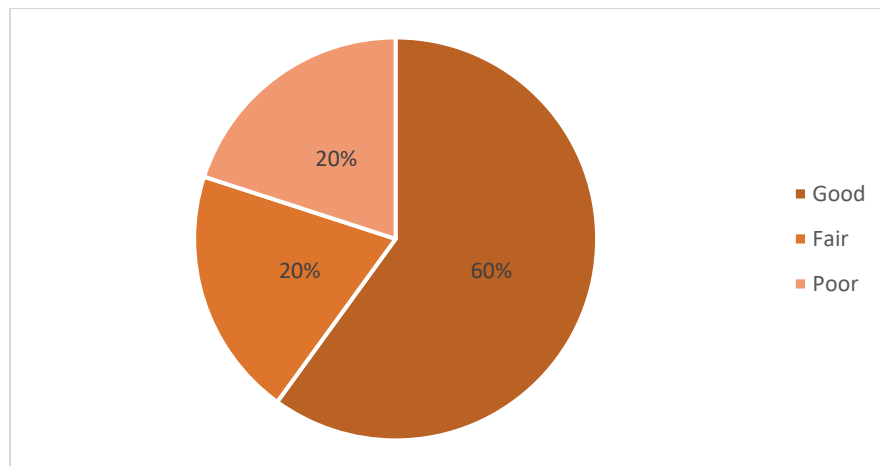


Figure 6. Leadership support

In summary, the research identifies key barriers to effective SCRM in the South African railway industry, including communication gaps, economic challenges, environmental factors, globalization complexities, organizational culture issues, and varying perceptions of compliance and leadership support. Improving communication, managing economic risks, addressing environmental and globalisation challenges, fostering a supportive organizational culture, ensuring robust legal frameworks, and enhancing leadership commitment are essential for strengthening SCRM practices. Adapting to these factors will be crucial for achieving resilience and efficiency in the supply chain.

4.3 Proposed Improvements

The recommendations made are based on the identified gaps in the application of SCRM practices in the South African Railway industry. Key recommendations emerging, include the enhancement of multi-stakeholder communication and collaboration, an increase in transparency, and training programs for the workforce are key in the development of a holistic approach in the implementation of effective mitigation approaches. To avoid disruptions in the supply chain or business operations, the organisation must strategize the management of economic risks through the diversification of suppliers, exploration of alternative source locations, and the adoption of contracting options that are flexible in the mitigation of the potential impact because of economic fluctuations.

There is a need for proactiveness in the identification and management of risks associated with the environment, and this could be done by taking into account the broader context of the railway industry, this could also assist in addressing vulnerabilities and potential threats linked to globalisation. Measures that could be taken include enhancement of partnership relations, and application of robust practices in the management of risks in the supply chain. A culture of continuous learning, adaptation to changing situations, and the involvement of the workforce in skills development are key in helping in the effective management of risks. In addition, the evaluations of legal and regulatory frameworks must be continuous to ensure they are aligned with the SCRM effectively. Finally, leadership support for the SCRM practices must be strengthened, as this could improve the application of SCRM.

5. Reliability and Validity

Validity assesses the degree to which a study successfully measures what it set out to measure, and reliability ensures that there's synergy in the findings, William (2024). In this study, we used content validity, phase validity, and literature triangulation. The researcher conducted a comprehensive literature review to determine the ability to cover the entirety of the literature relating to the subject of interest. The questionnaire was shared with the industry experts to ensure that the questions measure the concept of interest and are easy to understand and interpret. Moreover, an interview protocol was developed subsequent to obtaining feedback from the industry experts and factoring in their opinions to amend the questionnaire. Content validation was done by consulting experts in the industry and submitting to the ethics committee of the university to obtain assurance and alignment with the subject of interest. Literature triangulation was done by comparing the results of the study and contrasting them with the findings from the literature to ensure relevance and alignment.

6. Conclusion

The study highlights the critical role of effective SCRM in enhancing the resilience and performance of the South African railway industry. Key areas for improvement include internal processes, stakeholder engagement, communication, and adaptability to economic and environmental challenges. The findings emphasize the need for a proactive and integrated approach to risk management, supported by strong leadership and a culture of continuous learning. Future research should explore innovative SCRM models tailored to the complexities of global supply chains and assess their applicability in developing economies like South Africa

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Biographies

Thembekile Mangquku completed her MPhil (Engineering Management) from the University of Johannesburg and obtained her Post Graduate Diploma (Risk Management) from the University of South Africa, has a BTech (Operations Management) and a National Diploma in Electrical Engineering from the University of Johannesburg.

She has sixteen years of working experience in the railway industry and is an associate member of the Institute of Risk Management South Africa (IRMSA). She specialises in enterprise risk management and safety management systems.

Dr Bheki B. S. Makhanya is a senior researcher in the Postgraduate School of Engineering Management at the University of Johannesburg. He holds a PhD in Engineering Management from the University of Johannesburg. His research interest includes the cost of quality, total quality management, reliability improvement and risk management.

Prof Jan Harm Christiaan Pretorius obtained his BSc Hons (Electrotechnics) (1980), MEng (1982) and DEng (1997) degrees in Electrical and Electronic Engineering at the Rand Afrikaans University and an MSc (Laser Engineering and Pulse Power) at the University of St Andrews in Scotland (1989). He worked at the South African Atomic Energy Corporation as a Senior Consulting Engineer for 15 years. He also worked as the Technology Manager at the Satellite Applications Centre. He is currently a professor at the Postgraduate School of Engineering Management in the Faculty of Engineering and the Built Environment where he has worked since 1998. He has co-authored over 240 research papers and supervised 61 PhDs and over 270 Master's students. He is a registered professional engineer, professional Measurement and Verification practitioner, senior member of the Institute of the IEEE, a fellow of the SAIEE and a fellow of the South African Academy of Engineering.