INVESTIGATING STRATEGIES TO IMPROVE SUPERIOR SUSTAINABLE PERFORMANCE IN THE NAMIBIAN MINING INDUSTRY

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Abstract

The mining industry is the primary sector anchor and the largest contributor to the gross domestic product (GDP) of the Namibian economy and it can potentially drive the country towards industrialization by adding value to its products via the implementation of the Mineral Beneficiation Strategy (MBS). Unfortunately, the mining industry is currently unsustainable because 52% of the operations have stopped production. This research is aimed at investigating strategies that may potentially improve superior sustainable performance in the Namibian mining industry. The research methodology applied, utilised the explanatory sequential mixed methods research (MMR) approach. In this case, quantitative and qualitative data were collected by using a self-administered open-ended questionnaire and a semi-structured interview guide, respectively. To improve superior sustainable performance, the data inferred that the mines should successfully execute strategic projects such as the life of mine extension, increasing production, improving efficiencies, and improving all-in sustaining cost (AISC). It was found that the major factors negatively influencing superior sustainable performance include the following: a decline in commodity prices, mine flooding due to underground water, geotechnical risks, depleted ore reserves, declined ore grade, and mineralogical changes. The strategies to improve superior sustainable performance were established by applying a SWOT/TOWS analysis model and by creating an integrated strategy map that consider several mining operation sustainability aspects. Initiatives for reducing the cost of electrical power were recommended i.e., building a nuclear power plant, green hydrogen plant and the Kudu gas power station. Further research should focus on the policy regarding tax relief for mining companies that are struggling to remain sustainable.

Keywords: Strategic Management, Sustainable Performance, Mining Industry, Mineral Beneficiation

Declaration

I, Thomas Ehongo Moongo, hereby declare that this research truly reflects my own effort, and that it was never submitted for any qualification at any other University neither partly nor entirely. I also declare that this thesis contains my original work, and the work of other authors has been acknowledged appropriately. This thesis may not be reproduced or transmitted without acquiring permission in writing from the Author or from the University of Namibia (UNAM).

Thomas Ehongo Moongo	___________	April 2023
Name	Signature	Date

"Culture eats strategy for breakfast" - Peter Drucker

"Strategy without execution is just hallucination" - John McAuliffe

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Sir Isaac Newton (1675) said "*if I have seen further, it is by standing on the shoulders of Giants*". My sincere thanks go to my supervisor, Dr. Felix G. Bello, for his constant and caring unwavering support while conducting this research. He went beyond his call of duty by reviewing the extended abstract for this research that was published as part of the conference proceedings. He also made time to attend the Southern African Institute of Mining And Metallurgy (SAIMM) hybrid conference on Sustainable Development in the Minerals Industry (SDIMI), the 10th International Conference where I presented this research to an international audience. I highly appreciate the guidance and coaching provided. Thank you very much.

A list of publications and conference presentations:

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List of Abbreviations

AI	Artificial Intelligence
AISC	All-In Sustaining Cost
AP	Acid Plant
BSC	Balanced Scorecard
BAT	Best Available Technology
BFS	Bankable Feasibility Study
CAS	Complex Adaptive Systems
CAPEX	Capital Expenditure
CGN	China General Nuclear Power Corporation
COP	Cost Of Production
COM	Chamber Of Mines
COVID-19	Coronavirus Disease
DTP	Digital Technology Programme
DMPE	Department of Mining and Process Engineering
DPMT	Dundee Precious Metal Tsumeb
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
ECB	Electricity Control Board
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EVs	Electric Vehicles
EW	Electrowinning
FS	Feasibility Study

GDP	Gross Domestic Product
HPP	Harambe Prosperity Plan
KPI	Key Performance Indicator
IRR	Internal Rate of Return
LOM	Life Of Mine
LHM	Langer Heinrich Mine
LME	London Metal Exchange
LDI	Lac Des Iles
LHD	Load-Haul Dump
MLF	Machine Learning Functionality
MME	Ministry of Mines and Energy
MOA	Memorandum Of Agreement
MMR	Mixed Methods Research
MBS	Mineral Beneficiation Strategy
NAMIS	Namibia Minerals Industry Symposium
NATO	North Atlantic Treaty Organization
NDP	National Development Plan
NCE	Namibia Chamber of Environment
NMCF	Namibian Mine Closure Framework
NUST	Namibia University of Science and Technology
NPV	Net Present Value
Q1	First Quarter
RE	Renewable energy

RO	Reverse Osmosis
ROI	Return On Investment
ROM	Run Of Mine
RP2.0	Rosh Pinah Expansion Project
RHF	Rotary Holding Furnace
R&D	Research And Development
SADC	Southern African Development Community
SAG	Semi-Autogenous
SBU	Strategic Business Unit
SO	Strengths and Opportunities
WT	Weaknesses And Threats
SACU	Southern African Customs Union
SADC	Southern African Development Community
SAIMM	Southern African Institute of Mining and Metallurgy
SDIMI	Sustainable Development in the Minerals Industry
SU	Swakop Uranium
SLO	Social License to Operate
SHE	Safety, Health And Environmental
SPUT	Sprott Physical Uranium Trust
SWOT	Strength, Weakness, Opportunity, And Threat
SX	Solvent Extraction
H_2SO_4	Sulphuric Acid
PAYE	Pay As You Earn

PCS	Plant Control Systems
PPA	Power Purchase Agreement
PV	Photovoltaic
TDR	Time Domain Reflectometry
PESTLE	Political, Economic, Social, Technology, Legal, And Environment
PS	Pierce-Smith
PPI	Policy Perception Index
TSF	Tailings Storage Facility
TPA	Tons Per Annum
VAT	Value Added Tax
WGC	World Gold Council

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CHAPTER ONE: INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction

The Namibian minerals industry produces various commodities including special high-grade zinc, gold bullion, blister copper, grade A copper cathodes, uranium oxide, gem-quality diamonds, cement, semi-precious stones, salt, chemicals, tin concentrate, zinc, and lead concentrates (Moongo & Michael, 2021). The mining industry is the biggest contributing sector to the national economy in comparison to agriculture and fishing. It contributed 9.0%, 9.4%, 10.1% and 9.1% in 2018, 2019, 2020 and 2021, respectively. Therefore, it can potentially drive the country towards industrialisation (Chamber of Mines, 2020). It is on this basis that a Mineral Beneficiation Strategy (MBS) was developed to ensure that the minerals are utilised as raw materials (feed stock) that can be beneficiated to contribute further to industrialisation and manufacturing via value-addition within Namibia (Ministry of Mines and Energy, 2019; Malango, 2015).

Improving superior sustainable performance for the mining industry is essential for Namibia to become an industrialised country. Namibia envisions to be an industrialised country as stipulated in Vision 2030, the Harambe Prosperity Plan (HPP), the 5th National Development Plan (NDP5), and other high-level strategies such as “Growth at home” which is Namibia’s execution strategy for industrialisation (Ministry of Trade and Industry, 2018; Vision 2030, 2004; Harambe Prosperity Plan, 2016). Unfortunately, Namibia’s industrialisation vision by adding value to mining products via setting up several manufacturing industries hence resulting in industrialisation may be drastically affected if more mines continue ceasing production. However, an investigation into strategies to improve superior sustainable performance in the Namibian mining industry may assist in stabilising the industry by coming up with strategies that can potentially improve superior sustainable performance.

1.2 Background of the study

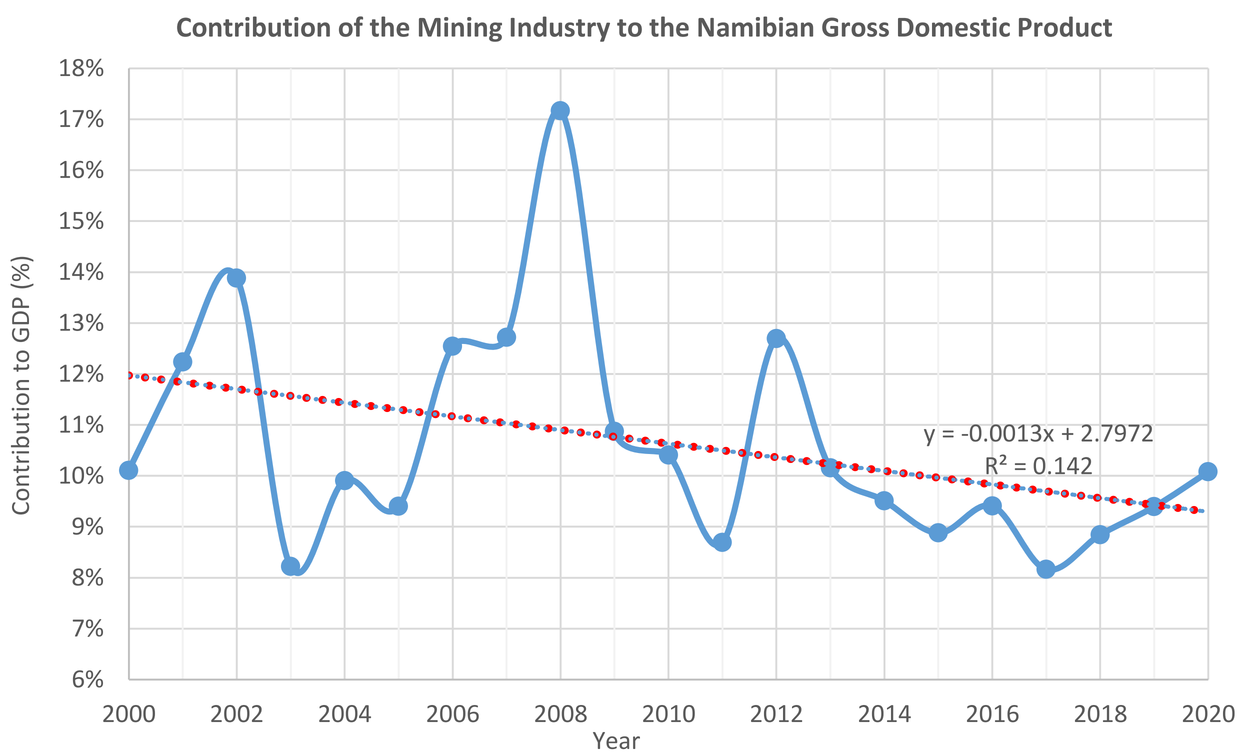
This research focused on investigating strategies to improve superior sustainable performance in the Namibian mining industry. The research was necessitated by a puzzling statistic that indicated that approximately 52% of operations in the Namibian mining industry have ceased production between 2000 and 2021. The author has identified a knowledge gap in terms of the application of strategic management principles to address this unchartered/unexplored challenge by applying an explanatory sequential mixed methods research approach. Improving superior sustainable performance in the mining industry is critical for the successful implementation of the Mineral Beneficiation Strategy (MBS) which can significantly contribute to the realisation of the envisioned industrialisation in Namibia. This research has a potential to drive the Namibian mining industry towards sustainable beneficiation of minerals by establishing superior sustainable performance strategies that address practical challenges and maximize on the existing opportunities.

The application of strategic management has been positively correlated with improved business performance. However, not all mining operations make use of strategic management processes. A study by Boikanyo et al. (2016) concluded that approximately 20% of mining companies in South Africa, Africa, and globally were not utilising strategic management processes. As such, about 60% of them were not having satisfactory productivity and 30% of them had unstable cash flows. Such effects can potentially result in the closure of mines. In Namibia, 52% of the mines that operated between 2000 and 2021 have stopped production. This puzzling statistic triggered to author to investigate the extent to which strategic management is applied in the Namibian mining industry.

After conducting a thorough literature review it was noted that no research has been done to establish strategies for improving superior sustainable performance in the Namibian mining industry. It was established that strategy implementation is not a commonly researched area, especially functional strategies at operational level. Therefore future research should focus on this area (Li et al., 2014). Moreover, according to Boikanyo et al. (2016), "there is still a void in academia and practice about the use of strategic management processes and analytical tools in the mining sector for strategy formulation and implementation" (p. 485). In addition, the study by Boikanyo et al. (2016) recommended future studies to focus on hardly researched areas by examining critical success factors for strategies in the mining industry, studying the effect of the geographical location of the mines, and the effect of the regulatory framework on the performance of the mines. This research is therefore filling this identified knowledge gap in the literature by addressing the above-mentioned recommendations specifically for the Namibian mining industry. It is worth noting that the main objective of the above-mentioned researchers was to investigate the extent to which strategic management process is applied in the mining industry. However, the current study contributes to the body of knowledge and industrial practice by investigating strategies to improve superior sustainable performance for mines in Namibia.

1.3 Statement of the problem

It is not clear why there is an increasing trend of mines ceasing production in Namibia. Considering the prior identified knowledge gap, it is critical to investigate this challenge from a different angle. The current situation is that from the year 2000 to 2021, 13 out of 25 (52%) of the mining operations in Namibia have stopped production either temporarily or permanently. As a result, the contribution of the Namibian mining industry to the Gross Domestic Product (GDP) is also having a decreasing trend as can be seen on the negative slope of the model in Figure 1 and it could have been improved better than it is presently.



Source: Chamber of Mines (2021) via https://chamberofmines.org.na/stats/

Figure 1 *: Contribution of the mining industry to Namibian gross domestic product*

Between the year 2000 and 2021, it was observed that 13 mining operations stopped production or were put on care and maintenance temporarily or permanently at some point due to several reasons. The mining operations that ceased production and those that could have been operating during the period concerned are as follows: 1) Kombat Copper Mine, 2) Okorusu Fluorspar Mine, 3) Okanjande Graphite Mine, 4) Otjozondu Manganese Mine, 5) Elizabeth Bay Mine, 6) Desert Lion Lithium Project, 7) Namib Lead and Zinc Mine, 8) Langer Heinrich Uranium Mine, 9) Trekkopje Uranium Mine, 10) Otjihase Mine, 11) Matchless Mine, 12) Tschudi Copper Mine, and 13) Skorpion Zinc Mine.

The increasing trend of mines not continuing with production caused a lot of other problems for example decreasing the generation of the Government income in the form of Pay As You Earn (PAYE), Value Added Tax (VAT), corporate taxes, royalties, and export levies. Moreover, it increased the national unemployment rate especially among the youth due to multiple resultant retrenchments. This does not give confidence for investing in setting up manufacturing industries that depend on raw materials originating from the mining industry (downstream beneficiation) or that will be supplying raw materials utilised for mineral processing (side stream beneficiation). Ideally, the mining industry should have few mines ceasing production and more mines commencing operation. This prevailing situation needs to be investigated so that superior sustainable performance strategies can be established to potentially reverse or ease the increasing trend of mines ceasing production.

Essentially, the MBS is a good starting point for boosting manufacturing and industrialisation in Namibia. However, two main challenges identified in the MBS are the attraction of investors and inadequate capacity for the mining industry to supply sufficient raw materials for the manufacturing industry (Ministry of Mines and Energy, 2019). Although additional raw materials (minerals) can be imported, other countries may consider setting up similar manufacturing industries instead of exporting all their mining products as unfinished goods. Worse enough, some of the local mines may not be sustainably operated to give investors confidence in setting up local manufacturing industries.

Consequently, this study may fill the identified research gap and it can potentially enable mines to operate profitably in the long term. It may also assist with contributing to the realisation of the envisioned manufacturing industry and hence industrialisation in Namibia by fortifying the knowledge gap identified and addressing some of the challenges highlighted regarding the implementation of the MBS. This area is rarely researched in academia. Therefore, this research attempts to provide significant academic and practical solutions by bridging the deficiencies that may hamper value-addition to minerals and also contribute to the body of knowledge. It might also enhance investment decision confidence for setting up manufacturing industries in Namibia.

1.4 Objectives of the study

This study aims to investigate strategies that may potentially assist with improving superior sustainable performance in the Namibian mining industry. Improving superior sustainable performance in the mining industry may assist with the successful implementation of the MBS and hence contribute toward Namibia's industrialisation vision. The specific objectives of the study are:

(i) To assess the application of strategic management as a tool for improving superior sustainable performance in the Namibian mining industry.

(ii) To examine the critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry.

(iii) To evaluate the effect of governmental regulatory frameworks and policies on the implementation of strategies to improve superior sustainable performance.

(iv) To develop strategies for improving superior sustainable performance for mines in the Namibian mining industry.

(v) To create an integrated strategy map for improving superior sustainable performance for the mining industry.

1.5 Significance of the study

The research attempts to provide significant academic and practical solutions by filling the identified knowledge gap and further exploring the recommendations given by other authors. The study has tapped into uncharted/unexplored waters by developing strategies that can improve superior sustainable performance of mines in the Namibian mining industry. This study may contribute further to the body of knowledge by attempting to decrease or ease the increasing trend of mines ceasing production in Namibia.

Essentially, the study may be significant to the realisation of the envisioned manufacturing industry and hence industrialisation in Namibia by addressing issues related to the implementation of the MBS. It may also enhance investment decision confidence for setting up manufacturing industries in Namibia that may acquire raw materials from a superior sustainably performing local mining industry.

Moreover, this research has the potential to improve the contribution of the mining industry to the gross domestic product (GDP), maintaining and increasing employment opportunities, and increasing other Governmental income generation opportunities such as Pay As You Earn (PAYE), Value Added Tax (VAT), corporate taxes, royalties, and export levies. In general, the research contributes also signify the importance of the applications of strategic management in different industries.

1.6 Limitation of the study

The two main limitations of the study are data collection, especially from mines that have suspended production and respondents being restricted from sharing confidential mining company information. The first limitation occurred because it was difficult to get in touch with people from the mines that ceased production. The second limitation is that respondents signed confidentiality agreements when they were employed by the mines. The impact of these limitations is the delay in the collection of data, low response rate, and consequently delayed data analysis.

The first limitation was addressed by tracing respondents from mines that have ceased production by utilising a search function on professional networking websites such as LinkedIn and by asking other respondents. The second limitation was addressed by informing the respondents that their anonymity will be respected, and they should feel free not to answer questions they were not comfortable with. The researcher also observed that respondents who were either retrenched or who moved to another mine were willing to give more information about their previous mining companies. Those who were either studying or recently obtained post-graduate qualifications were also very cooperative.

The researcher has noted that the study by Boikanyo et al. (2016) researched a total of 300 mining organisations in South Africa, Africa, and globally, and a response rate of 64% was achieved. The interpretation was done based on this response rate. A similar thing was done also for this research within Namibia after considering the mitigation measures to the above limitations and a better response rate of 68% was obtained via the questionnaire survey.

1.7 Delimitation of the study

The inclusionary delimitations of the study include mines that have operated in Namibia between the year 2000 and 2021. Mining projects that were at an advanced development stage during this period were also included in the study. This is because they might have been affected or delayed by the same issues affecting fully operational mines. The exclusionary delimitations of the study include new projects which were still under exploration and mines outside Namibia.

1.8. Structure of the Thesis

The thesis is structured as follows: Chapter One covers the introduction and background to the study, Chapter Two incorporates a literature review, Chapter Three discusses the research methodology, Chapter Four contains results and discussions, and Chapter Five entails conclusions and recommendations.

1.9. Chapter Summary

This chapter was focused on the introduction and background section for this research. The following topics were covered: introduction, background of the study, statement of the problem, objectives of the study, significance of the study, limitations of the study, delimitations, and the thesis structure. In short, it was highlighted that the Namibian mining industry is the primary sector anchor and the largest contributor to the gross domestic product (GDP). Unfortunately, the mining industry is currently unsustainable and this research is aimed at easing the situation by investigating strategies that may potentially improve superior sustainable performance. The research will be critical to the realisation of the envisioned manufacturing industry in Namibia by addressing issues related to the implementation of the Mineral Beneficiation Strategy (MBS).

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The literature review chapter covers basic concepts of strategy, mining strategy, sustainability of mines in Namibia, possible root causes of mines closing in Namibia, mineral beneficiation, mineral beneficiation strategy (MBS), and its challenges especially in the Namibian mining industry.

2.2 Understanding the strategy concept

Based on the reviewed literature, the word strategy was initially adopted in the military industry before it was applied in business (Nickols, 2016). Therefore, there is no universally agreed definition of strategy. Although it comes from the Greek word strategia, which translates to "*generalship*", the term was first coined in Sun Tzu's classic referred as 'The Art of War'. Strategy is focused on the deployment of troops into position before the opponent is attacked. Strategy was defined as "the art of distributing and applying military means to fulfil the ends of policy" (Nickols, 2016, p. 2). The concept was then transferred to business by replacing troops with resources.

The frequently used definition of strategy that was given by Johnson and Scholes is that a "strategy is the direction and scope of an organization over the long term, which achieves advantage in a changing environment through its configuration of resources and competences with the aim of fulfilling stakeholder expectations" (Steinmann et al., 2015, p. 1). George Steiner who is considered the father of strategic planning referred to it as the visionary and directional decisions made by top management which are executed to ensure the realization of the direction of the organisation by determining the means to achieve the desired ends (Nickols, 2016). Shavarini et al. (2013) define it as a comprehensive master plan for accomplishing the objectives and missions of the business. This definitions of strategy are aligned with the visionary and directional decisions made to drive Namibia towards becoming an industrialised nation by adding value to the products from the mining industry via the establishment of the mineral beneficiation strategy (MBS) and its implementation plan.

Another interesting viewpoint is given by Michael Porter who explained strategy from a competitive strategy viewpoint. He argues that a competitive strategy is focusing on establishing a competitive position and it is “about being different”. Porter (1996) defines competitive strategy as the choice of a deliberate set of different actions and distinguished decisions undertaken by a business and represented as a roadmap for accomplishing unique business objectives to attain an inimitable competitive advantage to achieve the envisioned future state of the business which is different from that of competitors (Casadesus-Masanell & Ricart, 2009).

In the case of the Namibian mining industry, the competitive advantage stems from the fact that Namibia is currently the second biggest producer of uranium world-wide. Therefore, Namibia need to make a deliberate and distinct decision to ensure that value-addition to the produced uranium oxide is done locally for instance by setting up nuclear power plants. This is a unique opportunity at which Namibia has a strategic advantage as compared to many other countries. This research will then assist with improving superior sustainable performance of the overall mining industry including uranium mines.

2.3 Tests for a winning strategy

There are three tests that a winning strategy should pass. These tests are the fit test, the competitive advantage test, and the performance test. The fit test entails demonstrating that the strategy fits both dynamic circumstances of the environment within and outside the organisation. The second test is focused on establishing a strategy that can enable the company to have a sustainable competitive advantage over its rivals. Lastly, the performance test ensures that the business attains superior performance especially when it comes to market share, profitability, and competitive strength (Kaplan & Norton, 1996). This tests for a winning strategy can also be applied to the superior sustainable strategy presented in this research.

In the context of the mining industry, the mine should have superlative profitability by decreasing the cost of production (COP) and maintaining a healthy all-in sustaining cost (AISC) via executing operational duties more efficiently and effectively as compared to competitors. Another option for increasing the profitability of the mines is product differentiation, for example by producing byproducts. Good examples from the Namibian mining industry include: Skorpion Zinc Mine that produces copper cement, Langer Heinrich Uranium Mine planning to produce vanadium as a byproduct, Dundee Precious Metal Tsumeb smelter producing sulphuric acid as a byproduct etc. Therefore, it may be rightfully assumed that operational activities are the building block of competitive advantage. Hence, it is crucial for operational activities to be different from those of the rivals and this is the essence of strategy (Porter, 1996). Essentially, operational activities are a key for mining companies to maintain their strategic position and for them to survive different challenges.

2.4 Levels of strategy

In general, there are three primary levels of the strategy corresponding to the levels of management for an organisation. These levels of the strategy include corporate strategy, competitive or business strategy, and operational or functional strategy. It is critical for the business to establish well-coordinated strategic thinking, strategic planning, and strategic management which are all related at all three levels for it to succeed. An appropriate organisational structure normally assists with cascading the strategy from the corporate level to the business level and then to the functional level (Wheelwright, 1984; Ritson, 2011; Steinmann et al., 2015; Nickols, 2008; Shavarini et al., 2013; Kaplan & Norton, 2006). These three levels of strategy are discussed and depicted in Figure 2. A similar organizational structure is also applied in the mining industry in Namibia. The corporate strategy and the business strategy can be established at the headquarter of the mining company e.g., at B2Gold's headquarter in Vancouver, Canada. While the operational strategy can be developed and executed at the Otjikoto Gold Mine in Namibia.

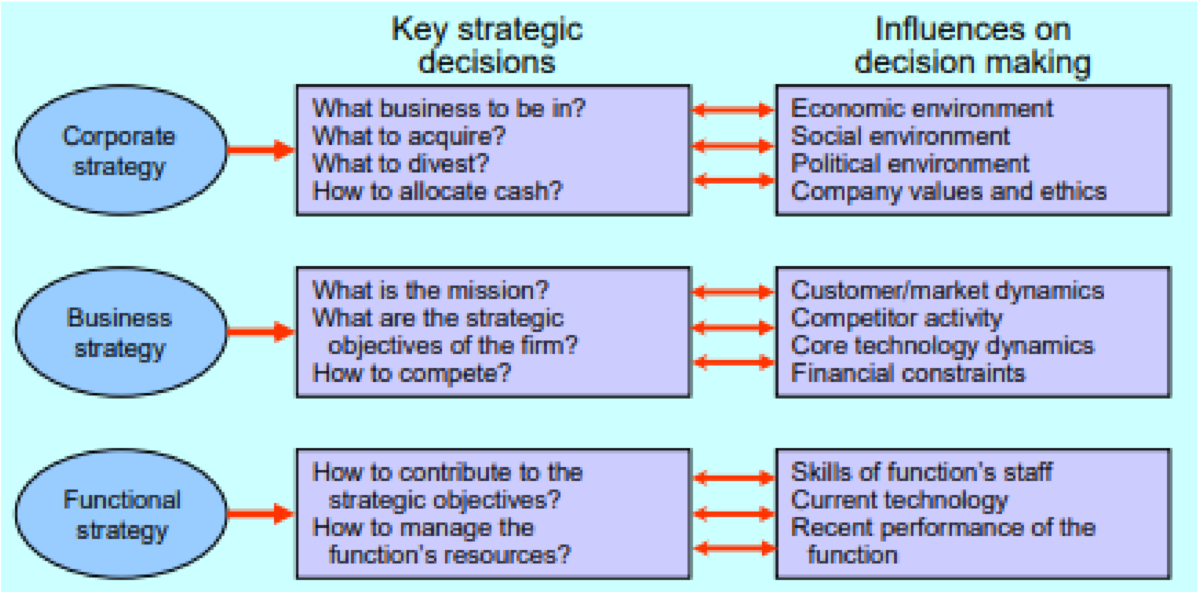


Figure 2: *A summary of the levels of strategy*

2.4.1 Corporate level strategy

McLaughlin et al. (1991) report that the corporate strategy process entails strategic activities such as objective setting, external environmental analysis, and the analysis of the weaknesses and strengths within the organisation. Therefore, the corporate level strategy focuses on decisions regarding the market area or business area in which the company is operating and resource allocation for various business units (Ritson, 2011; Steinmann et al., 2015; Wheelwright, 1984; Li et al., 2008; McLaughlin et al., 1991).

2.4.2 Business level strategy

Unlike the corporate strategy, business strategy is utilised as a tool for achieving a competitive advantage within the business area the company is operating (Shavarini et al., 2013; Ohmae, 1982). Business strategies are categorised into four types, namely, reactor, prospector, defender, and analyser (Rhee & Mehra, 2006). The competitive or business strategy entails setting the scope of each strategic business unit (SBU), establishing a connection between the corporate level strategy and the operations strategy, and it ensures that the business can remain sustainable by establishing a powerful competitive advantage. For this to be achieved, the products must be provided to the right markets, and they must meet customer specifications (Ritson, 2011; Steinmann et al., 2015; Wheelwright, 1984). Two concepts may be used for business strategy, they are cost leadership and differentiation (Porter, 1980; Surujhlal et al., 2014; Wright et al., 1991; Murray, 1988; Jones & Butler, 1988).

2.4.3 Functional level strategy

The functional level strategy also referred to as operational level strategy is focused on the means, especially on how various business functions such as human resources, marketing, production, finance, etc., create a synergy that assists with supporting the desired competitive business strategy (Ritson, 2011). The business functions are divided into two categories, namely, primary functions e.g., production, manufacturing, etc., and supporting functions such as human resources, information technology, etc. (Ritson, 2011; Wheelwright, 1984; Steinmann et al., 2015). This study mainly focuses on operations strategy, hence the need to fully understand it.

2.5 Operations strategy

Operations strategy was defined by Slack and Lewis (2011) as "the total pattern of decisions that shape the long-term capabilities of any type of operation and their contribution to overall strategy, through the reconciliation of market requirements with operations resources" (p. 22). Therefore, it entails establishing a long-term strategy and processes for sustaining a competitive advantage (Veiga & de Lima, 2020). Considering the fact that, the operations strategy is focused on long-term success of the mine by improving sustainability of the operation, this is exactly what this research is aiming to achieve. The strategies established in this research are therefore operational level strategies. It is of paramount importance to recognise operations as a critical aspect of the value chain when formulating corporate and business strategies (Fiorentino, 2016; Brown & Blackmon, 2005). Since the operations function is answerable to the production of goods and services. It can be rightfully assumed that the operations department is the profit-generating engine of the mine and an appropriate strategy should be established to decrease the cost of production (COP), improve the all-in sustaining cost (AISC), and increase profitability (Shavarini et al., 2013; Schroeder et al., 2011; Skinner, 1969). The factors that influence profit-generation of the mines were investigated in this research. This is because this is one of the key factor that affect the sustainability of the mining industry in Namibia. It is normally a lagging indicator, because it is a result of many other factors which were not well managed at the mine.

2.5.1 Four perspectives on operations strategy

Four perspectives of operations strategy were found in the reviewed literature. The perspectives are as follows: a top-down reflection of the entire business, a bottom-up reflection of operational improvement necessary to achieve strategic intentions, translating market requirements into operations decisions, and maximising from operational resources. In most cases, the mining companies prefer bottom approach. This is because it allows practical challenges to be addressed appropriately. However, a combination of the perspectives is somewhat the best optoin. The four perspectives are depicted in Figure 3. A combination of these four perspectives gives a better view of what operations strategy is all about (Slack & Lewis, 2011; Shavarini et al., 2013).

The top-down perspective is focusing on high-level decisions that are made as part of the corporate and business-level strategies. Such decisions are normally cascaded into the operations strategy. The bottom-up perspective is a result of strategies that emerge from daily practical life experiences established at the operations level. The makes the strategy very realistic to the mining operations. Since the strategies established in this research are focused on operations strategies, further literature review was done on operations strategy in the next section. It is essential that the operations strategy is tailored to the required qualitative standards of the customers. Lastly, the resources of the operation should be able to support long-term operations strategy (Slack & Lewis, 2011).

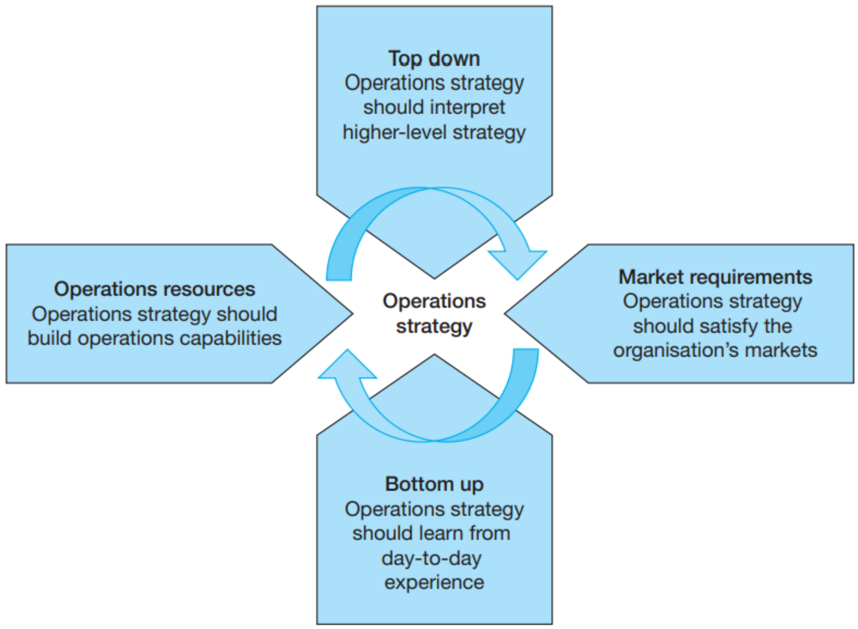


Figure 3: The four perspectives on operations strategy *(Source:* Slack & Lewis, 2011)

2.6 The process of establishing the operations strategy

The process of establishing the operations strategy entails reconciling the operations resources with the market requirements and it is executed through four stages as shown in Figure 4 (Slack & Lewis, 2011). For the Namibian mining industry, this would entail characterizing the ore reserves and ensuring that there is a market for the final products at the right quality and price. The first of the four stages involves operations strategy formulation. In this stage, the objectives and decisions of the operations strategy are aligned or articulated by considering the gap between operations resources and market requirements. This is normally initiated by the top management of the mine and then it cascades down to operations staff. Therefore, all operational challenges will be holistically addressed via strategy formulation for the mine.

During this stage, Michael Porter's five forces should be considered for establishing static and defensive approaches. The second stage ensures that the implementation of the operations strategy is aligned with operations resource capability, and market requirements. Implementation of strategies in the Namibian mining industry is a challenge. In general most of the strategies struggle with this phase. Therefore, appropriate action should be taken to ensure that the implementation is done well. The third stage involves monitoring the operations strategy activities, plans, and performance. This assists in making sure that the activities are executed as planned. The last stage is normally executed together with the previous stage (Slack & Lewis, 2011).

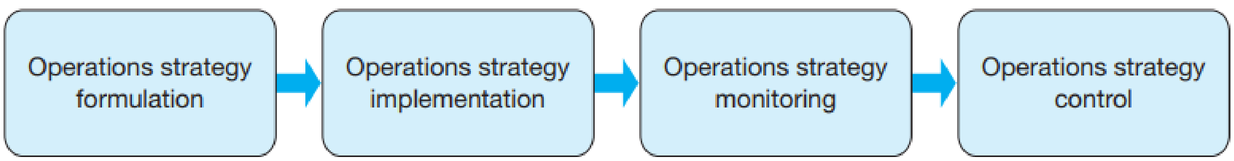


Figure 4: Operations strategy process stages *(Slack & Lewis, 2011)*

2.7 Strategic operational decisions

Operational areas that require operational strategic decision-making should be first identified before the development of operations strategies. According to Shavarini et al. (2013), such operational areas include vertical integration, capacity, facilities, product technologies, and process technology. For a typical mine, the strategic operational decisions can be executed if the general manager work in coordination with all other managers such that the entire operation is covered from geology, mining and processing. The support functions should also be involved.

2.7.1 Vertical integration strategy

Vertical integration is a crucial operational decision in which the company owns or controls the distributors or suppliers. In this case, the supply chain is integrated, and it is owned by the company (Beckman & Rosenfield, 2008; Shavarini et al., 2013). A good example of vertical integration in the Namibian mining industry is at Swakop Uranium Mine. This mine supply uranium oxide to China and it is 90% owned by China General Nuclear Holding. Therefore, it is used for nuclear power generation in China. Which means the Chinese company controls the entire value chain from production of uranium oxide to production of nuclear power (Swakop Uranium, 2022).

2.7.2 Capacity strategy

The quantity of the products required should be established to fulfil a specific demand (Beckman & Rosenfield, 2008). The capacity strategy can be achieved by doing three things. The first is developing a lead strategy via establishing the future demand forecast. The second is the lag-strategy in which the company is more conservative due to unfulfilled average demand. The third option is the stay-even method which is applied when the average demand is achieved, however, the business is having excess capacity and insufficient capacity half of the time.

2.7.3 Facilities strategy

The facilities strategy considers the location and size of the facilities as strategic options (Stevenson, 2009). Different sizes of the facilities have different advantages. Small facilities create a more convenient environment, improving flexibility and enhancing the response rate to market demand. While larger facilities enable businesses to have economies of scale. Moreover, for raw materials that can end up decreasing in size and weight during the production process, it is better for the facility to be located near raw materials (Shavarini et al., 2013).

2.7.4 Product technology strategy

Decisions for the selection and design of products are made by management, and it influences the design of the entire process (Heizer & Render, 1993). A lot of businesses are forced to develop new products and there are at least three options that should be considered in this case, namely, developing a new product line, developing product applications, and offering new products (Stevenson, 2009). Other researchers concluded that there is a correlation between flexibility, product innovation, and product quality (Alegre-Vidal et al., 2004).

2.7.5 Process technology strategy

This is a capital-intensive decision that influences the process technology which is applied in the production of differentiated goods. Four types of process technology strategies were identified in the reviewed literature, they are, variety-based strategy, standard-based strategy, automation-based strategy, and mass customisation strategy (Heizer & Render, 1993). All the above-mentioned strategies that are considered as areas of operations decision-making have been summarised in Figure 5. In the Namibian mining industry, a number of mines are working on re-designing their processes in order to remain sustainable. This is critical for the long term success of the mine.

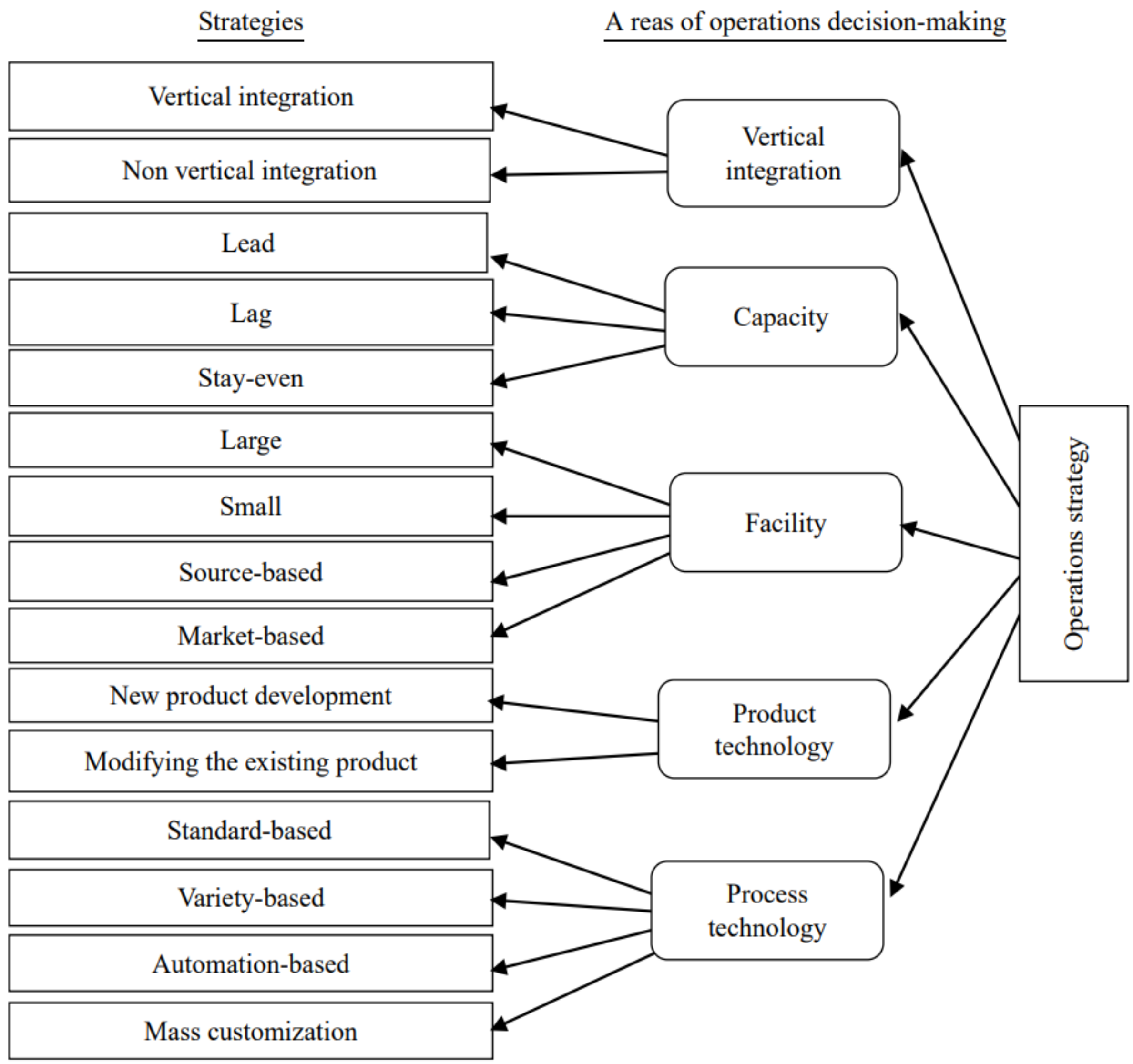


Figure 5: Operations strategy framework [Source: *(Heizer & Render, 1993)*]

2.8 Strategy Formulation

The process by which strategies are executed involves stages such as initial assessment, situational analysis, strategy formulation, strategy implementation and then monitoring and control (Boikanyo et al., 2016). Strategy formulation entails creating a strategy that is part of the strategic plan to be executed (Ulwick, 1999). Therefore, strategy formulation refers to the process of creating a strategy to ensure a better future for the business by establishing a road map that will result in a strategic breakthrough by strengthening the competitive advantage and strategic position of the business. The logical elements that constitute the strategy formulation process are strategic intent, strategic choice, and strategic assessment (Ulwick, 1999).

During strategy formulation, a high-level intention of the business should be considered. Therefore, the strategic intent is critical. The strategic choice has to do with specific decisions made with the faith that they will direct the organisation towards achieving the strategic intentions (Macmillan & Tampoe, n.d.). The strategic assessment focuses on the overall assessment of the strategy formulated in terms of the probability of the company attaining the defined strategic intent and on the consequences of the action that may be taken. The entire formulation process should be done by consulting different stakeholders (Surujhlal et al., 2014). In the Namibian mining industry, the strategies are formulated by having a specialized departmental or operational level meeting annually in order to set strategies for improving the operation.

2.9 Types of strategic formulation

Based on the literature reviewed, seven types of strategy formulations exist. They are as follows: planned strategy, unrealised strategy, deliberate strategy, emergent strategy, imposed strategy, realised strategy, and opportunistic strategy (Ritson, 2011; Casadesus-Masanell & Ricart, 2009). The arrangement between these strategies is shown in Figure 6. In the mining industry, different tyes of strategy formulation can be actualized depending on the existing practical challenges on the ground. These strategy formulations were the ones that were investigated in this research in order to develop best practices that will assist with improving superior sustainable performance in the long term.

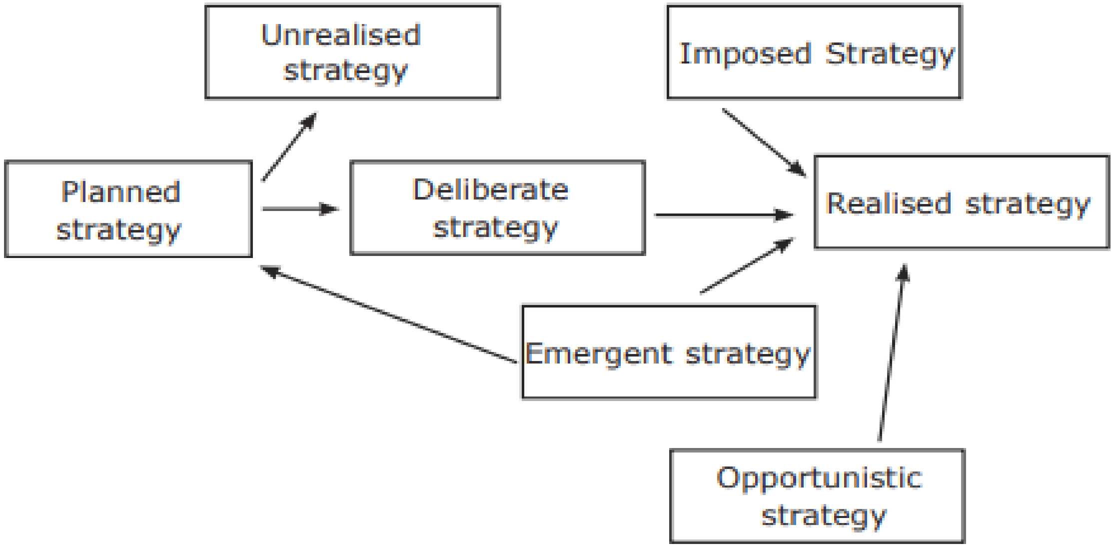


Figure 6*: Types of strategies*

2.9.1 Planned intended and deliberate strategy

Strategies that are intentionally executed under appropriately monitored and controlled environments after preparing for them well are referred to as either a planned intended strategy and/or a deliberate strategy. In such cases, various options of written strategies are evaluated by the strategists, and then the superior options are chosen for execution. Therefore, strategic planning is a critical aspect of planned intended strategy and deliberate strategy (Ritson, 2011).

2.9.2 Emergent strategy

Some of the strategies emerge as time goes on and they are not necessarily planned or deliberate. The emergent strategies may not be written down and no comprehensive planning has been done for them. They are normally done when responding to changes in the business (Ritson, 2011).

2.9.3 Opportunistic strategy

Strategies that take advantage of new opportunities that arise within the business environment are referred to as opportunistic strategies. In this case, the strategy may be developed in search of new opportunities. Sometimes opportunistic strategies are made by making decisions as a response to dramatic changes towards accomplishing new encounters.

2.9.4 Imposed strategy

An imposed strategy is the strategy that is forced upon the business due to an external force. The company may be forced to formulate a specific strategy due to government policies and other legal frameworks in place. It can also occur due to technological changes.

2.9.5 Realised and unrealised strategy

A strategy that is executed accordingly and comes to reality is referred to as a realised strategy. While the strategy that failed during its execution stage and was never realised is called an unrealised strategy (Ritson, 2011; Casadesus-Masanell & Ricart, 2009).

2.10 A generic strategy

Based on the research done by Porter (1996), a generic strategy framework concentrates on two areas namely, differentiation and low-cost leadership. These two scopes have two dimensions each. Either can be broad or focus/narrow as shown in Figure 7. In most cases, companies apply low-cost leadership and differentiation entangled with other strategies for them to remain competitive. For most mines in the Namibian mining industry, the final product cannot be easily differentiated unless there are byproducts that can be produced. However, most mines are focused on low-cost leadership. In this case the mines, try by all means to keep the cost of production (COP) and all-in sustaining cost under control. This is critical for the long term success of the business. As such, different approaches are used to ensure implement low-cost leadership. This research has also investigated such approaches.

Figure 7: *Generic business strategies*

(Ritson, 2011)

2.10.1 Low-cost leadership strategy

This strategy requires the business to be more efficient and effective as compared to rivals, hence decreasing the cost of production, managing the all-in sustaining cost (AISC), and being more competitive. Ideally, the company should attempt to produce cheaper goods that are of an improved quality than rivals. Low-cost leadership can be achieved by sustaining economic factors such as adjusting the degree of vertical integration, high experience curve benefits, and economies of scale. This can only be achieved by a firm that is focused on having improved productivity, using cheaper yet high-quality raw materials, and low cost of production (Ritson, 2011; González-Benito & Suárez-González, 2010; Porter, 1987; Fiorentino, 2016). Namibian mines implement low-cost leadership differently because it depends on the opportunities they have and potential strategies that they can implement.

2.10.2 Differentiation strategy

The company can evaluate the possibility of supplying quality-based differentiated products or services as compared to the other businesses. This strategy goes beyond being more effective than the operations of the competitors and having differently configured business processes. Hence, this results in the production of uniquely featured products which are preferred by customers (Fiorentino, 2016). The benefits of the differentiation strategy are similar to those of the cost-leadership strategy (Ritson, 2011). Some of the mines can produce differentiated products by producing byproducts in addition to their main products.

2.11 Strategic planning

To achieve strategic imperatives, it is essential to have a good plan in place and that is where strategic planning is concerned. The strategic planning process involves envisioning future priorities and principal objectives of the business. It helps with aligning the company towards the higher-level future it intends to attain and the strategic objectives can be achieved with high efficiency and effectiveness as compared to rivals. Therefore, strategic planning is executed by appreciating the needs and requirements of stakeholders and knowing the challenges associated with accomplishing strategic objectives, future trends, the mission, and the vision of the business (United Nations, n.d.). In summary, strategic planning imperatives are displayed in Figure 8.

Figure 8: *Strategic planning considerations* (United Nations, n.d.).

2.11.1 Scenario planning

Scenario planning is one of the commonly used long-term strategy planning tools. It considers the dynamic and complexity of the business environment and the potential risks associated with achieving the strategy. It works by reviewing a wide range of possibilities and perspectives that may occur within the business radar. Therefore, it acts proactively as an early warning system for minimising potential catastrophe to achieving the strategy. Various scenarios are considered, hence assessing multiple pathways towards achieving the vision. During strategy execution, all the scenarios or possible paths are then monitored and controlled, hence ensuring that the strategy is executed effectively (Surujhlal et al., 2014; Smith, 2012; Bodwell & Chermack, 2010; Shoemaker, 1995). Scenario planning may be executed by carrying out the eight steps as shown in Figure 9. This is further elaborated in Figure 10. This can also be done in the mining industry, by evaluating several scenarios of the operation by considering the existing practical challenges. This is critical for the survival of the operation in the long term.

Figure 9: *Steps for conducting scenario planning*

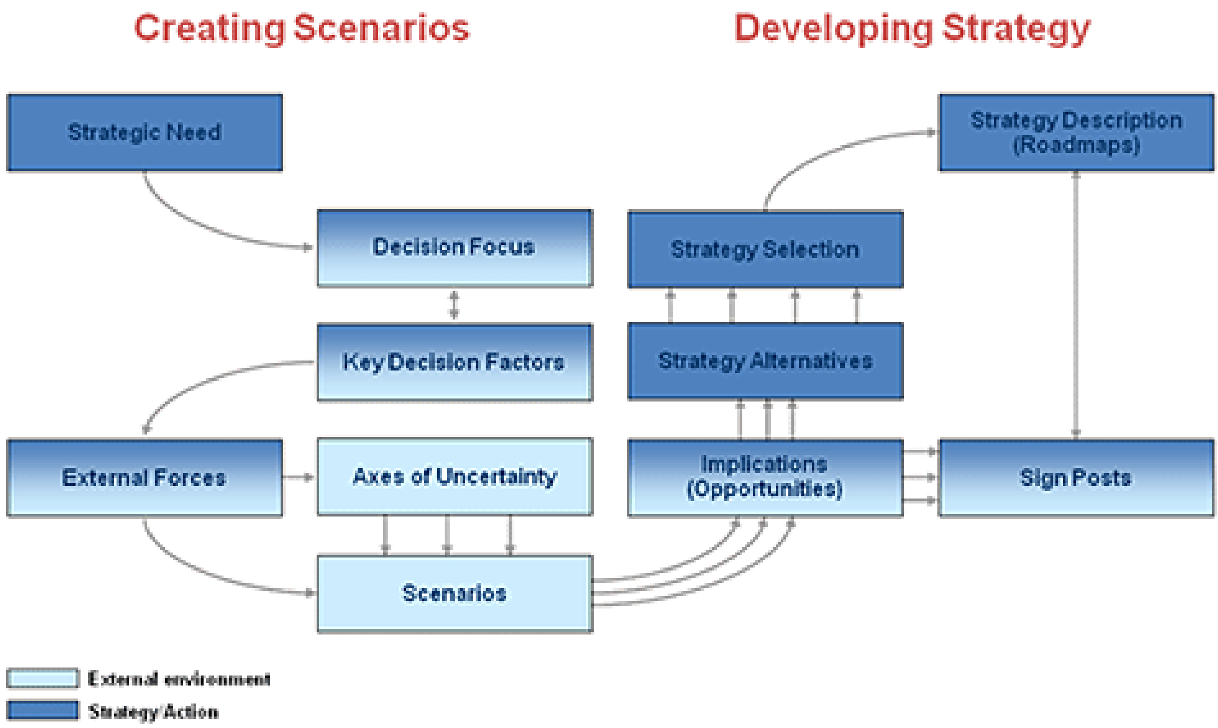


Figure 10: *How creating scenarios fit into strategy development*

2.11.2 Building a strategic plan

Building a proper strategic plan requires the utilisation of numerous elements such as external and internal input gatherings, setting the vision statement, creating strategic objectives, using the strategy map, setting measures for strategic performance, establishing strategic initiatives, establishing strategic risk management plans, and managing a strategy (United Nations, n.d.). These elements are further discussed below.

2.11.2.1 External and internal input gathering

When building a strategic plan, the strategist should collect information regarding issues, challenges, and potential trends that can affect strategy implementation. External information from clients is critical to ensure that their requirements are achieved, and this can be acquired via a thorough environmental scanning process. On the one hand, an external environmental scan is conducted by assessing the Political, Economic, Social, Technology, Legal, and Environment (PESTLE) analysis as shown in Figure 11. This is cemented by also assessing the security/safety, religion, regulatory, and demographic analysis. On the other hand, internal input is mainly acquired by executing a strength, weakness, opportunity, and threat (SWOT) analysis as shown in Figure 12 (United Nations, n.d.).

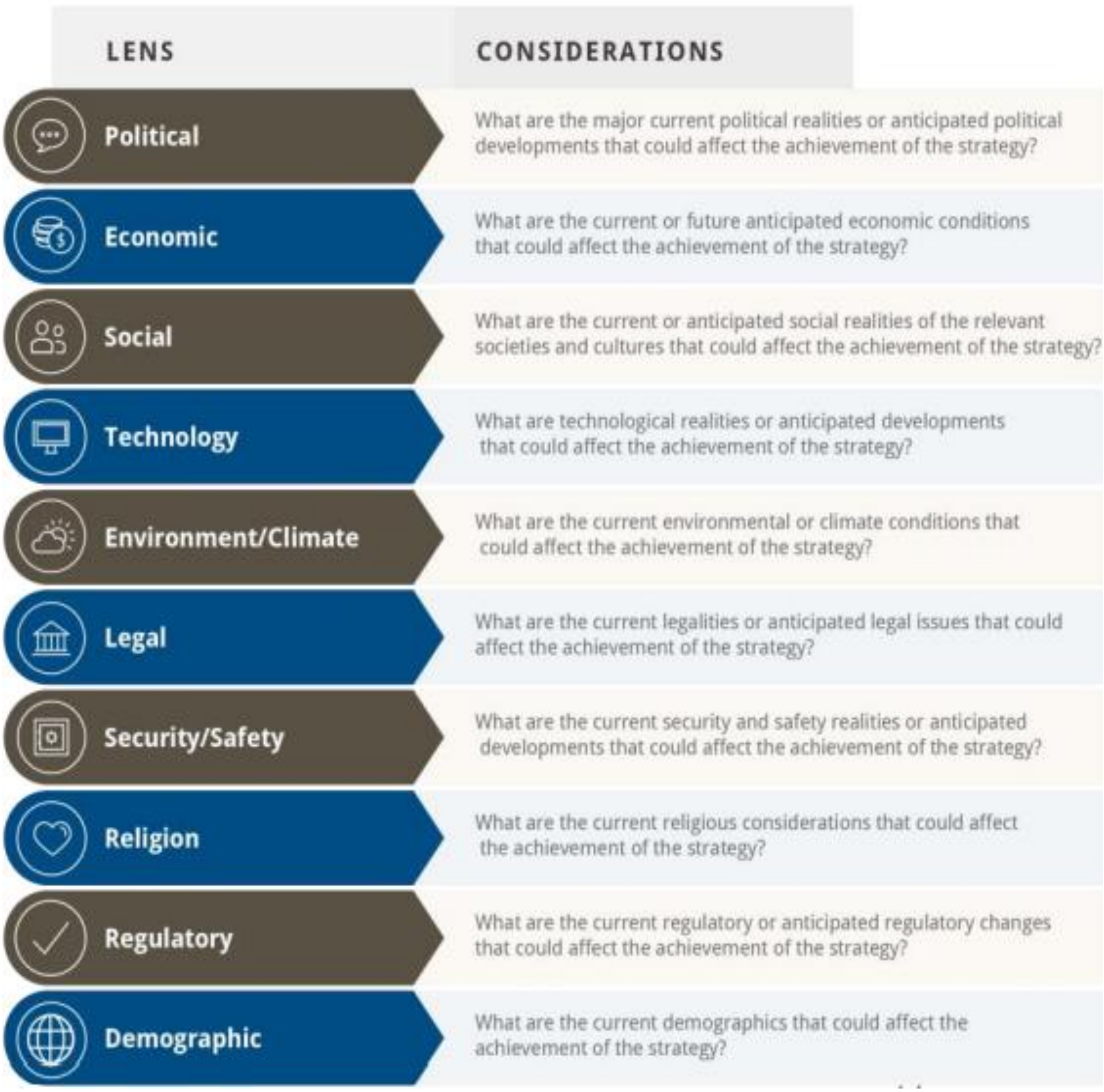


Figure 11: *Considerations for conducting external stakeholder and issue scanning (United Nations, n.d.)*

Source: (United Nations, n.d.)

Figure 12: *A SWOT analysis schematic*

2.11.2.2 Vision statement setting

The vision statement should be set up by management because it assists with establishing a well-focused long-term direction and goal of the business. Ideally, a meaningful and valuable vision statement should be constituted by time horizon, measurability, and unique approach (United Nations, n.d.). The vision statement is further elaborated in Figure 13 and Figure 14. The mines normally have a vision statement on their company profiles or websites.

Figure 13: Critical components of the vision statement
Source: (United Nations, n.d.)

Figure 14: *Example of a vision statement with all critical components*

2.11.2.3 Creating objectives and using a strategy map

The next step of the strategic planning process involves creating objectives and developing a strategy map. During this stage, the mission and strategy of the business are translated into tangible objectives and measures by making use of a balanced scorecard. It balances financial and non-financial measures. It also gives a balance between outcome measures and future performance drive measures. It plays a critical role in 1) giving improved feedback and learning of the strategy, 2) clarifying and translating the vision and strategy, and 3) communicating and linking strategic initiatives (Kaplan & Norton, 1996). The components of the balanced scorecard are shown in Figure 15. A strategy map is hardly applied in the mining industry. However, it is a powerful tool.

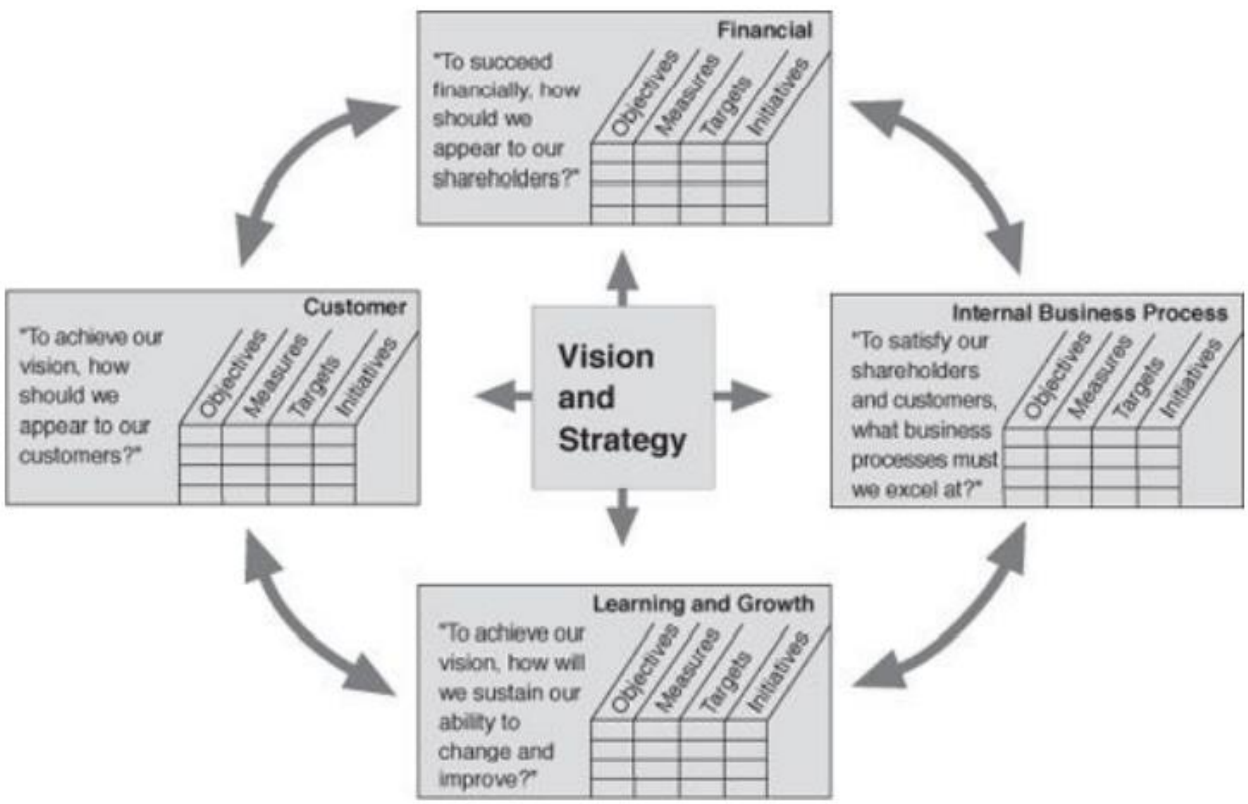


Figure 15: *Balanced scorecard,* Source: *(Kaplan & Norton, 1996)*

2.12 Strategy map

Unlike traditional strategies, a strategy map may be viewed as a visual tool that can present interlinked strategic objectives on a single page by showing the cause-and-effect amongst them. This is normally done by using a balanced score card. The strategy maps are created because they concentrate on strategic objectives and key strategic measures; they clearly display how strategic objectives are driven by clear strategic initiatives; they communicate the strategy of the business; and they act as a proper model for driving the implementation of the strategy (United Nations, n.d.; Slack & Lewis, 2011). A typically integrated strategy map is shown in Figure 16. Some of the mines in the Namibian mining industry have an integrated strategy map drawn from the operation strategy. This allows them to set targets and establish strategic initiatives in the form of strategic projects that they can execute. The strategic initiatives established are then implemented at operational level to improve sustainability of the mine. This research has uncovered such strategic initiatives/projects for the entire Namibian mining industry.

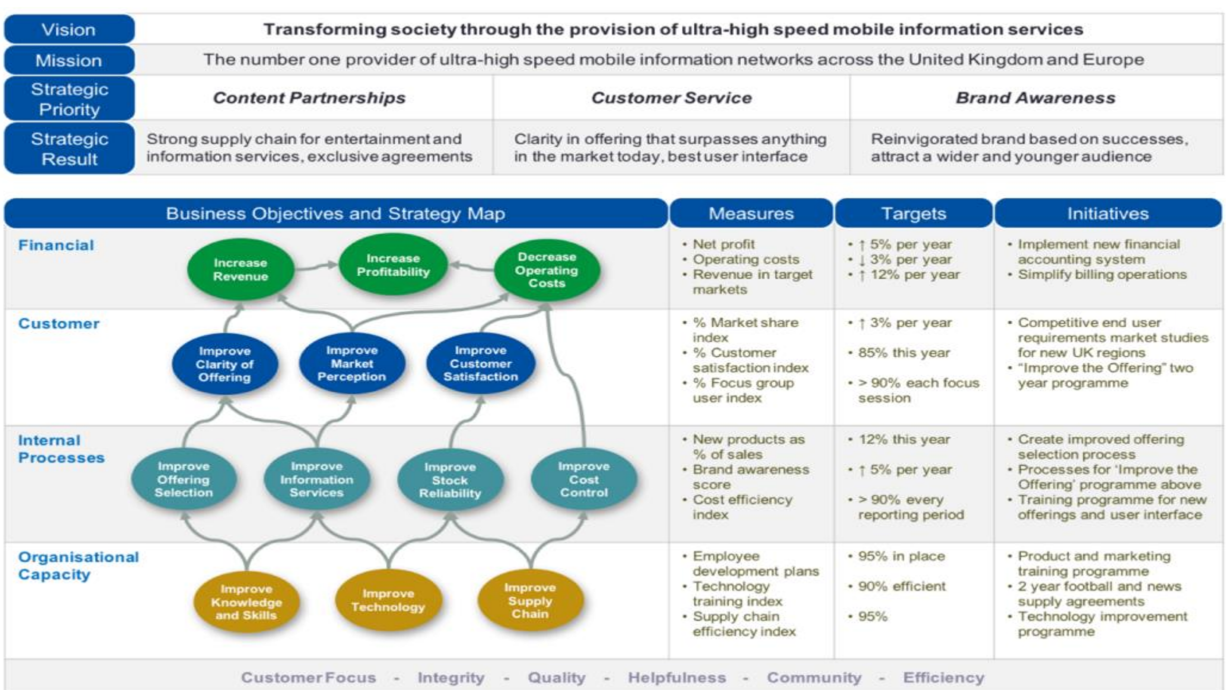


Figure 16 A typical integrated strategy map

2.13 Strategic performance measures and strategic initiatives

After establishing strategic objectives by using a strategy map, it is essential to monitor and control progress made during strategy implementation by establishing effective strategic performance measures. This allows management to remain focused on the leading and lagging performance indicators. The measures should be characterised in terms of the following aspects: measure name, measure description, strategic objective linkage, measure owner, data source(s), collection frequency, chart display format, and target level (United Nations, n.d.). Thereafter, the strategic initiatives aligned with the objectives should be established based on the strategic performance measures. Both strategic performance measures and strategic initiatives are shown in Figure 17.

The strategic initiatives will materialize as strategic projects that a mine should implement. The strategic projects are critical for extending the Life of Mine (LOM) and for improving production in the long term. Typical real examples of strategic projects in the Namibian mining industry include Otjikoto Gold Mine and Navachab Gold Mine which are developing an underground mine in addition to the existing surface mine, Skorpion Zinc Mine refinery conversion project for the treatment of both oxide and sulphide zinc ore, and Dundee Precious Metal Tsumeb smelter building a sulphuric acid plant so that they can reduce sulphur dioxide emissions and then convert it into sulphuric acid that they can sell as a byproduct of the smelter (B2Gold, 2019; Botshiwe, 2021; Tshiningayamwe, 2021; Dundee Precious Metal, 2012).

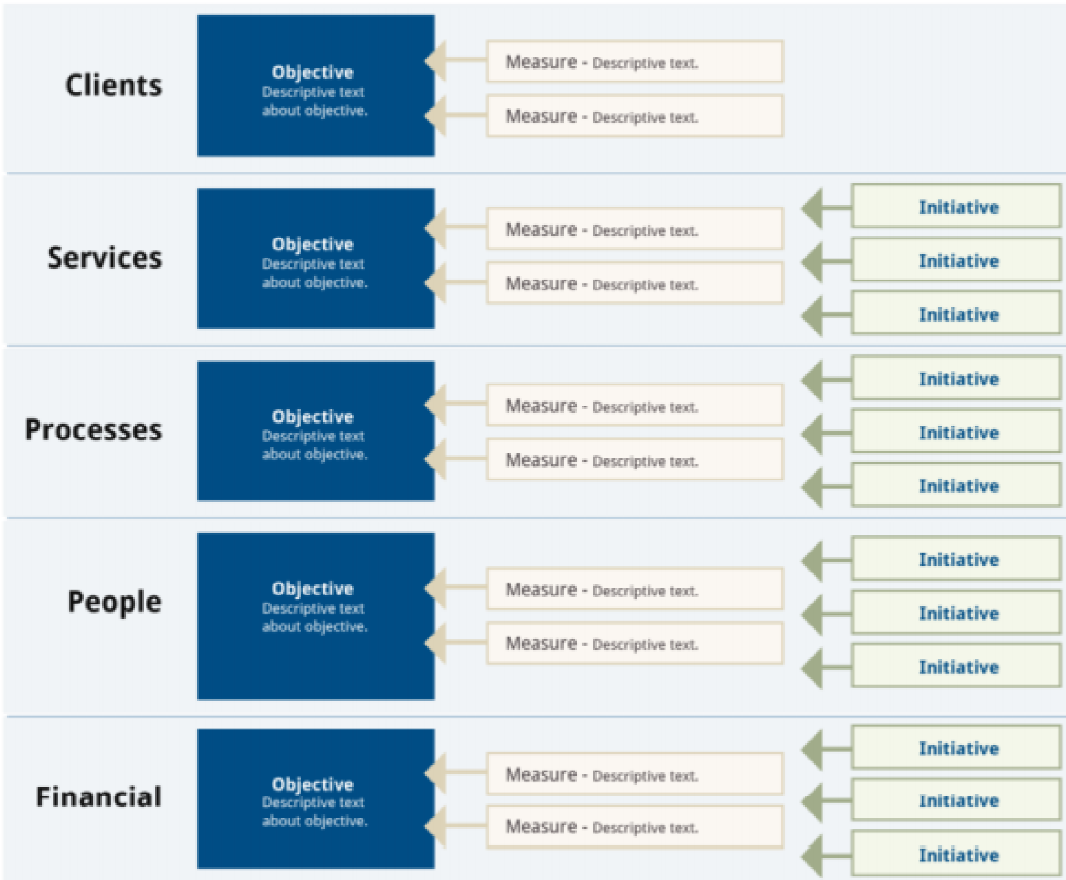


Figure 17: *Alignment between initiatives, performance measures and objectives of the strategy (United Nations, n.d.).*

2.14 Strategic risk management

There are always risks that may threaten strategy execution and they must be managed appropriately to ensure strategic initiatives are delivered accordingly. During enterprise risk planning, top management should be involved in the risk management process which incorporates the following: risk identification, risk evaluation/assessment, and developing appropriate risk mitigation. In general, strategic risks may originate from the internal and external business environment, some of the risks may affect the composition of the strategy and other risks affect strategic initiatives. The risk management process that can be applied for strategies is shown in Figure 18. Therefore, the risks need to be identified, prioritised, mitigated and monitored. As such, management strategic review meetings should be conducted regularly to make sure the business remains focused, employees accountable, and the business is driven towards desired outcomes. For the strategy review meeting to be effective, the required information and data should be available immediately before and during the review meeting (United Nations, n.d.; Dudek, Krzykowska-Piotrowska, & Siergiejcyk, 2020).

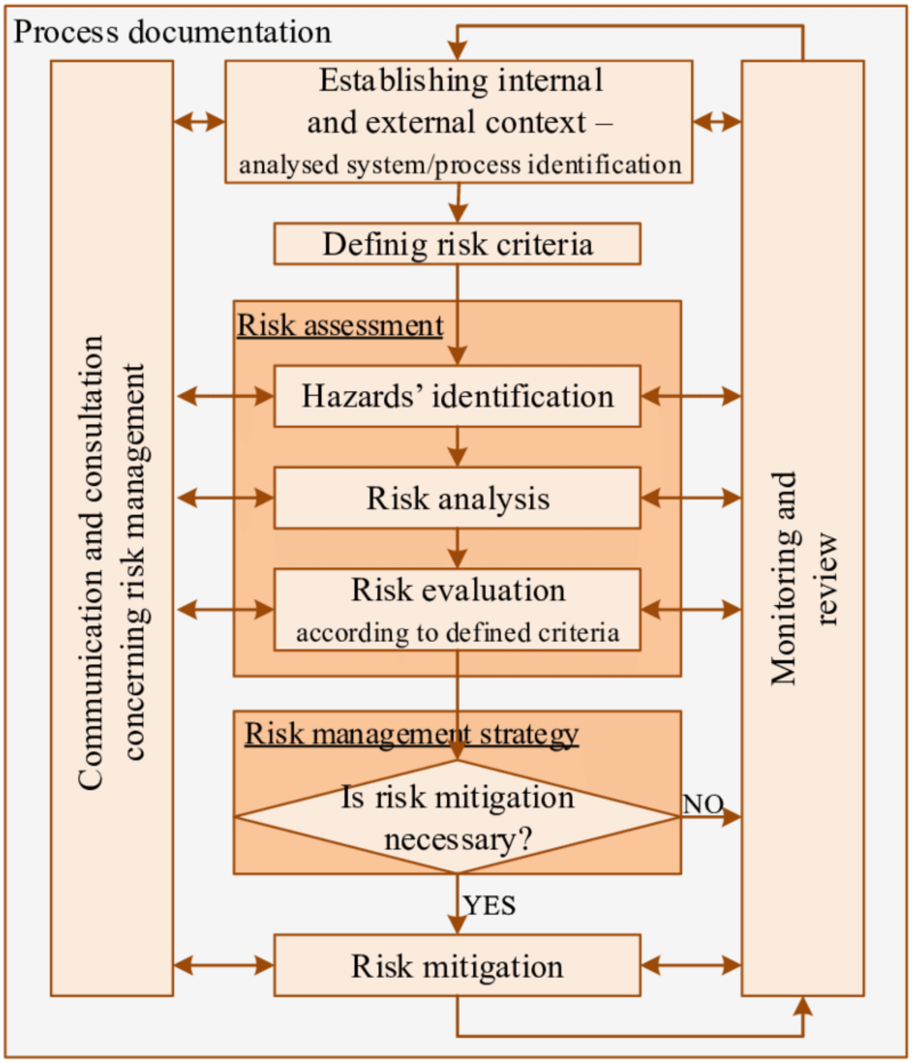


Figure 18: *Risk management process (Dudek, Krzykowska-Piotrowska, & Siergiejcyk, 2020)*

2.15 Strategy implementation

Strategy implementation refers to the iterative process of actioning strategic plans in order to apply the resources of the business to take advantage of opportunities in the competitive business environment. Therefore, it is aimed at operationalising strategic plans or the implementation of strategic decisions so that the strategic intentions can be achieved (Li, Guohui, & Eppler, 2008; Boikanyo, Lotriet, & Buys, 2016). The reviewed literature indicated that strategy implementation is more difficult and complex as compared to strategy formulation. It is therefore considered as a craft rather than a science due to numerous challenges associated with strategy implementation (Li, Guohui, & Eppler, 2008). Just like for any other industry, the Namibian mining industry also struggle with the implementation of the operation strategy. This is partly because, most of the mines do not have an organization structure specifically tailored for strategy execution. Unless for those mines that have a strategic project department which is responsible for the execution of strategic projects.

2.16 Factors influencing strategy implementation

Based on the study by Li, Guohui, and Eppler (2008), it was reported that about 57% of the business strategies fail due to poor strategy implementation. The mining industry is not an exception to this, and this research can establish the failure of strategy implementation in the Namibian mining industry. Factors that can influence strategy implementation in the mining industry range from commodity prices, ore grade decline, depleted mineral reserve, geotechnical risks, changes in technology, and many others. Moreover, it has been indicated that strategy implementation is not as frequently researched as compared to strategy formulation. As such, several factors influencing strategy implementation were identified, and they range from communication between the implementers to the systems or mechanisms of strategy implementation, coordination, and control (Li, Guohui, & Eppler, 2008).

The factors influencing strategy implementation were categorised into three groups, namely: a) soft factors or people-oriented factors which involve strategy executors, communication-related issues, the implementation tactics, dedication, and consensus about the strategy b) the hard or institutional factors comprised of organisational structure, and general administrative systems within the organisation c) mixed factors which are constituted of both hard and soft factors include factors such as strategy formulation (Li, Guohui, & Eppler, 2014). These factors can also be experienced in the mining industry. Therefore, the effect of these factors on strategy implementation in the mining industry should be investigated because they can potentially affect superior sustainable performance.

In short, there are nine factors influencing strategy implementation and these are “1) the strategy formulation process, 2) the strategy executors (managers and employees), 3) the organizational structure, 4) communication activities, 5) the level of commitment to the strategy, 6) the consensus regarding the strategy, 7) the relationships among different units/departments and different strategy levels, 8) the employed implementation tactics, and 9) the administrative system in place” (Li et al., 2008, p. 11). These nine factors that influence strategy implementation are depicted in Figure 19. These factors depend on the nature of the business, and they apply to the mining industry also. Other factors include culture, firm size, market environment, implementation stages, internal guidelines, the power structure, material resources, market orientation, and rewards/incentives (Li, Guohui, & Eppler, 2008).

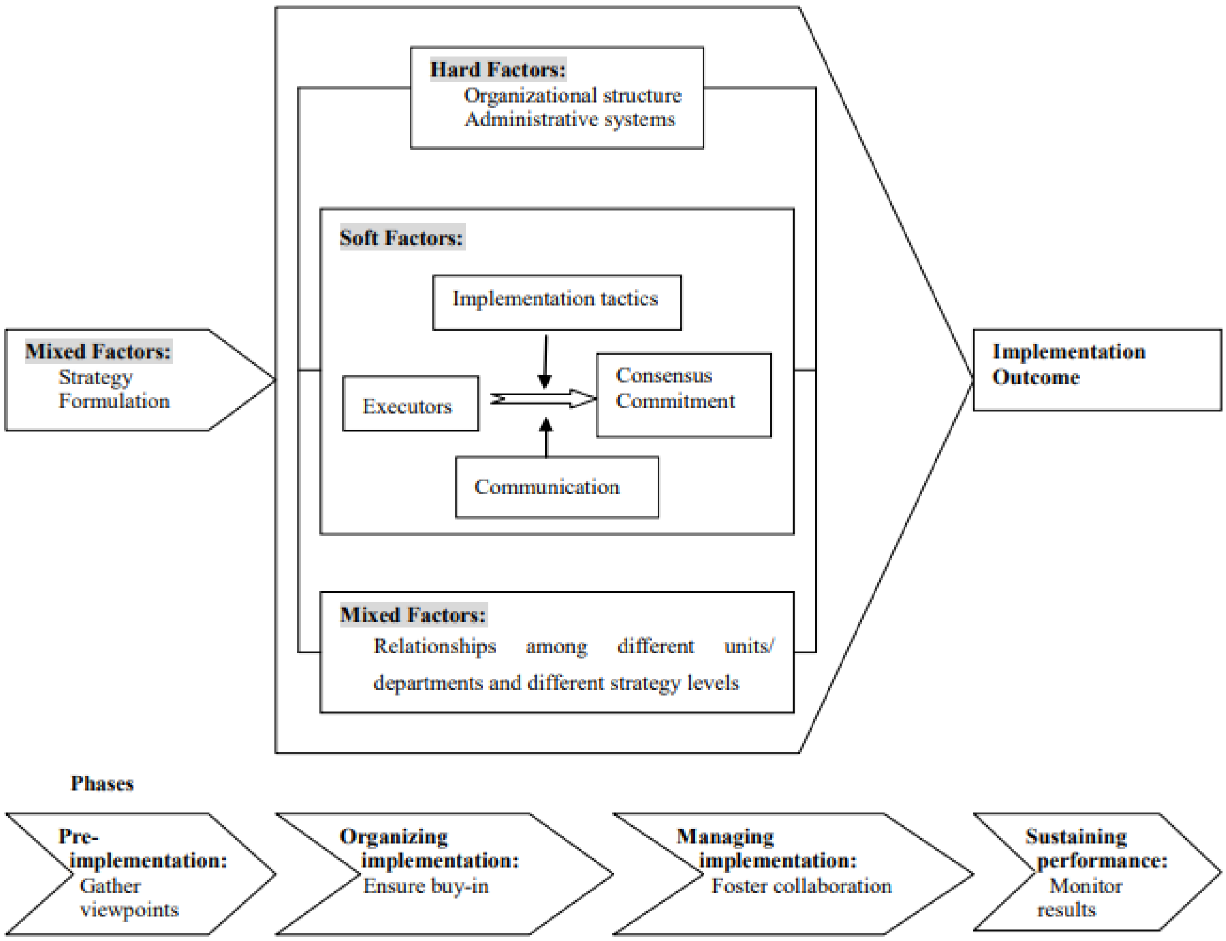


Figure 19: *A framework of strategy implementation research (Li, Guohui, & Eppler, 2008)*

2.17 Application of strategic management in the mining industry

The study by Boikanyo, Lotriet, and Buys (2016) focused on investigating the degree to which strategic management is applied in the mining industry. These researchers concluded that approximately 20% of mining companies worldwide, especially in South Africa, and Africa do not fully apply strategic management. Although their study was done worldwide, only a response rate of 64% was achieved. Unlike, this research which is localised to the Namibian mining industry which has a 68% response rate. The researchers indicated that consequently, unsatisfactory productivity and unstable cash flows were reported for about 60% and 30% of the mining ventures, respectively. The paper suggested the need for mining companies to deliver superior sustainable performance through the formulation and implementation of appropriate strategies.

Although the enterprise strategy is focused on transitioning the mining company towards the intended future state, the business should make decisions about things like its geographical location. Other strategic decisions are a function of physical features of the ore body, for instance, mineralogy, ore grades, mineral reserve, etc. This forms the basis for deciding on how mining operations will be conducted. Therefore, a mining business can form strategic partnerships with exploration companies as a means of differentiating itself from its rivals (Surujhlal et al., 2014).

2.17.1 Mining strategy levels

According to Kuma and Rathore (as cited in Boikanyo et al., 2016), a "mining strategy is defined as the connection between the mining organisation and its current and forthcoming business facets. It also determines long-term goals and objectives of the mining industry and management of resources, as well as actions required for carrying the defined goals" (p. 2). In the mining industry, a corporate strategy involves decisions related to the scope of the mining company for example which minerals should be mined, and this translates to the market in which the business competes. The corporate strategy of the mine also incorporates the acquisition of new mining resources and vertical integration between business units. On the one hand, the manner in which the business competes and how it acquires a competitive advantage within the chosen mining sector depends on the business strategy. On the other hand, the functional level strategy for a mining company entails resource management at the operational level.

2.17.2 Significance of the mining strategy

The mining strategy assists with establishing a long-term competitive position and it can improve the financial performance of the mining company (Thompson et al., 2012). Similarly, the study by Boikanyo et al. (2016) highlights that a mining strategy can improve productivity, enhances business performance, and it can stabilise cash flows. Moreover, it can potentially sustain superior sustainable performance (Wells, 2012; Fred, 2011). According to Wells (2012), a mining strategy ensures the long-term viability of the mining company. High concentration should be put on the building blocks of long-term strategic planning and short-term prioritisation by executing high-level and operational strategies.

As part of the long-term strategy of the business model, sustainable advantage raw material sources should be established via exploration. This will be critical for making financial and non-financial strategic directives that allow appropriate investment decision-making. Essentially, the mining strategy should be constituted of the mining method, mine design, processing technology, and sustainable choices. "During challenging times such as these, mining companies can choose to pursue a 'survival strategy' or a 'leadership strategy'. Those pursuing a survival strategy will cut costs to the bone while adopting a risk-averse posture and focusing on defending their core business. Other companies adopt a leadership strategy, looking to identify unusual opportunities, enabling the mining company to gain ground during the downturn and to make step changes in performance" (Deloitte Consulting, 2013 as cited in Boikanyo et al., 2016, p. 4).

2.17.3 Strategic long-term planning within the mining strategy

For a mine, long-term planning involves the integration of processes and techniques that enables mineral asset exploitation in the long term (Surujhlal et al., 2014). Such strategies ensure optimal resource exploitation via the application of strategies focused on changing the market and economic conditions of the overall mineral asset portfolio.

Traditional approaches were reported to be inadequate due to the business and operational complexity of modern mining companies calls for the establishment of strategic planning and asset management approaches by analysing complex adaptive systems (CAS) (Komljenovic et al., 2015). The following factors contribute to the complexity of the mining industry, they are as follows: strategic risks associated with the technology, natural, market, organization, economic, political, financial, etc.

The strategic risks can influence the implementation of the strategy negatively or positively. A risk management process comprised of risk identification, risk analysis, and risk mitigation should be conducted. The risks in the mining industry include geotechnical risks, occupational health and safety risks, operational risks, etc. The nature of the ore body, mineralogical variability, geotechnical competence of the rocks, underground water flooding the pit, etc. The market is influenced by valuable mineral supply and demand. The commodity price directly affects the profitability of the mine positively or negatively and hence the sustainability of the mine. Mining companies are multinational giants, and they are subjected to different compulsory governmental laws and regulations which makes the mining industry complex. When companies make investment decisions, they consider the economic condition of the country. Politics play a role because investors are attracted to politically stable countries.

To remain competitive and sustainable while dealing with multidimensional complexity, mining companies should establish innovative strategic planning and asset management solutions to have a positive influence on globalization and elevated competition. According to Glouberman and Zimmerman (2002) "advice and input from technical experts, strategic planners or knowledgeable managers may be insufficient or too narrowly focused to adequately manage the complexity of systems and structures in a constantly changing and barely predictable environment" (as cited in Komljenovic et al., 2015, p. 341). As a result, mining companies experience poor efficiencies because of limited analysis and management of complex issues.

2.17.4 The link between a mining business plan and a mining strategy

As part of the mining company's business plan, the long-term strategy needs to be re-assessed and adjusted accordingly and it must be aligned with the supporting functions of the mine. When executing the business plan process, the following critical components should be considered, namely: "enterprise strategic intent, business value optimisation, long-term planning procedures (planning cycle, mine extraction strategies, mining right plans, long term-plans), capital investment prioritisation, real option analysis, and project value tracking.

In addition to that, other critical components of the business plan process include portfolio optimization, upside or downside responses (contingency plan), execution plans for supporting capability: project portfolio execution, metallurgical process capacity (smelting, refining, effluent), infrastructure (water, electricity, roads, rail, housing), people (skills, motivation, organizational culture), and community (stakeholder alignment and participation)" (Surujhlal et al., 2014). The linkages between the business plan and the strategy are illustrated in Figure 20.

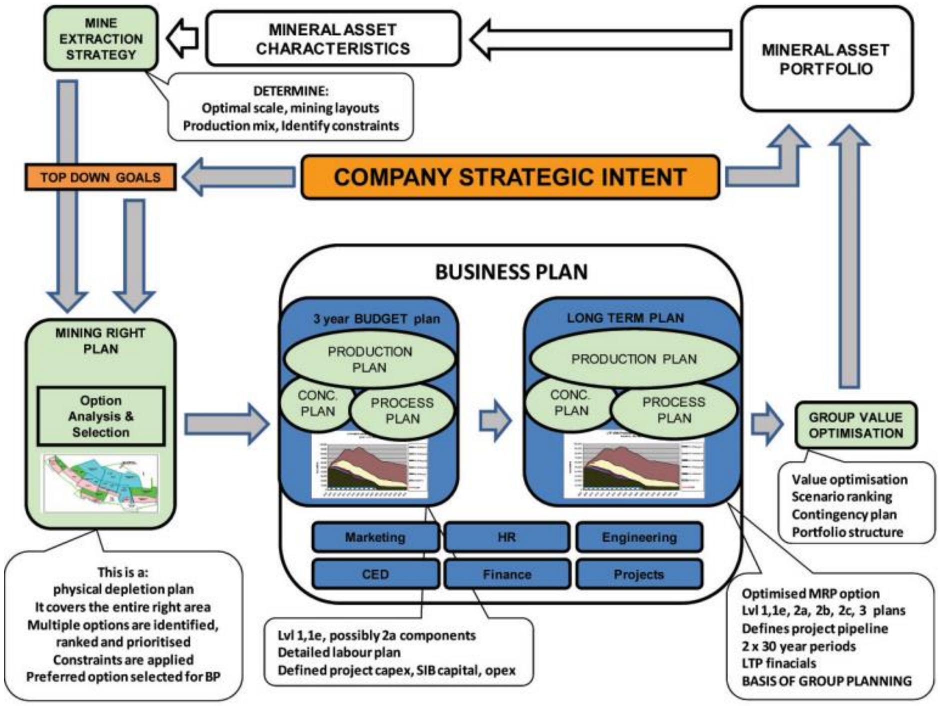


Figure 20: *Business planning – key elements and interrelationships (Surujhlal et al., 2014)*

2.17.5 Strategic options for the mining industry

The strategic decisions incorporated in the strategic mine plan influence the long-term viability of the mineral asset. These strategic decisions depend on the market conditions, future expectations, supply, and demand of mineral commodities. This can guide expected cost curve forecast trends. Depending on all these factors, the mine strategy may opt to do nothing, identify continuous improvement projects, open a new mine, expand operations, outsource operations, or close the mine (Surujhlal et al., 2014). The choice depends on the investment risks involved, return on investment (ROI), etc. The nature of the mining project also affects its viability (Shafiee et al., 2009; Shafiee et al., 2009).

2.17.6 Strategy dynamics in the mining industry

According to Warren (as cited in Surujhlal et al., 2014), "strategy dynamics is an approach that provides an explanation for business performance through times that are rigorous and fact-based, and which can inform confident insights into the future" (p.172). Because strategies can become more complex and dynamic over time, strategists should be well versed in the drivers of business performance. It is often a simple exercise to explain business performance by using cash flows. However, for the mining company, it is more complex because the revenues are dependent on other variable factors such as metal production rate, and the spot market price of that specific metal. The costs are influenced by costs related to labour costs, cost of mining, cost of processing, cost of utilities, and many other cost components (Surujhlal et al., 2014).

2.18 Sustainability of the Namibian mining industry

According to Brundtland (1987), sustainability is described as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs". However, due to the nature of mining operations that extract limited non-renewable resources. Sustainability is viewed slightly differently in the mining industry by focusing on decreasing the drastic effects on the environment, people and economic activities, and also limiting extraction rates to rates below the capability of establishing new resources so that the opportunities for future generations are not compromised (Gorman & Dzombak, 2018).

Therefore, mines only operate for a certain period which is referred to as Life of Mine (LOM). Although their operational life is limited, they should still be sustainably operated. It is critical that the mines are operated sustainably so that their LOM is extended beyond the initially planned life of mine. This can be achieved by conducting further geological exploration activities so that new ore bodies may be discovered, the mine and processing plants are designed and operated optimally, keeping the cost of production (COP) low, optimizing the all-in sustaining cost (AISC), commodity prices remaining on a high side, no major safety, health and environmental (SHE) accidents, successfully working on strategic projects etc.

If the mines are not operated sustainably, most of them will cease production. This research is therefore looking into how superior sustainable performance strategies are applied in the Namibian mining industry. It is essential to know more about the Namibian mining industry so that all mining operations that should be operating can be identified. Some of the mining projects were at an advanced stage such that they should have been operational by now. As shown in Table ***1*** below, from 2000 to 2021 there have been 25 mining operations/projects in Namibia. Amongst these mining operations/projects, 13/25 or 52% of them have stopped production at some point. This does not give the confidence to invest in the manufacturing industry that will depend on raw materials (feedstock) from the mining industry at all. Unless the mines are operating with superior sustainable performance by applying appropriate strategies. The study has attempted to seek justification for why some of the mines are still operating while others have halted production.

Table 1: *A summary of the operational status of mines in Namibia*

No.	Mining Operation Name	Main Shareholder	Production in 2019	Life of mine	Leftover years	Operating Period	Operational status	Restart plans
1	Tschudi Copper Mine	Weatherly Mining Namibia Limited	14,940 tons of grade A copper cathodes	2015 - 2026	5 years	11 years	On care & maintenance since 2020	Further exploration done.
2	Dundee Precious Metal Smelter	Dundee Precious Investment	45,953 tons of blister copper 223,007 tons of sulphuric acid	1963 - 2030	9 years	67 years	Producing	-
3	Kombat Copper Mine	Trigon Metal Inc.	0 tons of copper concentrated	1962 - 2008	4 years	46 years	On care & maintenance	Studies conducted for a possible restart
4	Ohorongo Cement	Schwenk Group	770,000 short tons of cement	2011 - 2311	290 years	300 years	Producing	-
5	Whale Rock Cement	Whale Rock Cement (Pty) Ltd	1.5 million tons of cement	2018 - 2318	297 years	300 years	Producing	-
6	Okorusu Fluorspar Mine	Northern Graphite Corporation	0 tons of acid-grade fluorspar concentrate	1920 – 2014 (Closed in 1963)	0 years	94 years	On care & maintenance	Feasibility study conducted. Viable higher grade ore resources are depleted
7	Okanjande Graphite Mine	Northern Graphite Corporation	0 tons of graphite flakes	2017 - 2055	38 years	2 years	On care & maintenance since 2018	Working on to restart the operation.
8	Otjikoto Gold Mine	B2Gold Namibia (Pty) Ltd	5,045 kg of gold bullion	2014 - 2027	6 years	13 years	Producing	Working on a new underground mine project
9	Navachab Gold Mine	QKR Namibia Mineral Holdings	1,481 kg of gold bullion	1989 - 2036	15 years	47 years	Producing	Working on a new underground mine project
10	Otjozondu Manganese Mine	Shaw River Manganese Limited	No information available	2012 - 2062	48 years	50 years	On care & maintenance since 2014	No information found on restart plans
11	Uis Tin Mine	Afri Tin Mining Namibia	7 tons of tin concentrate	2019 - 2040	19 years	21 years	Producing	-
12	Desert Lion Lithium Project	Desert Lion Energy (PTY) Ltd	0 tons of lithium concentrate	2017 - 2031	13 years	14 years	On care & maintenance since 2018	In the process of raising capital to further develop the mine
13	Namib Lead And Zinc Mine	North River Resources Plc	2,267 tons of zinc concentrate 764 tons of lead concentrate	2019 - 2027	7 years	8 years	On care & maintenance since 2020	No information found on restart plans
14	RÖssing Uranium Mine	China National Nuclear Corporation Limited (CNNC)	2,448.5 tons of uranium oxide	1976 - 2026	5 years	50 years	Producing	-
15	Swakop Uranium Mine	China General Nuclear	4,010 tons	2016 - 2036	15 years	20 years	Producing	-
16	Langer Heinrich Uranium Mine	Paladin Energy (Pty) Ltd	0 tons of uranium oxide	2007 - 2035	17 years	11 years	On care & maintenance since 2018	Feasibility study done for restarting
17	Trekkopje Uranium Mine	ORANO	0 tons of uranium oxide	Did not start yet	8 years	8 years	On care & maintenance (never produced)	Awaiting uranium price increase
18	Otjihase Mine	Weatherly Mining Namibia Limited	0 tons of copper, silver & gold	1976 – 2015 (Restarted in 2011)	10 years	39 years	On care & maintenance since 2015	Operations sold to another company
19	Matchless Mine	Weatherly Mining Namibia Limited	0 tons of copper, silver & gold	2005 – 2015 (Restarted in 2011)	10 years	10 years	On care & maintenance since 2015	Operations sold to another company
20	Skorpion Zinc Mine	Vedanta Resources plc	67,295 tons of special high-grade zinc (SHG)	2003 - 2020	0 years	17 years	On care & maintenance since 2020	Working on the refinery conversion project.
21	Rosh Pinah Zinc Mine	Trevali Mining Corporation	100,409 tons of zinc concentrate 13,019 tons of lead concentrate	1969 - 2032	11 years	63 years	Producing	-
22	Debmarine Namibia	De Beers Marine Namibia (Pty) Ltd	1,292,000 carats	2001 - 2051	30 years	50 years	Producing	-
23	Namdeb Southern Coastal Mines	Namdeb Holdings, Government & De Beers	407,986 carats (total)	1928 – 2022	1 year	94 years	Producing	-
24	Namdeb Orange River Mines	Namdeb Holdings, Government & De Beers	407,986 carats (total)	Daberas: 1999 – 2023 Sendelingsdrif: 2014 - 2025	2 years 4 years	24 years 11 years	Producing	-
25	Lodestone Iron Mine	Lodestone Holdings Group	4,030 tons	2015 - 2035	5 years	20 years	Producing	-

2.19 Potential causes of closure of mines and possible mitigation

Some of the challenges drastically affecting the local mining industry and possibly contributing to the closure of the mines include the depressed mining industry with declining commodity prices, especially for uranium and lithium, declined ore grades, depleted mineral reserves, elevated corporate social responsibilities (CSR), increasing cost of production, and many others (Namibia University of Science and Technology, 2021).

Therefore, to improve superior sustainable performance, strategies should be formulated to address some of these challenges. According to Boikanyo, Lotriet, and Buys (2016) mining businesses intend to deliver superior sustainable performance by attaining improved return on investment (ROI) which is consistently acquired over a long term as compared to the competitors. This can only be improved if the mines have a good strategy in place.

In this case, a mining strategy should be established to connect the mining company with other business facets, it defines the long-term strategic objectives of the business, how resources are managed and how a competitive position is established (Porter, 1996). Operational strategies were reported to be the basis for long-term strategic planning and prioritization for the overall vision of the mine and the investment decisions.

This is normally centred around the mining method, mine design, processing plant design, technology applied, sustainability investment decisions made etc. Such decisions may be done concerning a survival strategy or leadership strategy (Stacey et al., 2010; Boikanyo et al., 2016).

2.20 Sustainable life of mine (LOM)

Wellmer and Scholz (2018) examined the sustainability of the mining industry as the first stage of the circular economy. The authors agreed with other researchers on the traditional definition of sustainable development that it is "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 1). However, they further indicated that this is a normative principle because for non-renewable resources which a limited in the earth's crust their exploitation should be done by solving challenges by utilising human ingenuity and creativity. This is similar to a circular economy which focuses on the optimization of substitute processes and the development of new technologies.

In addition to that Wellmer and Scholz (2018), discussed that the lifetime of a mine, from a sustainability viewpoint, should be prolonged as far as possible and the orebody grades (within the cut-off grade) can be as low as possible. Therefore, mine planning by considering factors affecting economic optimal cut-off grade is critical. According to Wellmer and Scholz (2018), the optimal rate of mining can be calculated by applying Taylor's rule for the lifetime of the mine for different types of ore deposits up to 300-400m. Tylor's rule is represented by the formula that considers the lifetime in years (given by $t_{life,n}$) and the total tonnages of the reserve (res_{exp}). Tylor's formula is written as follows:

$$t_{life,n} \approx 0.2\times\sqrt[4]{res_{exp}} \quad \text{...Equation 1}$$

It is critical to know that learning effects can affect the mine capacity. Unlike dynamic economic evaluation methods that favour short lifetimes such as Taylor's rule, learning effects are done over a longer period. In this case, extra ore reserved is discovered over time as geological exploration continues. This occurs mainly for ore deposits which are limited by extrapolability. This happens because as mining operations progress further exploration is done to understand the ore body well, hence the learning effect (Wellmer & Scholz, 2018). A similar situation has been experienced in the Namibian mining industry and it results in mines extending their lifetime. As a result, the optimal lifetime of a mine considering the learning effect is complex to determine. The influence of the learning effects on the mine capacity is depicted in Figure 21.

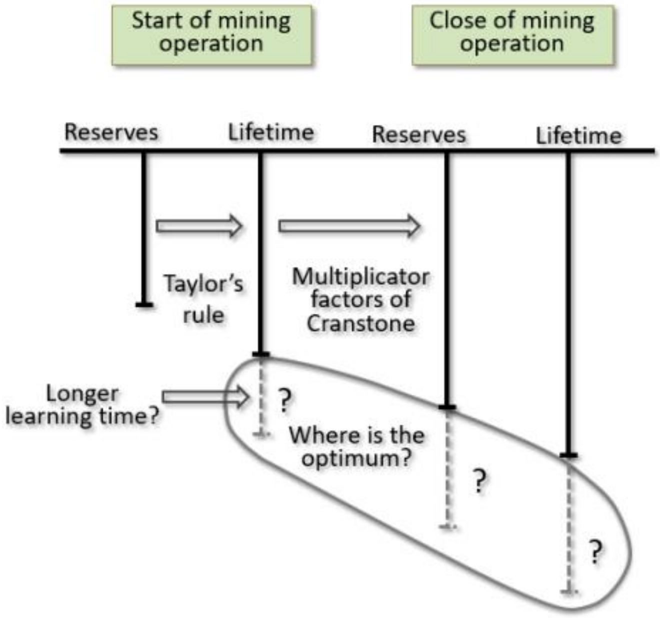


Figure 2: *Schematic representation of the learning effects on the mine capacity*

Source: (Wellmer & Scholz, 2018)

2.21 Sustainability aspects of the lifetime of a mine

Based on the research by Wellmer and Scholz (2018) although the price of copper for example has been constant for over a century (100 years), however, the copper grade has declined over the same period from approximately 2% to 1%. Essentially, for the copper mines to remain sustainable during this period there have been technological developments that resulted in a decreased cost of production (COP) and unhealthy all-in sustaining cost (AISC) while the copper grade has been on a decreasing trend (see Figure 22). One of the strategies utilised by the Aitik Mine in Sweden is the production of byproducts. This mine processed the lowest copper grade of about 0.22% Cu due to technological capabilities that enabled profitable exploitation of the low-grade ore body mainly because of the learning effects. However, they were also producing byproducts such as gold and silver which increased the operational revenues by 30% to 40%.

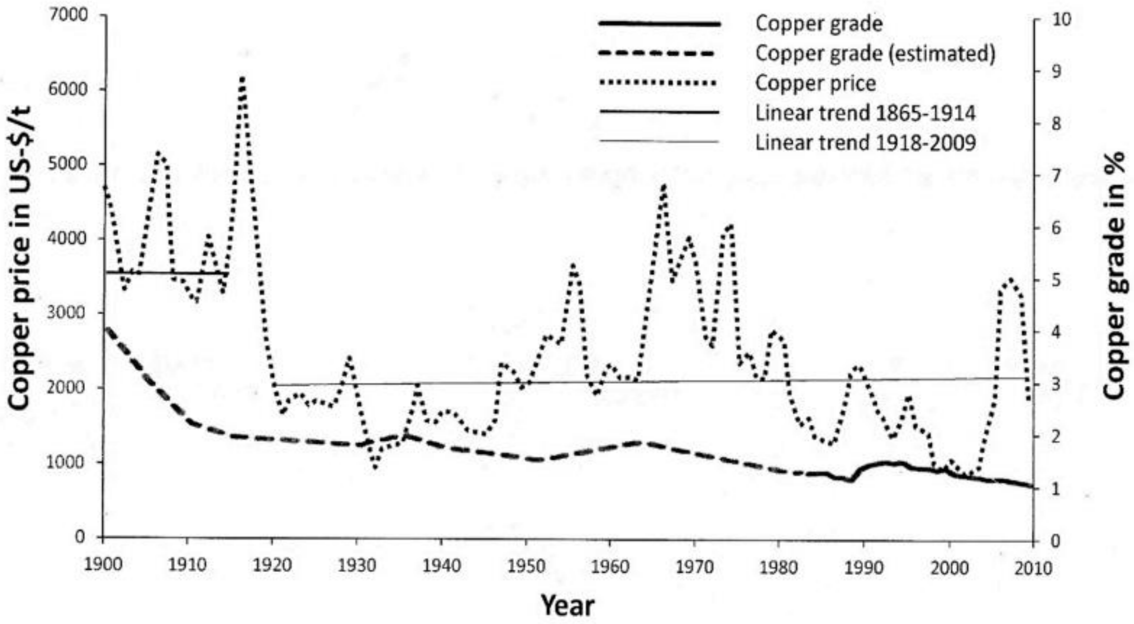


Figure 22: Average mined copper grade and copper prices worldwide
Source: (Wellmer & Scholz, 2018)

The cut-off grade affects investment decisions, the cost of production (COP), and all-in sustaining cost (AISC) for any mine. From a sustainability perspective, the cut-off grade should be as low as possible, yet it should allow the mine to operate profitably, and it should maximise the reserves. This is also referred to as the operating cost cut-off or break-even cut-off grade because it enables economic operation, but it does not cover capital costs. Whenever such a cut-off grade is applied it optimises the mining operation from a sustainability perspective. Normally, in the industry, the rule of thumb used is that the cut-off grade is about half the average ore grade. Another sustainability strategy applied by mines is second-round mining because the investment required for infrastructure and the beneficiation plant is drastically reduced since they were covered by first-round mining (Wellmer & Scholz, 2018).

2.22 Mineral beneficiation

As indicated earlier, improving superior sustainable performance in the mining industry is critical for Namibia to become industrialised via value-addition to products from the mines and also manufacturing raw materials applied in the processing of minerals, both options can be facilitated by setting up manufacturing industries.

In a general context, mineral beneficiation was defined as the “transformation of a mineral (or a combination of minerals) into a higher value product which can either be consumed locally or exported” (Mungoshi, 2011, p. 7). Mineral beneficiation has two aspects, namely down-stream beneficiation which adds value to the final products of the mine, and side-stream beneficiation entails concentrating raw materials which are utilised in the production process. As such, total mineral beneficiation combines both downstream and side-stream beneficiation (Mungoshi, 2011).

Mineral beneficiation could also be categorised into two groups, namely metallurgical beneficiation, and economic beneficiation. In this case, metallurgical beneficiation targets utilizing metallurgical processes to upgrade the ore, hence producing semi-fabricated materials which can be utilized as feedstock for fabrication and manufacturing. While economic beneficiation entails value addition transformation of products from metallurgical beneficiation hence transforming them into products consumed directly by customers. Therefore, economic beneficiation depends on metallurgical beneficiation (Dworzanowski, 2013).

The study by Robinson and Von Below (1990) highlighted four stages of beneficiation, namely 1) saleable smelted or refined products, 2) fabricated allows, 3) semi-manufactured articles, and 4) fabricated articles. Similar stages of beneficiation were also developed by Mungoshi (2011) as shown in Table 2 and also by the Ministry of Mines and Energy (2019) as shown in Figure 23. In Namibia, a reputable mining industry has been established which is mainly focusing on metallurgical beneficiation (the first three stages of beneficiation). However, economic beneficiation or stage four of beneficiation has not been well established yet despite the high employment opportunities that may be realized in economic beneficiation. This is the reason why a mineral beneficiation strategy and its implementation plan were developed.

Table 2: *Four stages of the mineral beneficiation process* (Mungoshi, 2011)

Stage	Mineral Beneficiation Process Category	Process Flow Chart	Capital Intensity	Labour Intensity	Skills Intensity
1	The action of mining to produce an ore or mineral concentrate	Run of Mine Ore → Mineral Concentrate	High	High	Low
2	The action of converting concentrate into an upgraded bulk tonnage intermediate product	Matte/Slag Bulk Products → Refined Metals/Alloys	High	Med	Med
3	The action of converting intermediate products into refined product suitable for purchase by small and sophisticated industries	High Purity Metals/Alloys → Final Products-Worked Shapes & Forms	High	Low	High
4	The action of manufacturing final products for sale	Final Products-Worked Shapes & Forms → Final Products-Worked Shapes & Forms	Med to High	Med to High	High

(Mungoshi, 2011)

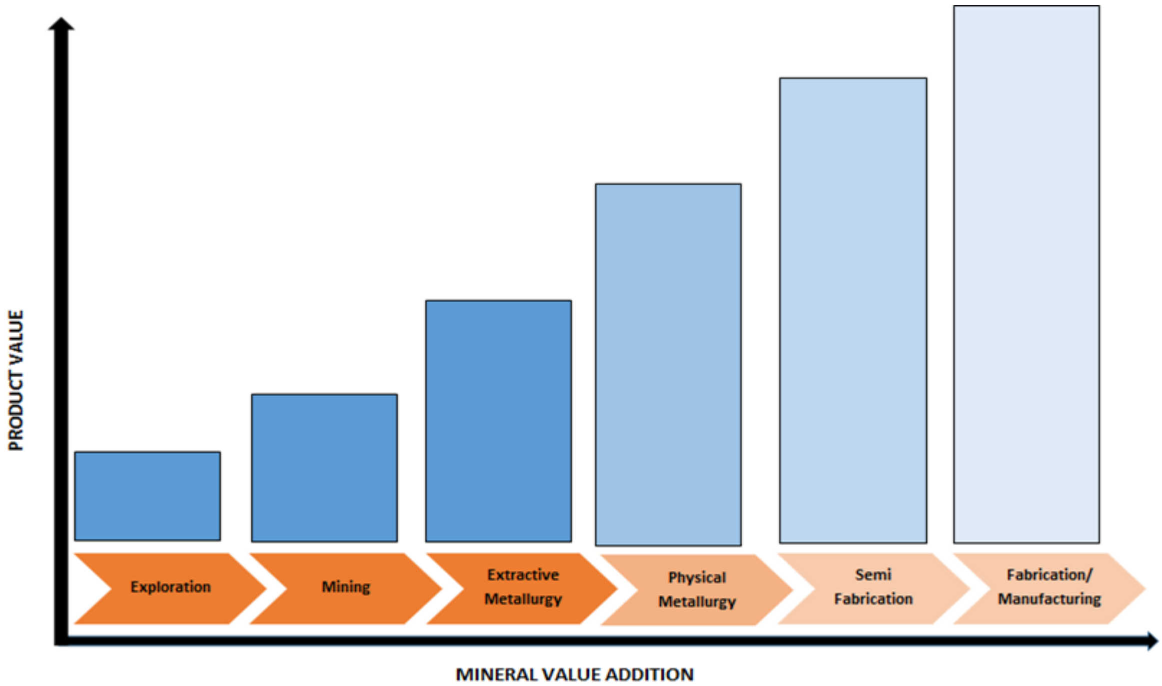


Figure 23: *Mining value chain,* Source*: (Ministry of Mines and Energy, 2019)*

2.23 Mineral beneficiation strategy

Most of the minerals from the Namibian mining industry are exported in a raw form because Namibia does not yet have a fully implemented Mineral Beneficiation Strategy (MBS). The MBS was initiated in 2019 to ensure sidestream, downstream, and upstream value addition to the minerals in Namibia. Essentially, mineral beneficiation can contribute to industrialisation due to the manufacturing industry that can be established thereby integrating the mining industry with other main sectors of the economy (Ministry of Mines and Energy, 2019).

2.23.1 Mineral beneficiation strategy implementation challenges

Numerous mineral beneficiation strategy implementation challenges have been experienced in countries such as Finland, South Africa, and Zimbabwe. According to the Ministry of Mines and Energy (2019), the Finnish minerals industry is facing challenges related to the skills shortage and unreliable supply of raw materials because raw materials such as cobalt are mainly exported from a politically unstable Democratic Republic of Congo (DRC). Meanwhile, South Africa is facing mineral beneficiation challenges related to legal issues.

In addition to that, the challenges related to governance issues in terms of politics, the economy, and other governance issues within the mining industry in Zimbabwe need to be addressed (Mungoshi, 2011). Other challenges entail establishing mineral beneficiation structures, beneficiation task teams, regulatory framework, investment promotion, and facilitation of relevant Research and Development (R&D) and technology. Mineral beneficiation challenges in developing countries are summarized in Figure 24 below.

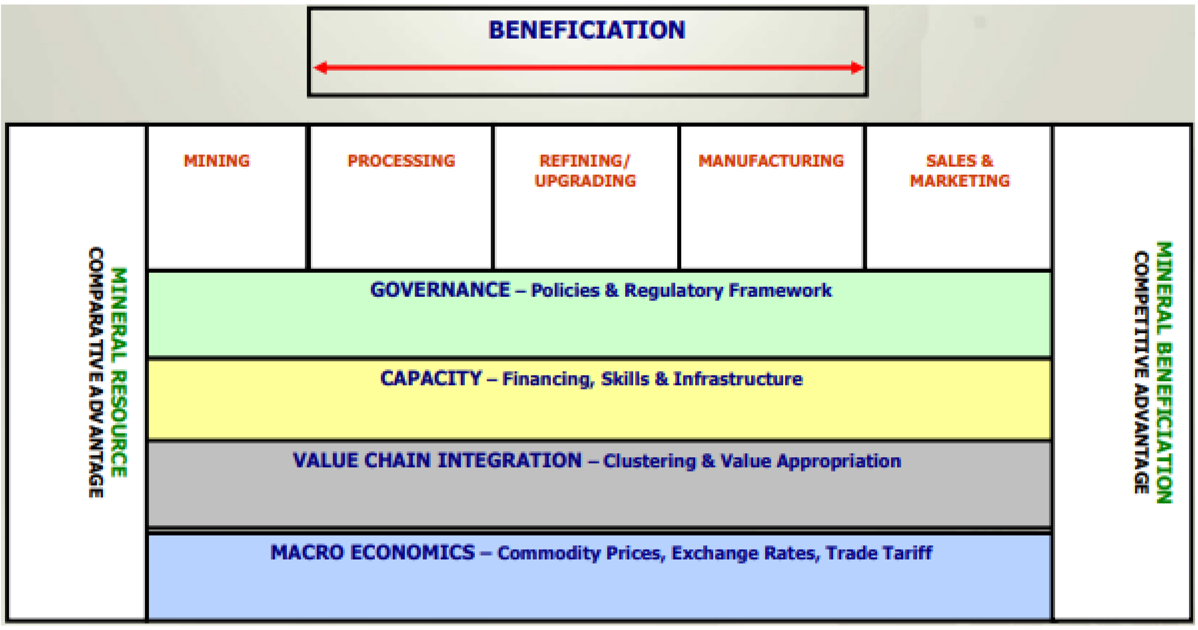


Figure 24: Beneficiation challenges in developing countries

Source: (Mungoshi, 2011)

According to the Ministry of Mines and Energy (2019), in Namibia, the identified challenges that limit beneficiation/manufacturing "are constrained by economic, technological, market, environmental and social factors as well as the lack of adequate infrastructure (transport, water, and energy), which can threaten long-term competitiveness" (p. 91).

In response to these identified mineral beneficiation challenges, seven intervention areas were identified in the MBS, namely: 1) Enhanced competitive environment; 2) Securing raw material and intermediate resources; 3) Skills development, research and innovation; 4) Investment attraction and retention; 5) Beneficiation technology and enabling infrastructure; 6) Marketing and trading of beneficiated products; and 7) Environmental stewardship and sustainability (Ministry of Mines and Energy, 2019).

Although interventions have been suggested for all the constraints, this research is mainly focusing on improving intervention 2) Securing raw material and intermediate resources, and intervention 4) Investment attraction and retention. This is because this research is focusing on investigating strategies to improve superior sustainable performance in the Namibian mining industry. The results of this research are expected to have a direct effect on these two interventions and hence influencing the mineral beneficiation strategy. These two essential interventions are further discussed below.

2.23.1.1 Inadequate capacity for beneficiation

According to the MBS study recently done in Namibia, the mineral resources available locally are not sufficient to give confidence to investors with an interest in further mineral beneficiation and setting up manufacturing industries. However, additional raw materials could be supplied from the neighbouring countries and other mines globally. It is worth noting that most of the local mines have long-term contracts with international companies. Further challenges related to inadequate capacity for beneficiation are depicted in Figure 25 (Ministry of Mines and Energy, 2019).

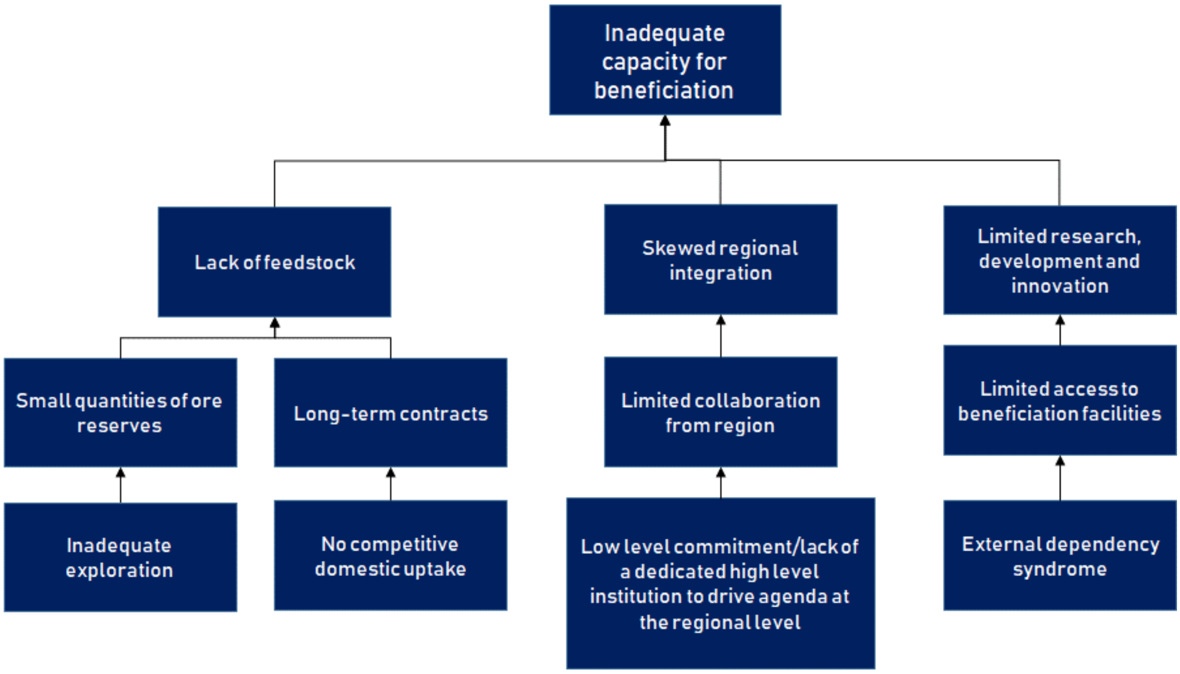


Figure 25: *Inadequate Capacity for Beneficiation* Source: *(Ministry of Mines and Energy, 2019)*

The MBS study proposed the following to curb the effects of inadequate capacity for beneficiation: 1) conducting extensive geological exploration and updating geological databases, 2) manufacturing industries and local mines entering into long-term contracts, and 3) acquiring additional mineral feedstock from mines abroad (Ministry of Mines and Energy, 2019). Although these are good approaches to address the inadequate capacity of beneficiation, other countries might also consider adding value to their minerals and as discussed earlier, there is an increasing trend of mine ceasing production. Therefore, it is best to investigate strategies that can improve superior sustainable performance of the mines hence decreasing the number of mines ceasing production. This can be done concurrently with other approaches.

2.23.1.2 Investment attraction and retention

Investors acquire bank loans to fund manufacturing projects and the financial institutions consider several factors prior to the allocation of a loan. The factors considered include the credit rating of the country i.e. Moody rating, the conditions of the market, nature of the business, return on investment (ROI), etc. Regrettably, due to the economic conditions in Namibia and other factors indicated in Figure 26. It is a challenge to source capital from financial institutions (Ministry of Mines and Energy, 2019).

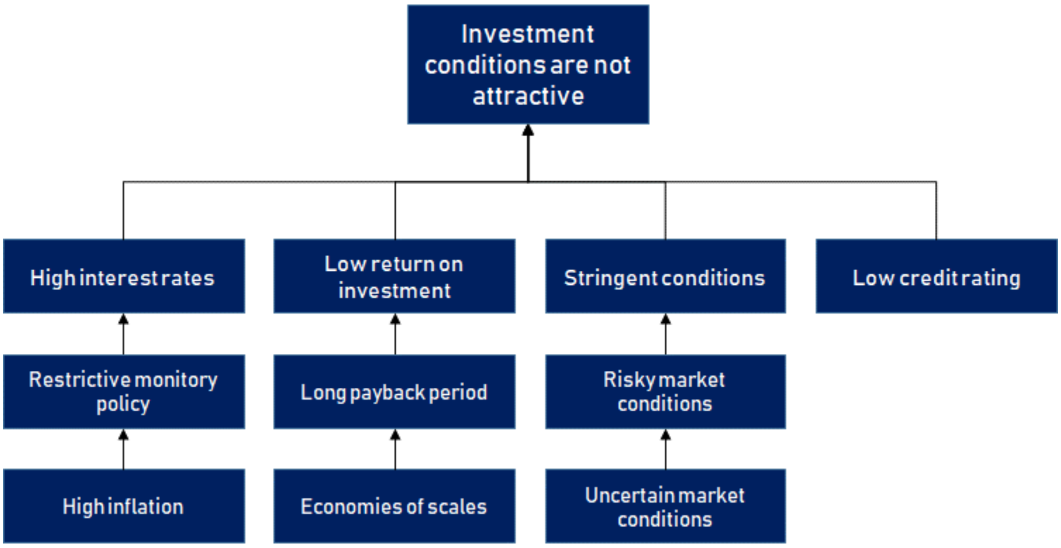


Figure 26: *Investment Attraction and Retention Source: (Ministry of Mines and Energy, 2019)*

It was suggested that the promotion of investment in manufacturing can potentially address the challenge of investment attraction and retention. This can be improved by linking willing investors with potential mineral projects and financial institutions can make it manageable for entrepreneurs to acquire loans. In addition to that, the promotion of markets where manufactured products are sold should be done and the construction of other high-value manufacturing and production facilities were also suggested such as a nuclear power plant, diamond jewellery manufacturing industries, etc (Ministry of Mines and Energy, 2019). These interventions might work, however, they are dependent on how stable the mining industry is because the investors will not risk financial resources if the mining industry is unstable, especially considering that there is an increasing trend of mines closing.

2.24 Effect of government regulations and policies on mining operations

One of the objectives of this research is to investigate the effect of the Namibian government regulations and policies on the implementation of strategies to improve superior sustainable performance in the mining industry. This is critical because the regulations can affect strategic projects by influencing exploration activities, investment decisions, infrastructure availability, import and export of raw materials, utilization and supply of water and electricity and other factors. Typical regulations and policies established by the Namibian government that can potentially affect strategy execution by mines include the minerals (prospecting and mining) act 33 of 1992, minerals policy of Namibia of 2002, labour act 11 of 2007, electricity act 4 of 2007, environmental management act 7 of 2007, public enterprises governance act 1 of 2019, Namibia water corporation act 12 of 1997, and others. These government policies and regulations may affect the successful implementation of strategic projects.

The minerals (prospecting and mining) act 33 of 1992 ensures that no mining activities such as prospecting and mining are not carried out without an appropriate license. The minerals policy of Namibia of 2002 makes provision for the sustainable contribution of the mining industry to Namibia's socio-economic development and to ensure that the mining industry is well developed. The labour act 11 of 2007 regulates the basic working conditions within the mining industry and all other industries. The electricity act 4 of 2007 regulates the electrical power supply to the mining industry via the established Electricity Control Board (ECB). The environmental management act 7 of 2007 aims to advocate for sustainable management of the environment in which mines are operating. This can be done by executing strategic projects in compliance with the Environmental Management Plan (EMP) and the Environmental Impact Assessment (EIA). The public enterprise governance act 1 of 2019 enables efficient governance of public enterprises that provide services to the mining industry such as the Namibia Power Corporation (NamPower), Namibia Water Corporation (NamWater), and Namibian Ports Authority (NamPort), TransNamib Holdings Limited, etc.

2.25. Chapter Summary

This chapter reviewed the critical literature focused on strategy in general, strategic management and their application in the mining industry. This was done by giving a brief discussion on the origin and definitions of strategy concepts. More attention was given to the application of strategic management in general and in the mining industry. The mineral beneficiation strategy and its challenges were also discussed. The literature review chapter also covered all critical aspects of the research objectives

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The research methodology chapter discusses how the study was conducted and the guiding principles applied. In general, this research follows a generic research process cycle displayed in Figure 27. However, a detailed discussion of the methodology is given further in this chapter. The research methodology chapter covers critical aspects such as the research paradigms and philosophical worldviews, research designs, variables under consideration, population, sample, research instruments, procedure, data analysis, validity, and research ethics.

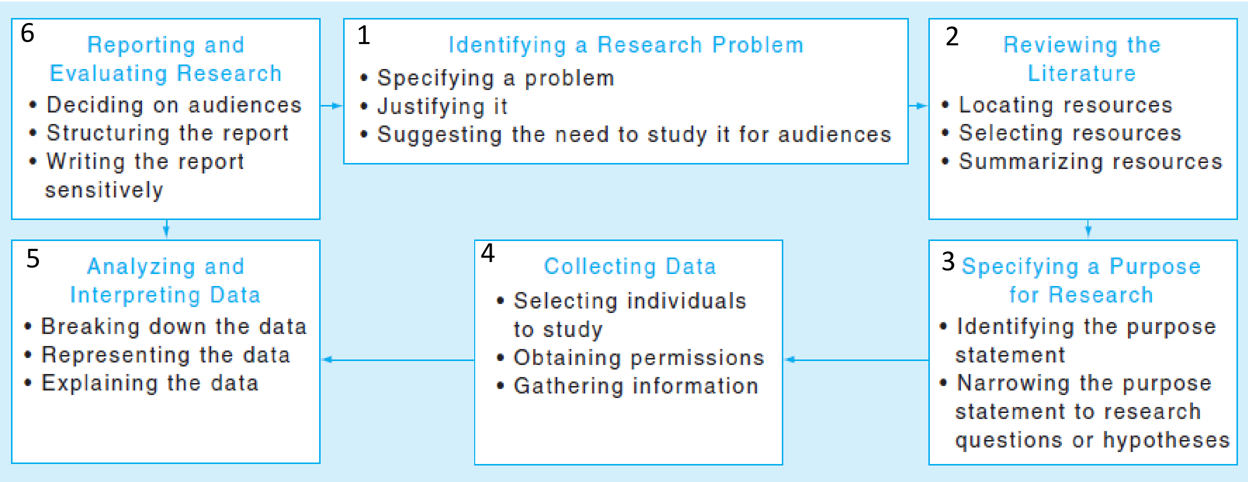


Figure 27: *The generic research process cycle* (Creswell, 2012)

3.2 Research paradigms and philosophical worldviews

A "paradigm is a general organising framework for theory and research that includes basic assumptions, key issues, models of quality research, and methods for seeking answers" (Neuman, 2011, p. 94). It may also be referred to as the philosophical way of thinking about research and it comprises elements such as epistemology, ontology, methodology and axiology. Therefore, these elements and the entire research are based on basic assumptions, values, norms, and beliefs. The epistemology was derived from the word episteme, which means knowledge. Therefore, it has to do with understanding how one comes to know something, whether we know if it is a reality or truth. Meanwhile, the ontology of a paradigm has to do with the assumptions applied to conclude if the phenomenon under investigation is real or it makes sense. The ethical issues emphasised during research proposal planning are referred to under the term axiology, this also includes issues such as privacy, accuracy, property, and accessibility (PAPA). The paradigms for research include the positivist paradigm, interpretivist/constructivist paradigm, critical/transformative paradigm, and the pragmatic paradigm (Kivanja & Kuyini, 2017). A pragmatic paradigm was applied for this research.

According to (Guba; Creswell) (as cited by Mabhiza, 2016), a philosophical worldview is basically a set of beliefs that guide action. Typical philosophical worldviews include positivism, interpretivism, and critical realism. The positivism philosophical worldview seeks to uncover objective causal relationships in order to forecast and control occurrences via empirical observations. In addition, postpositivism suggests that positivism is true to a certain extent. However, it must be noted that the interpretations depend on the assumptions and conjectures applied. While interpretivism worldview is utilised for understanding and explaining meaningful subjective social activities and experiences. Critical realism entails the fact that reality is not constant, it exposes myths and empowers people to radical transformation. The positivism worldview is applied for quantitative research while interpretivism is applied for qualitative research. Moreover, according to Pickard (2013), mixed methods research uses a pragmatic worldview to address research problems and it is a form of postpositivism research.

3.3 Research approaches

According to Creswell (as cited by Mabhiza, 2016), "a research approach is the intersection of philosophical assumptions, designs, and specific methods" (p. 247). Mabhiza (2016) also defines it as the plans and procedures which are applied during research, and it involves decisions ranging from detailed methods of data collection and analysis to the philosophical assumptions used. The research project may fall under two approaches, namely, qualitative and quantitative research. On the one hand, in quantitative research, the researcher establishes a research problem based on the trends or on the need to justify why a certain phenomenon occurs and the influence or effects between various variables are studied. Therefore, a literature review plays a significant role in justifying the observation of the variables. Quantitative research uses purpose statements, research questions, and hypotheses to collect numerical data for the identified variables which are analysed by applying statistical analysis (Creswell, 2012).

On the other hand, qualitative research is executed to explore a certain phenomenon. The literature review does not play a major role except for justifying the problem and it does not set the direction of the research. In this case, no numerical data is collected but words from individuals' perspectives. Such kind of data is not analysed using complex statistical analysis but by using text analysis (Creswell, 2012). Therefore, the mixed methods approach combines both qualitative and quantitative research approaches. It has features of both qualitative and quantitative research approaches. Figure 28 illustrates how the research approaches and designs fit into the entire research process flow. A mixed-methods research approach was applied for this research.

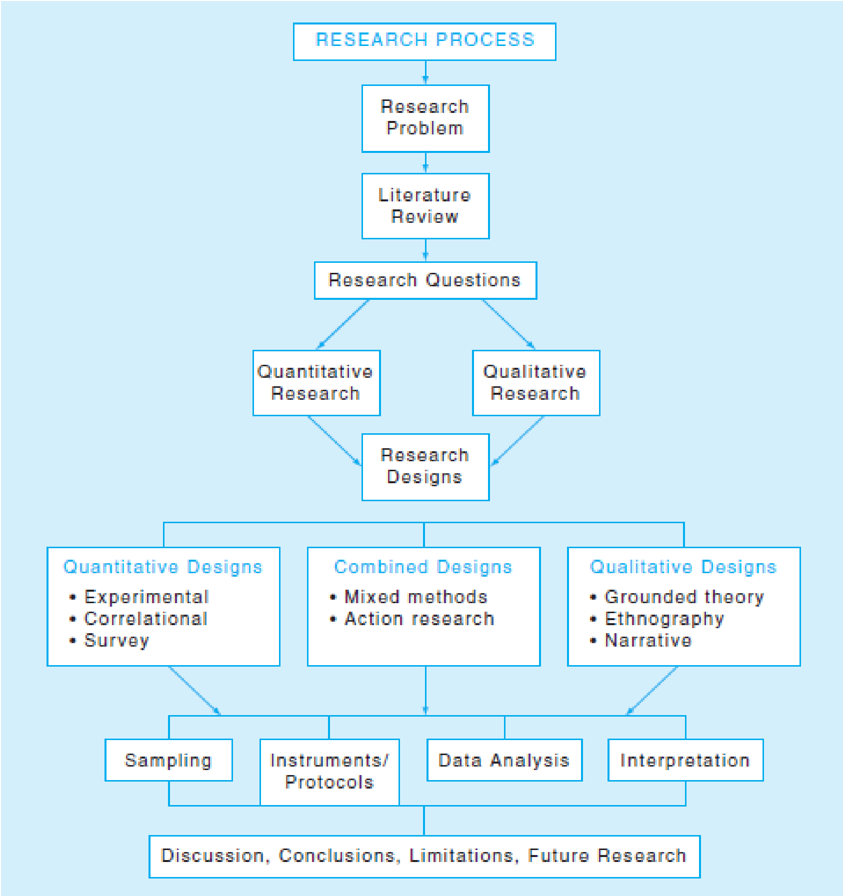


Figure 28*: The research process flow through research approaches* Source: *(Creswell, 2012)*

3.4 Research Designs

According to Creswell (2012), research design entails how research data is collected, analysed, and interpreted using quantitative and qualitative approaches. Therefore, research designs define the direction by which the research should be conducted, and they fall into qualitative, quantitative, and mixed methods approach (An investigation of the information seeking behaviours of veterinary scientists in Namibia, 2016). In general, there are eight research designs. The research designs that apply quantitative research approaches are 1) experimental designs, 2) correlational designs, and 3) survey designs. The ones that utilise qualitative approaches are 4) grounded theory designs, 5) ethnographic designs, and 6) narrative research designs. The last two designs, namely 7) mixed methods design and 8) action research designs are applied when combining both quantitative and qualitative approaches (Creswell, 2012). These research designs applied for each research approach are summarised in Figure 29.

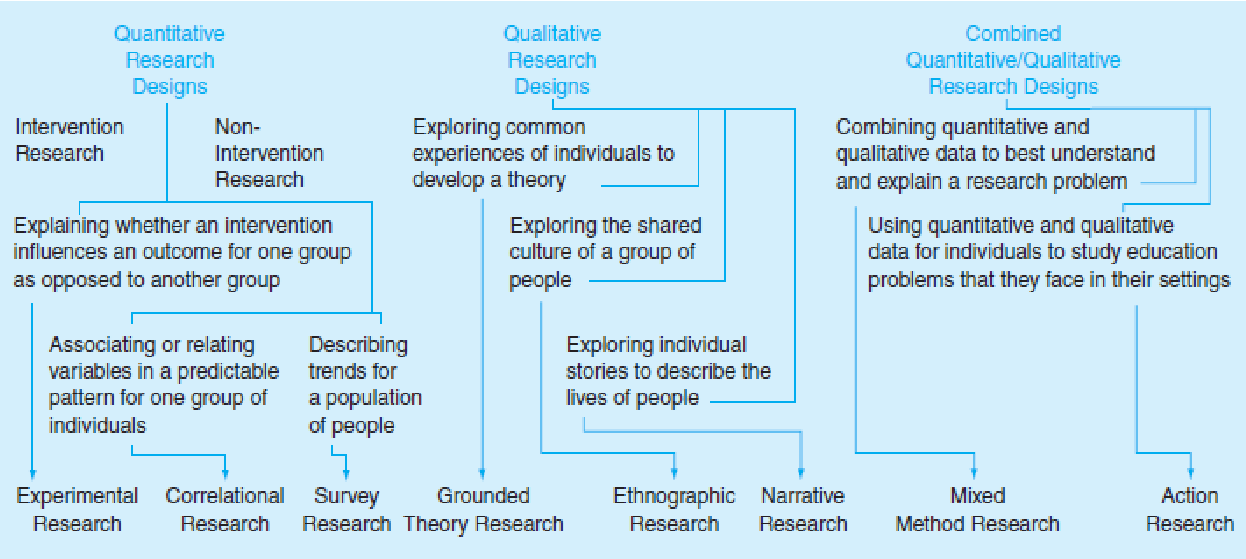


Figure 29: *Types of quantitative and qualitative research designs and their applications*

Source: (Creswell, 2012)

3.4.1 Mixed methods research (MMR)

In this study, mixed methods research (MMR) was applied. This design combines both qualitative and quantitative approaches in the collection, analysis, and interpretation of data. The mixed methods research (MMR) design was suitable for this study because it offers a technique that enabled complete and in-depth investigation of this unexplored challenge by combining both quantitative and qualitative research approaches. Therefore, it provided a better understanding of the research problem than either single research approach. The MMR enables the researcher to do triangulation, in this case, two data sources can be converged or integrated to come to the same conclusion (Creswell, 2012).

3.4.2 Types of mixed methods research (MMR) designs

There are six types of mixed method designs, namely, convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design, transformative design, and multiphase design. The convergent parallel design collects quantitative and qualitative data simultaneously or concurrently. While the sequential designs collect qualitative and quantitative data one after the other in a sequential manner (Creswell, 2012). The difference between the types of mixed method designs is shown in Figure 30. This study has applied an explanatory sequential mixed method design in which quantitative data is first collected and analysed which is then utilised as input into qualitative data collection and analysis. Other designs are either not sequential and/or do not allow quantitative data to build up into qualitative data. The explanatory sequential design is critical in this study because it enables an in-depth analysis. The exploratory sequential design could be used, however, collecting qualitative data first may not give a thorough analysis of the researched problem at an initial stage and it may be difficult to implement. It allows quantitative results to be explained at a later stage by making use of qualitative data. Hence, an explanatory sequential design would be best.

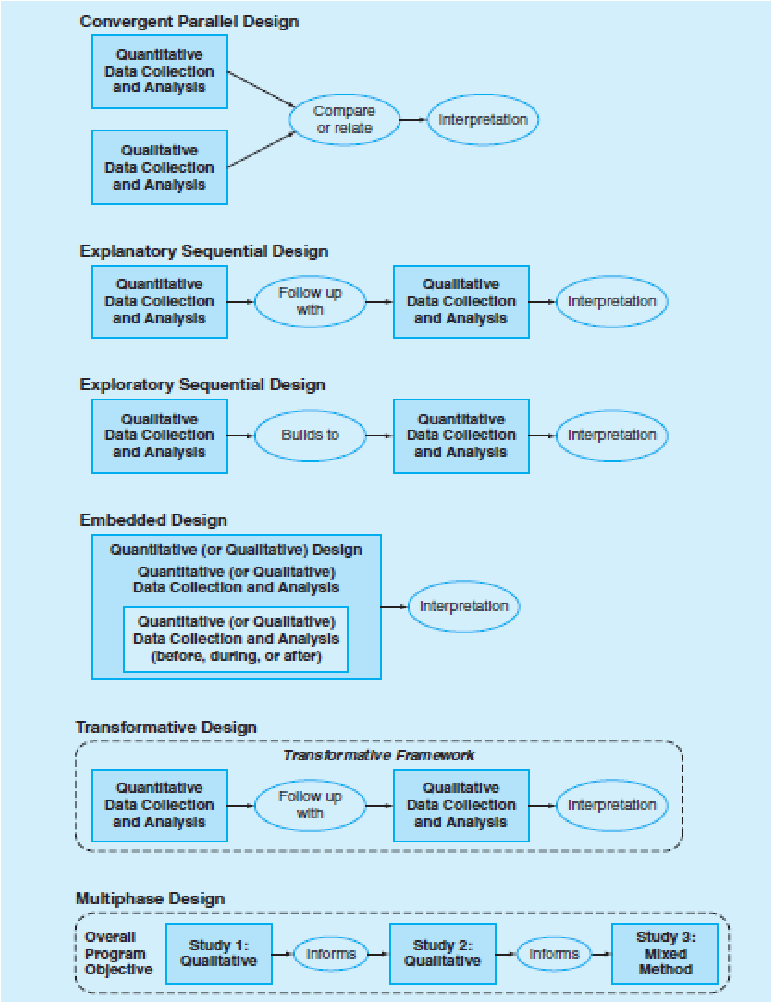


Figure 30: Types of mixed research methods *Source:* (Creswell, 2012)

3.5 Overall design of the study

The overall design of the study was guided by a pragmatic philosophical worldview of the explanatory sequential mixed methods research. In this case, a quantitative approach was applied by making use of the questionnaire survey method and the results were analysed. The findings became the input for the qualitative approach which was executed by establishing an interview protocol that led to the development of the interview guide. This design is shown in Figure 31.

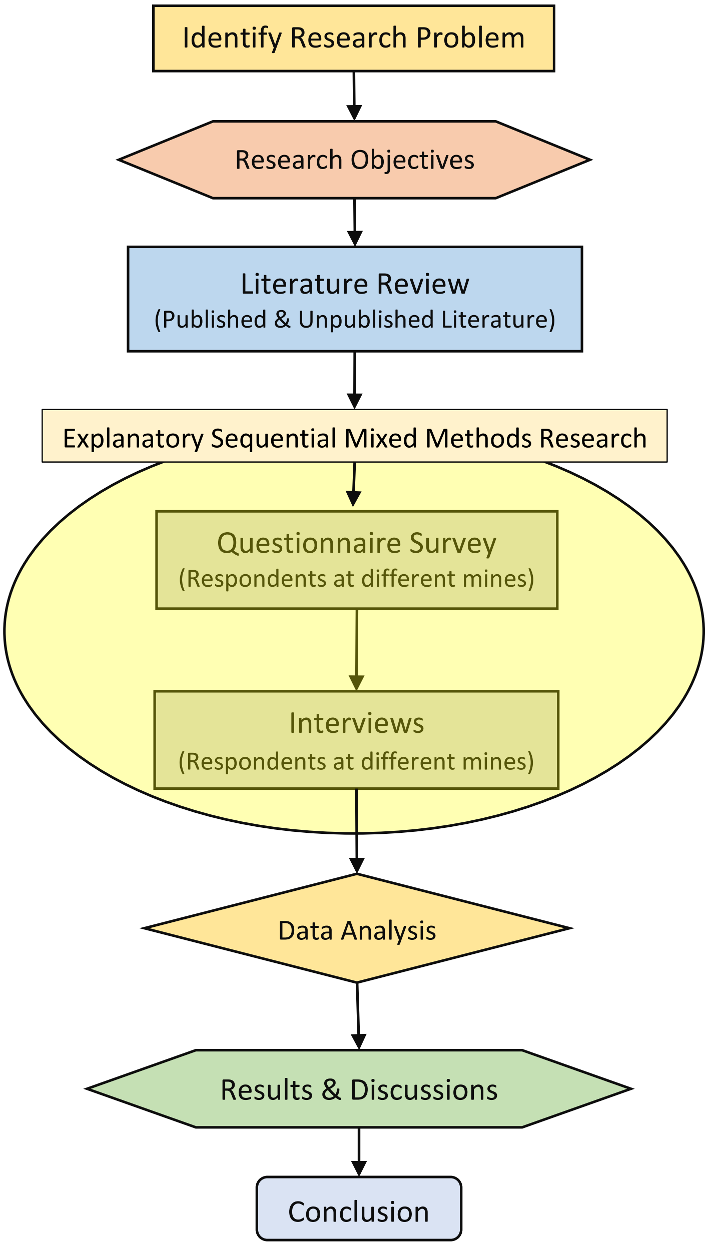


Figure 31: *Overall research methodology applied*

3.6 Population

The target population for this study consists of 25 mining operations located all over Namibia that operated and projects at an advanced stage that was in the Namibian mining industry from

2000 to 2021. Most of these mining operations are listed in Table ***1*** and their geographical distribution within Namibia is shown in Figure 32.

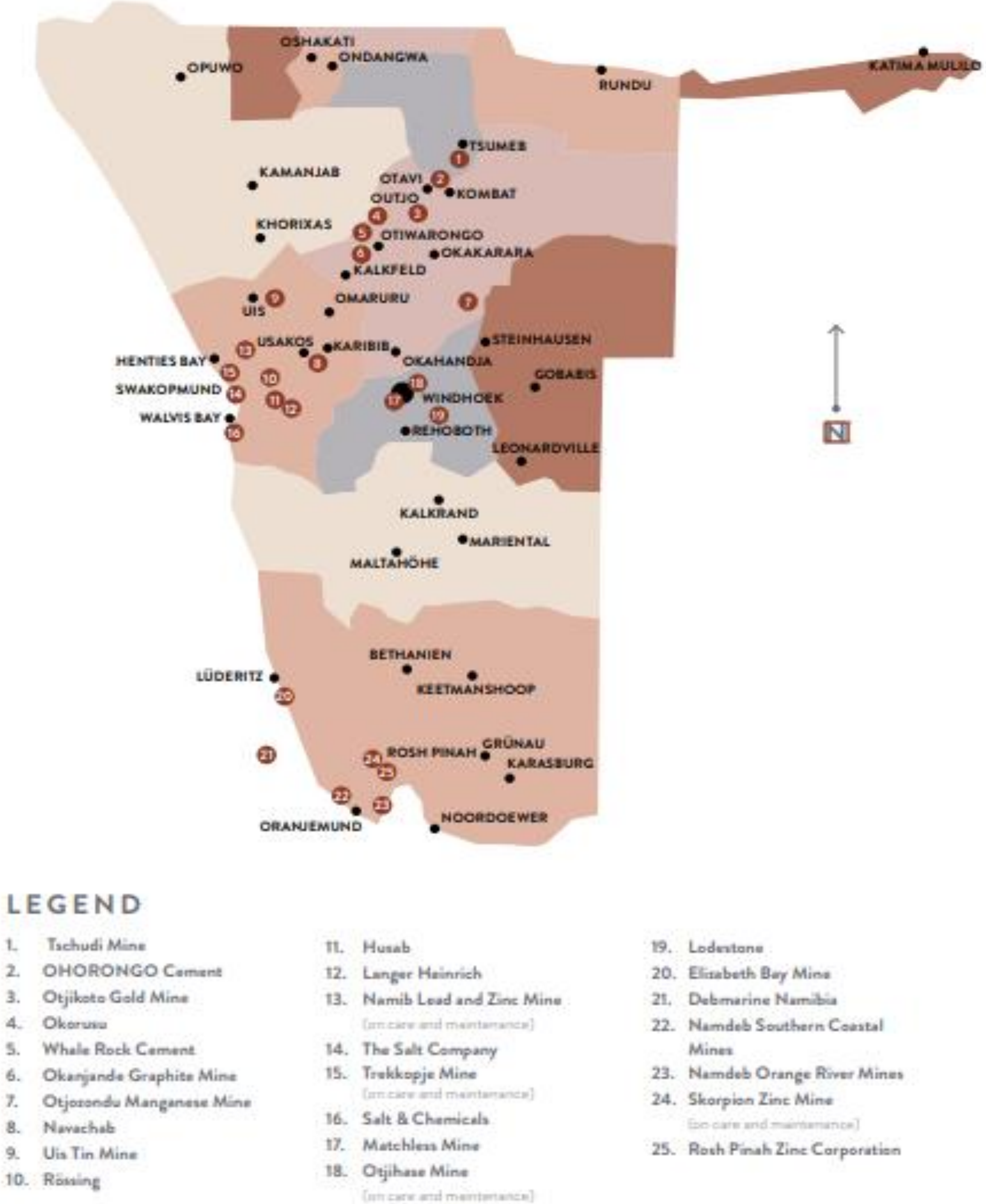


Figure 32: A map of mines in Namibia *Source: (Chamber of Mines, 2021)*

3.7 Sample

Simple random sampling is the probability sampling technique that was applied for selecting participants for the collection of both qualitative and quantitative data. However, after calculating the minimum quantity of operations required, it was decided to rather conduct a census in which the aim was to collect data from all the operations in the mining industry. This is because the sample size was very small, and the calculated sample size is almost equivalent to the population size. Therefore, all 25 mining operations in Namibia were targeted by this study.

By applying Slovene's sampling formula after considering the 5% margin of error, and a 95% confidence level, the calculated sample size of 24 mines was found, which is almost equivalent to the population size of 25 mines as shown below. Nonetheless, the same conclusion was also reached by applying the sample size table by Krejcie and Morgan (1970) as shown in Table 3. However, it should be noted that these methods are normally applied to large normally distributed populations. If the population size is small, the sample size may be assumed to be equivalent to the population size.

<u>Applying Slovene's sampling formula:</u>

$$n = \frac{N}{1+Ne^2}$$

$$= \frac{25}{1+25\times((5\%)^2)}$$

$$= 23.529$$

$$\approx 24$$

In which n is the sample size, N is the population size, and e is the margin of error.

Table 3: *Table for determining sample size from a given population*

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

(Krejcie & Morgan, 1970)

3.8 Research Instruments

For this study, the research instruments for quantitative data collection were the self-administered open-ended questionnaire and qualitative data collection via a semi-structured interview guide was utilised. The self-administered open-ended questionnaire was e-mailed to individual respondents at different mining operations upon requesting them. Moreover, the semi-structured interview guide was developed with input from quantitative data analysis. The interviews were conducted online using Zoom with the same individual respondents (one-on-one) using open-ended questions. The interview sessions were recorded to enable accurate data interpretation.

Regrettably, to adhere strictly to COVID-19 protocols, no face-to-face data collection was done with the respondents. The structure of both instruments incorporated a section on the application of strategic management, critical success factors of strategies used, sustainability of the operation, the effect of governmental regulations and policies on strategies, and superior sustainable performance aspects. Both research instruments were approved by the supervisor before they were applied for the research.

3.9 Procedure

As discussed previously, quantitative data were collected first and analysed, followed by qualitative data collection and analysis. Thereafter, the results of both quantitative and qualitative techniques were integrated and triangulated to make conclusions. As such, an open-ended questionnaire was e-mailed to the mines first via email, thereafter, followed by a semi-structured interview that was conducted online via zoom. Both research instruments were tailored to the research objectives that enabled the collection of data that successfully allowed the main aim of the study to be improved. The data collection procedure described in this section is summarised in Figure 33.

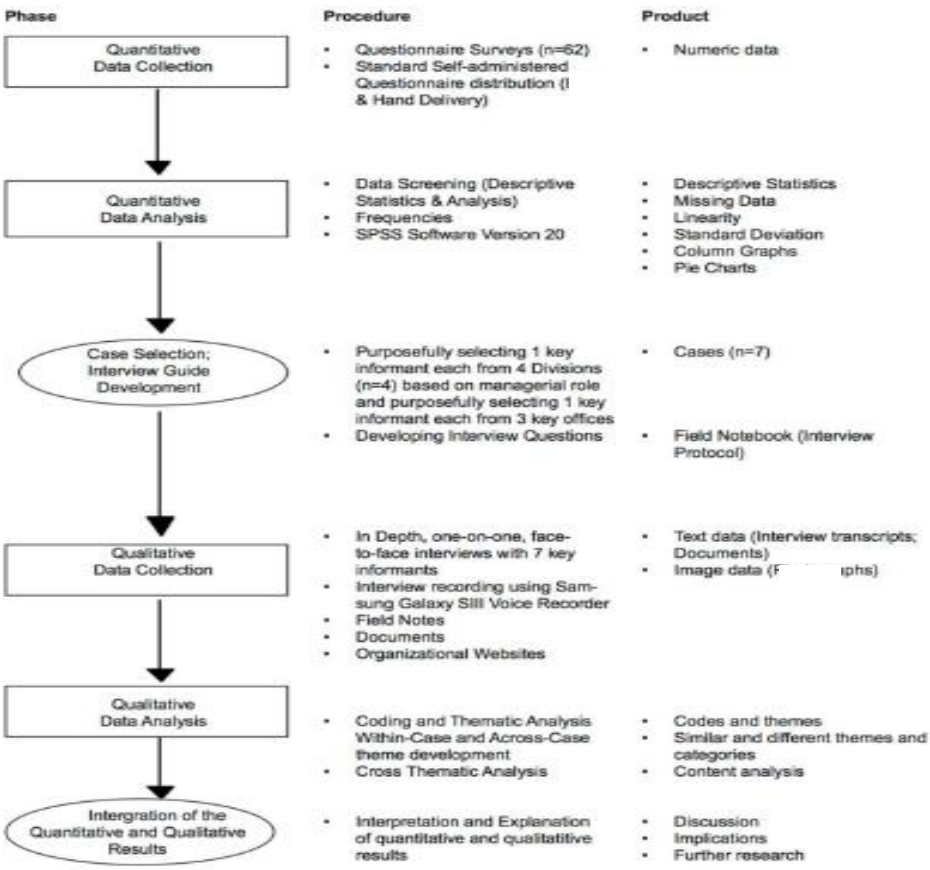


Figure 33: *A mixed methods explanatory sequential design procedure and research process*

Source: (An investigation of the information seeking behaviours of veterinary scientists in Namibia, 2016)

3.10 Data analysis

On the one hand, the collected quantitative data was processed by creating Pie charts, bar graphs, and Pareto Charts using Microsoft Excel. This was then followed by drawing inferences, an in-depth interpretation of the processed data, and then a discussion of the results. This formed a good basis for developing qualitative data collection tools.

On the other hand, qualitative data were analysed by applying thematic or content analysis and they were quantified during the analysis. According to Gibbs (as cited in Mabhiza, 2016), it is worth noting that interpretative philosophy is applied for qualitative data analysis to interpret the holistic understanding of respondents by following two steps, namely, general analysis by coding, and thematic analysis, and specific steps embedded in content analysis. The principal aim of this section is to provide a detailed insight into the obtained quantitative results.

Finally, the analysis of both quantitative and qualitative data was integrated as part of triangulation because part of the purpose of qualitative data was to confirm the analysis obtained from quantitative data analysis. This is the advantage of applying an explanatory sequential mixed methods research design.

3.11 Validity

According to Creswell (as cited by Mabhiza, 2016), the concept validity of research is concerned with issues regarding credibility, authenticity, and trustworthiness as far as data is collected, either by using quantitative, qualitative, or mixed methods. Consequently, data is analysed in terms of quantitative scores and other critical aspects such as data sources, and research participants. Considering that this research is applying a mixed methods research approach, the author has established validity for both qualitative and quantitative measures. Validity concerns for an explanatory sequential mixed method research design such as that applied in this research also include accuracy of the results, sample sizes, and the selection of the same respondents for both qualitative and quantitative research data collection (An investigation of the information seeking behaviours of veterinary scientists in Namibia, 2016).

3.12 Research Ethics

The questionnaires and interview guides had an introductory ethical statement (as shown in the appendix) in which the respondents were informed about voluntary participation and respect for their privacy. Further, the respondents were informed about their right to withdraw from the research should they wish to, for any reason. They were also given a guarantee that the data and information collected from them will be utilised strictly for this research, and will be kept confidential.

The participants permitted the researcher to record the interview sessions while maintaining their privacy, anonymity, and confidentiality. Moreover, the author has upheld and respected the privacy of the participants and their intellectual property rights. The researcher was committed to the research policy ethics guideline(s) for the University of Namibia (UNAM) especially when it comes to data storage, accurately transcribing interview records, and accurately reporting results (An investigation of the information seeking behaviours of veterinary scientists in Namibia, 2016).

Potential ethical dilemmas were addressed by allowing interviewees to complete consent forms. Moreover, a confidentiality agreement was signed and only the researcher had access to all the data stored for the research from all mines. The participants were protected and kept anonymous. The data will be shredded and destroyed after five years.

3.13 Chapter Summary

Chapter 3 focused on the research methodology applied in this research project. The chapter discussed the following aspects of a research methodology, namely, research paradigms and philosophical worldviews, research designs, variables under consideration, population, sample, research instruments, procedure, data analysis, validity, and research ethics. These aspects of the research guided the manner in which the study was conducted.

CHAPTER FOUR: RESULTS PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

The main aim of this research was to investigate strategies that may potentially assist with improving superior sustainable performance in the Namibian mining industry. Improving superior sustainable performance in the mining industry may most likely assist with the successful implementation of the Mineral Beneficiation Strategy (MBS) and hence contribute to the realisation of Namibia’s industrialisation vision.

4.2 Response rate

As required for the explanatory sequential mixed methods research, the author has collected quantitative data using a questionnaire survey and qualitative data via interviews from 17 mines in the Namibian mining industry. This represents a response rate of 68% of all 25 mines in the Namibian mining industry and they all had the same chance to be part of the sample as required for simple probability sampling.

4.3 Demographic information of respondents

Demographic information refers to the information of the respondents such as employment, education, sex, location, years of experience, and others (see Table 4). This information can assist the readers in understanding the background information of the respondents. The mining industry is mainly having male employees, as expected, this research had respondents who are 71% males and 29% females as shown in Figure 34.

Table 4: *Demographic information of respondents*

	Respondent's Demographic Information				
Mining Operation	**Location**	**Region**	**Years of experience**	**Education**	**Sex**
Debmarine Namibia	Windhoek	Khomas	4	Metallurgical Engineering	Male
Dundee Precious Metal Tsumeb	Tsumeb	Oshikoto	10	Metallurgical Engineering	Male
Imerys Graphite & Carbon	Walvis Bay	Erongo	25	Mechanical Engineering	Male
Kombat Mine	Otjiwarongo	Otjozondjupa	4	Geology	Female
Langer Heinrich Uranium	Uis	Erongo	5	Metallurgical Engineering	Male
Namdeb Orange River Mines	Oranjemund	||Karas	8	Chemical Engineering	Female
Namib Lead & Zinc	Walvis Bay	Erongo	25	Mechanical Engineering	Male
Navachab Gold Mine	Karibib	Erongo	10	Geology	Female
Okorusu Flourspar Mine	Otjiwarongo	Otjozondjupa	23	Metallurgical Engineering	Male
Otjihase Mine	Tsumeb	Oshikoto	8	Metallurgical Engineering	Male
Otjikoto Gold Mine	Otjiwarongo	Otjozondjupa	11	Mining Engineering	Male
Rosh Pinah Zinc Mine	Rosh Pinah	||Karas	15	Chemical Engineering	Male
Rossing Uranium Mine	Arandis	Erongo	10	Chemical Engineering	Male
Skorpion Zinc Mine	Rosh Pinah	||Karas	7	Mining Engineering	Female
Swakop Uranium Mine	Arandis	Erongo	8	Mining Engineering	Male
Tschudi Copper Mine	Tsumeb	Oshikoto	10	Geology	Female
Uis Tin Mine	Uis	Erongo	5	Metallurgical Engineering	Male
		Average	11		

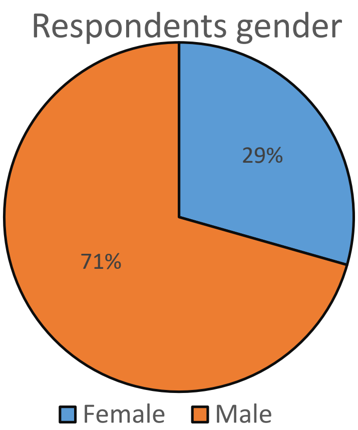


Figure 34: *Gender for respondents*

Most of the mines in the Namibian mining industry are uranium mines and they are located in the Erongo Region in addition to a few other mines in the same region. Therefore, about 7/17 of the respondents are located in the Erongo Region in Namibia. They are working mainly for the three 3 uranium mines (Rössing Uranium Mine, Swakop Uranium Mine, and Langer Heinrich Uranium Mine), Uis Tin Mine, Navachab Gold Mine, and Namib Lead and Zinc Mine. The seventh respondent who worked for the Imerys Graphite operation is also located in the Erongo Region. Three more respondents are situated in the Oshikoto Region and only one is located in Khomas Region working for Debmarine Namibia, as shown in Figure 35. The last three respondents in the Oshikoto Region worked at Tschudi Copper Mine, Dundee Precious Metal Tsumeb (DPMT), and Otjihase Mine.

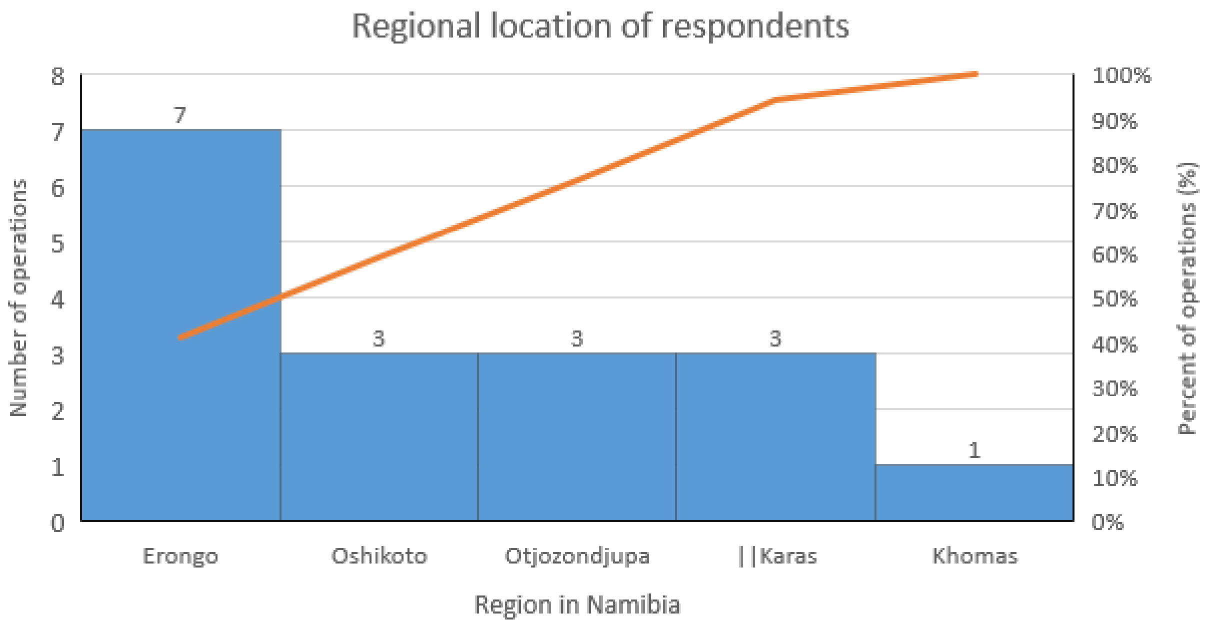


Figure 35: Regional location of respondents

In terms of the educational background of the respondents, approximately 35% (6/17) of the respondents studied metallurgical engineering. This is mainly because the researcher also studied metallurgical engineering at the undergraduate level, and it was more convenient for him to get in touch with other metallurgical engineers in the Namibian mining industry as compared to other professionals, especially due to the confidentiality associated with acquiring data from mines. This is followed by three respondents that each studied mining engineering, chemical engineering, and geology. The other profession is mechanical engineering, which had two respondents as shown in Figure 36.

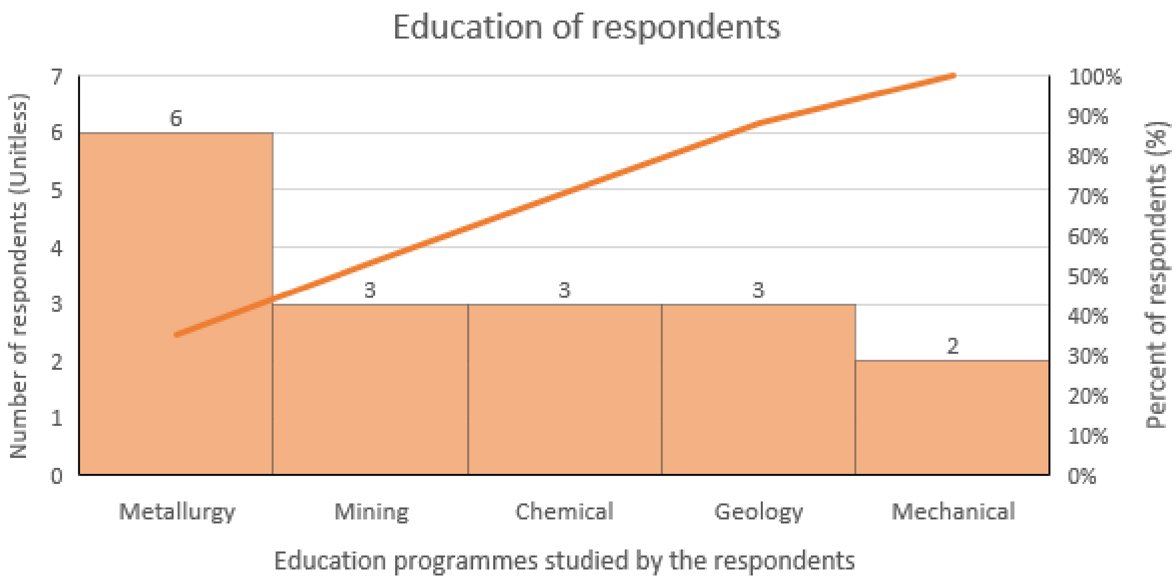


Figure 363: *Education programmes studied by the respondents*

In terms of industrial experience, one of the respondents work as a manager that has worked at Imerys Graphite Operation and Namib Lead and Zinc Mine and had at least 25 years of experience in the mining industry; and the respondent from Okorusu Fluorspar Mine is also a manager who has at least 23 years of industrial experience. In general, all the respondents had an average industrial experience of 11 years as shown in Figure 38 and they work at different management and supervisory levels.

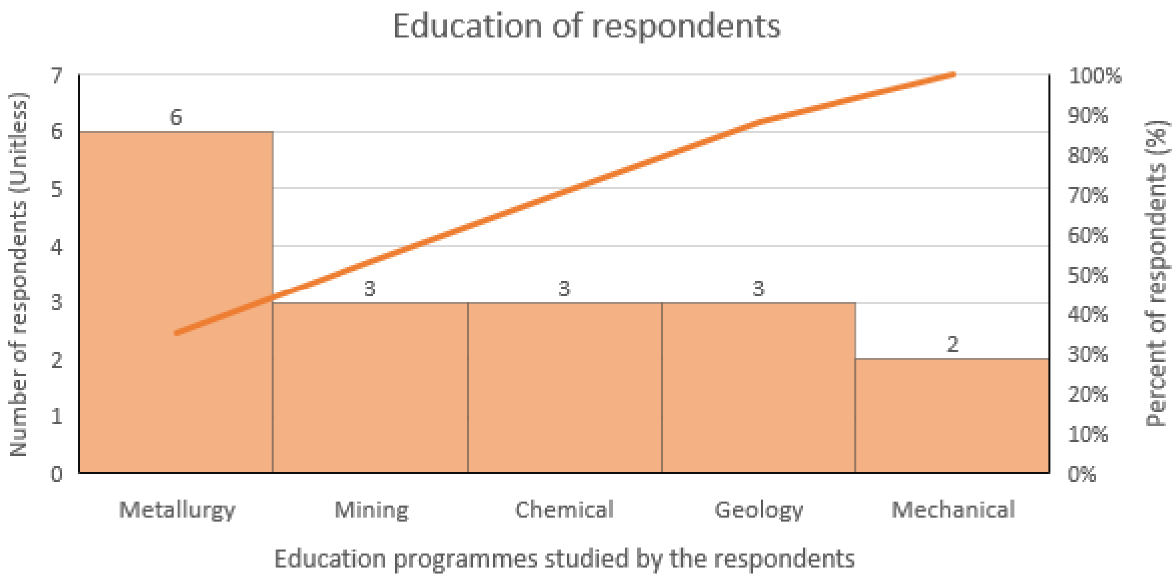


Figure 37: *Education programmes studied by the respondents*

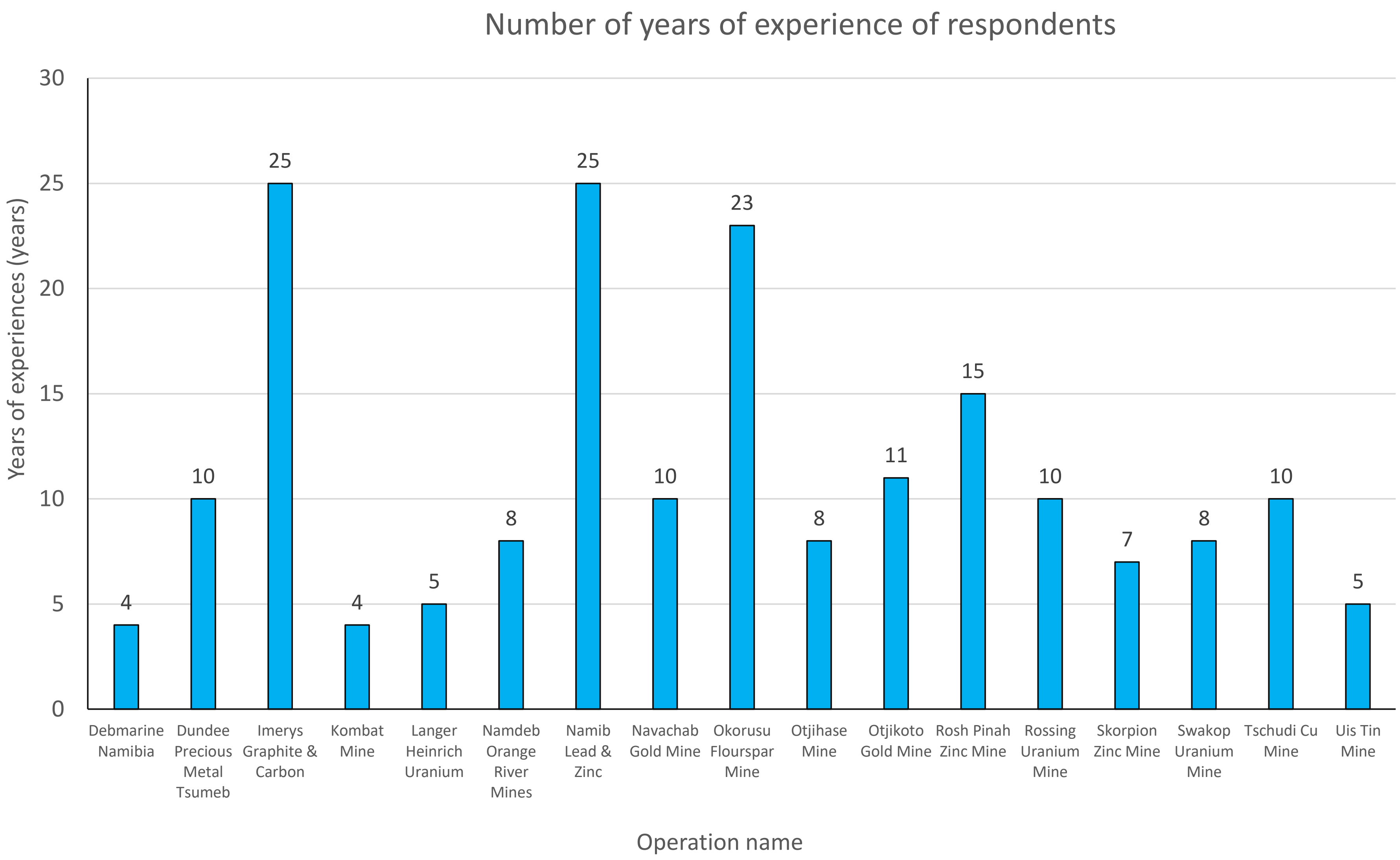


Figure 38: *Years of experience of respondents*

4.4 Life of mines in the Namibian mining industry

As highlighted by Wellmer and Scholz (2018), the life of a mine is a critical aspect of the sustainability of the mining operation. Information on the life of mine in the mining industry will set a good starting point for the discussion of the rest of the results within this chapter. Figure 39 shows the number of years mining operations have been producing in Namibia. It can be observed that Okorusu Fluorspar Mine has operated for approximately 93 years, and this is by far the longest operated mine in Namibia, as per collected data. However, this mine ceased production in 2014 mainly because the viable higher-grade ore resources have been depleted, which resulted in uneconomical production of 97% pure acid-grade Fluorspar concentrate. In addition to that, the demand for 97% pure acid-grade fluorspar concentrate has also decreased because of the global economic crisis. Although, the mine is still placed under care and maintenance further exploration and metallurgical research and development (R&D) are being executed for the possible restart of the operation (Dawe, 2014).

The other operation that has a notable long operation life is Dundee Precious Metal Tsumeb (DPMT) which has 75 years of life it has been operating for 67 years by 2022 and it has eight more years that it can operate in the future with a possibility of going beyond. This is one of the world's unique smelters that produce blister copper and sulphuric acid by treating complex copper concentrates from all over the world. It may be rightfully assumed that the long life of this smelter is attributable to the fact that this operation does not have its own mine, it treats complex copper concentrates from different operations globally, namely, from Opuwo (Namibia), El Brocal (Peru), Codelco (Chile), Chelopech (Bulgaria) and Armenia (Dundee Precious Metals, 2022; SLR, 2019).

Moreover, operations such as Rosh Pinah Zinc Mine, R*ö*ssing Uranium Mine, and Kombat Copper Mine have been operational for 53 years, 46 years, and 46 years, respectively. A common observation here is that Rosh Pinah Zinc Mine and Kombat Copper Mine are both concentrators which are processing the ore by froth flotation (Trevali, 2022; Trigon Metal, 2022). Interestingly, although the Imerys Graphite Mine is on care and maintenance, it is still having about 38 years left in its life of mine (LOM). This is followed by Debmarine Namibia with 29 years of life left. A similar trend can also be observed in Figure 39 and Figure 40 in terms of the percentage of the years operated up to 2022 and the percentage of the years left before the operation closes.

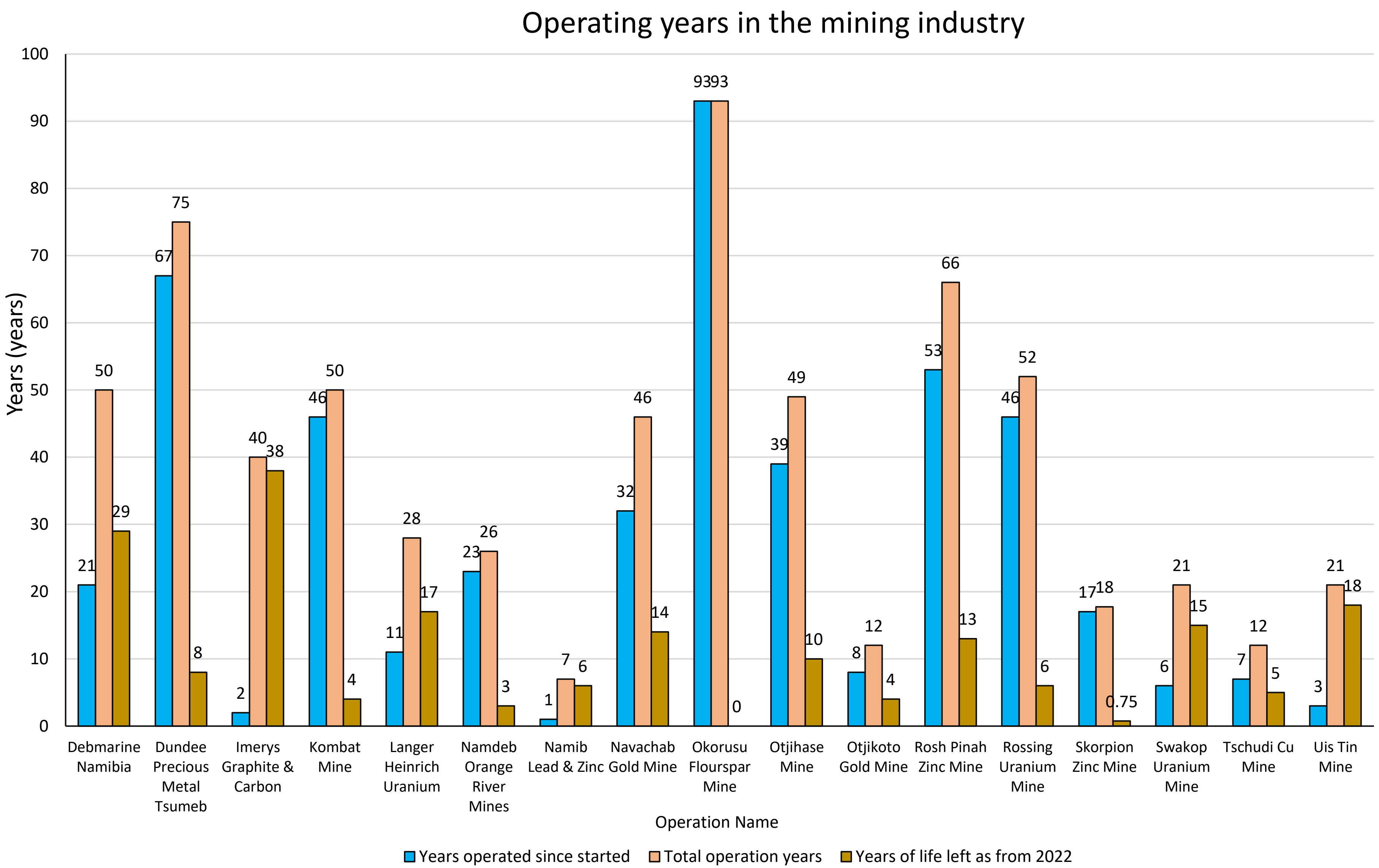


Figure 39: Number of years operating in the Namibian mining industry

Figure 40: *Production years since inception and percentage of the total years operated up to 2022*

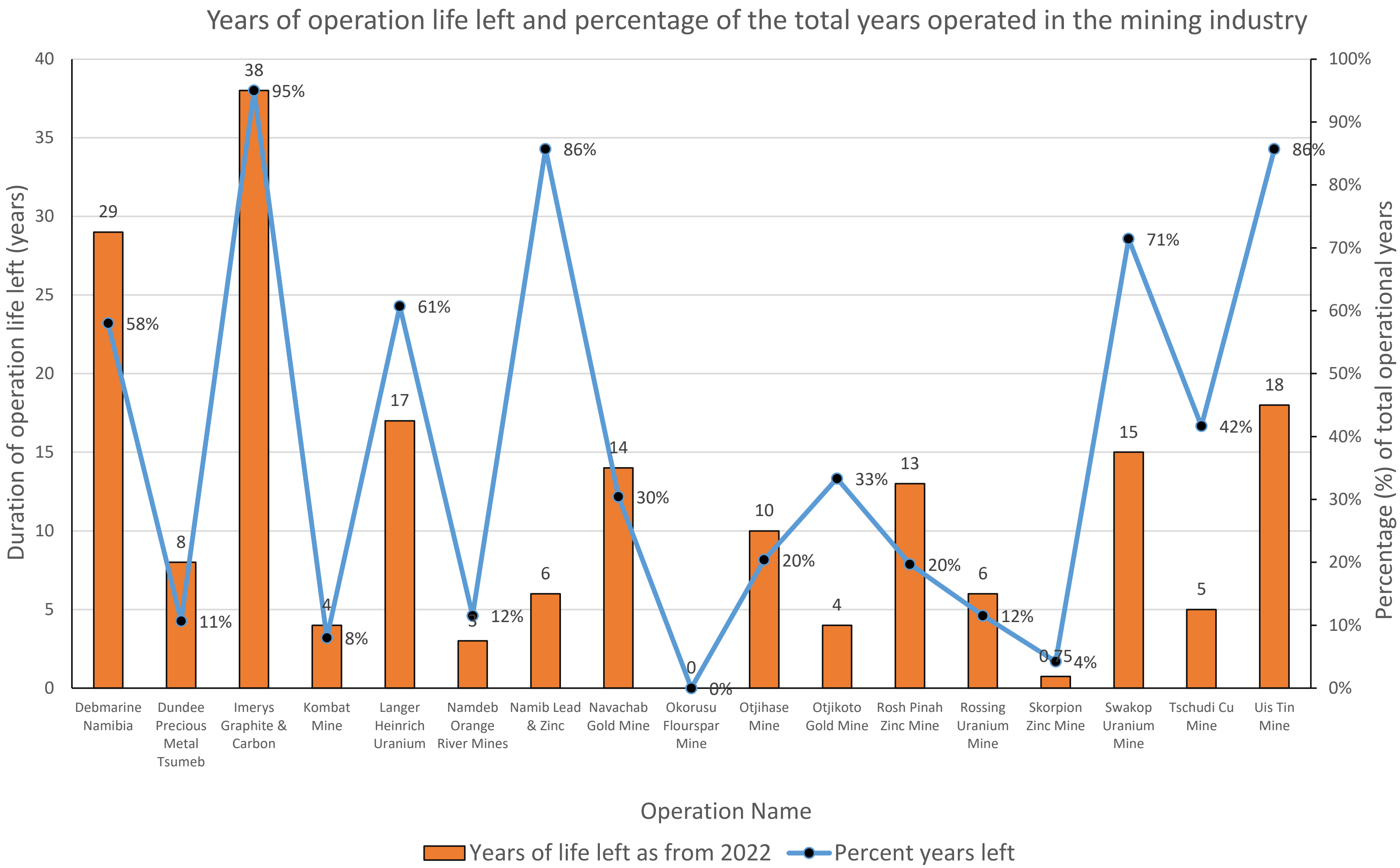


Figure 41: Years of operation life left, and percentage of the total years operated in the mining industry

4.5 Application of strategic management in the Namibian mining industry

4.5.1 Assessing the application of strategic management in the mining industry

The first objective of this research is focused on assessing the application of strategic management as a tool for improving superior sustainable performance in the Namibian mining industry. The study by Boikanyo et al. (2016) concludes that approximately 20% of mining companies in South Africa, Africa, and globally were not utilising strategic management processes. One would wonder if this is a similar case for the Namibian mining industry.

On the one hand, the questionnaire survey results shown in Figure 42 indicate that respondents strongly agreed and agreed that mining operations in Namibia are making use of formal strategy formulation. This was reported to be 18% and 47%, respectively. This gives a total of 65% of Namibian mines applying strategy formulation processes while the balance has 5% and 30% are undecided and disagree, respectively. On the other hand, all the interview results depicted in Figure 43 show that all (100%) of the operations apply the strategy steps involving building the plan and managing performance. This means some companies do not fully apply all the strategy formulation steps, but a general executable plan is created, and its application is monitored and controlled. The strategy formulation steps also include determining position, developing the strategy, building the plan, and managing performance. This finding is in line with 80% that was found by Boikanyo et al. (2016) in the study conducted in mining companies in South Africa, Africa, and globally.

Most of the operations that are or were on care and maintenance such as Kombat Copper Mine, Namib Lead and Zinc, Okorusu Fluorspar Mine, and Skorpion Zinc Mine have strategies in place. The same applies to operations that are planning to re-start or those that are barely trying to survive, especially the uranium mines that were significantly affected by the commodity price of uranium, e.g., the Langer Heinrich Uranium Mine and Rössing Uranium Mine. These operations are currently strategising in order to ensure that they will survive, and they will be able to restart optimally and sustainably.

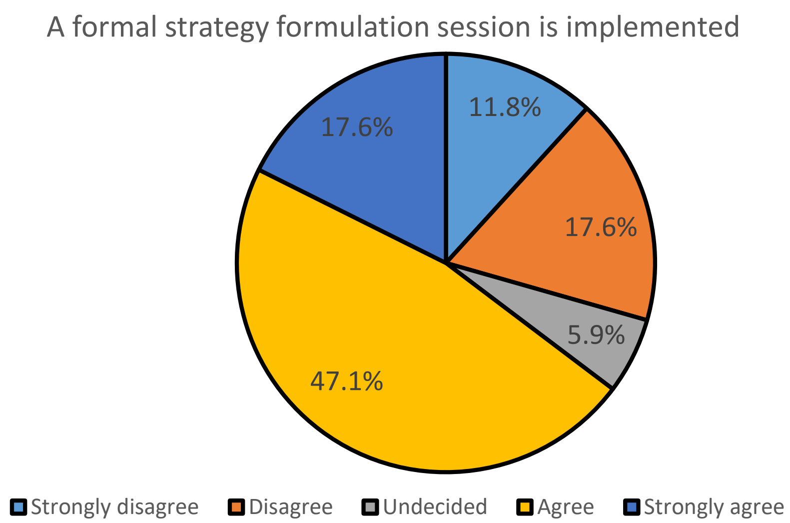


Figure 42: Application of a formal strategy formulation session in the mining industry

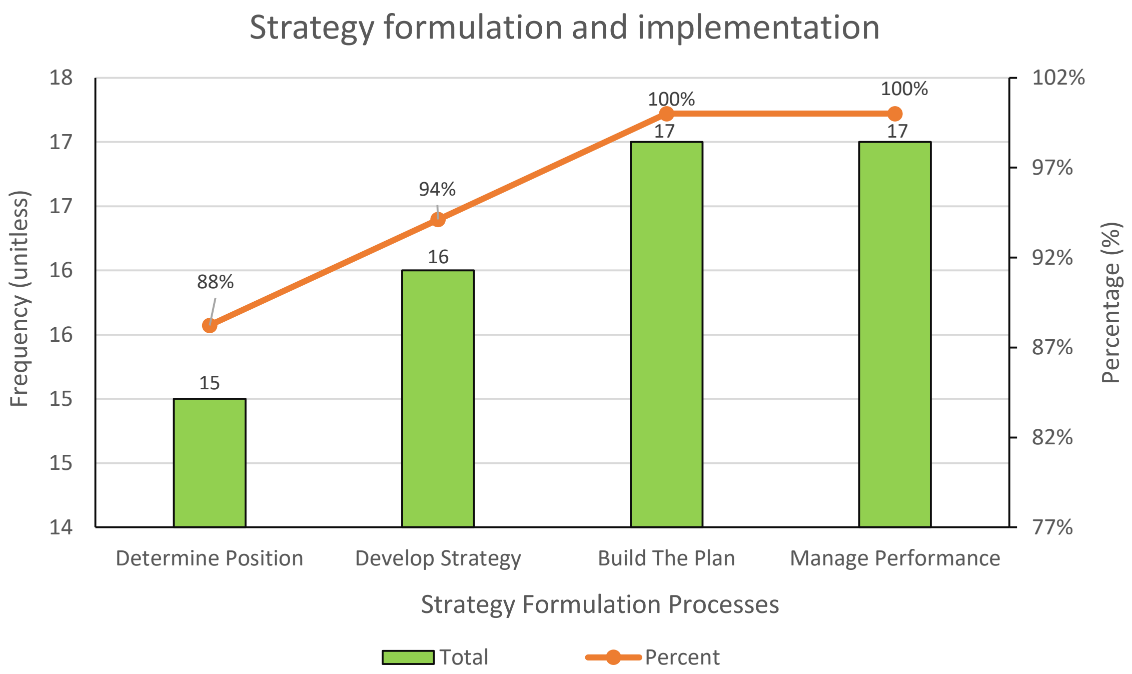


Figure 43: Strategy management process steps applied

4.5.2 Feasibility of strategic projects in the Namibian mining industry

The strategic projects can be considered as strategic initiatives that result from the strategic plan or strategy map, and they are critical for ensuring that the operation improves superior sustainable performance. However, before the strategic projects enter the execution phase, a comprehensive feasibility study and cost-benefit analysis should be completed. This will ensure that the strategic project will be beneficial, and will result in improved profitability. Moreover, it should also be feasible in all aspects such as technical, economic, financial, ecological/environmental, social, etc. As indicated in Figure 44 based on the questionnaire survey, approximately 71% and 6% of operations in the Namibian mining industry agree and strongly agree that the strategic projects at their companies are feasible in all aspects. Only 12% and 12% of the mining operations have disagreed and are undecided about having feasible strategic projects respectively.

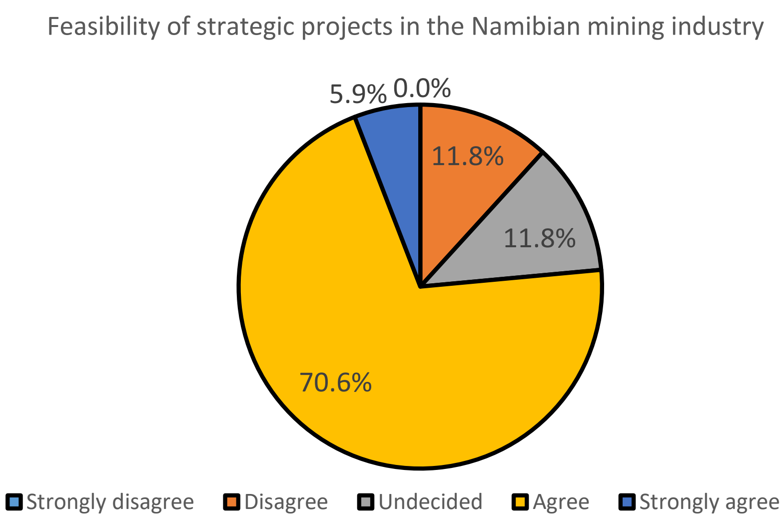


Figure 44: *Feasibility of strategic projects in the Namibian mining industry*

Most of the strategic projects in the mining industry focus on four main areas, namely, the life of mine extension, increasing production, improving efficiency, and improving all-in sustainable cost (AISC) and/or cost of production. The interview data shown in Figure 45 revealed that 88%, 94%, 94%, and 100% of the operations focus on strategic projects in these areas, respectively. These are all critical areas that will ensure that the operations will remain sustainable.

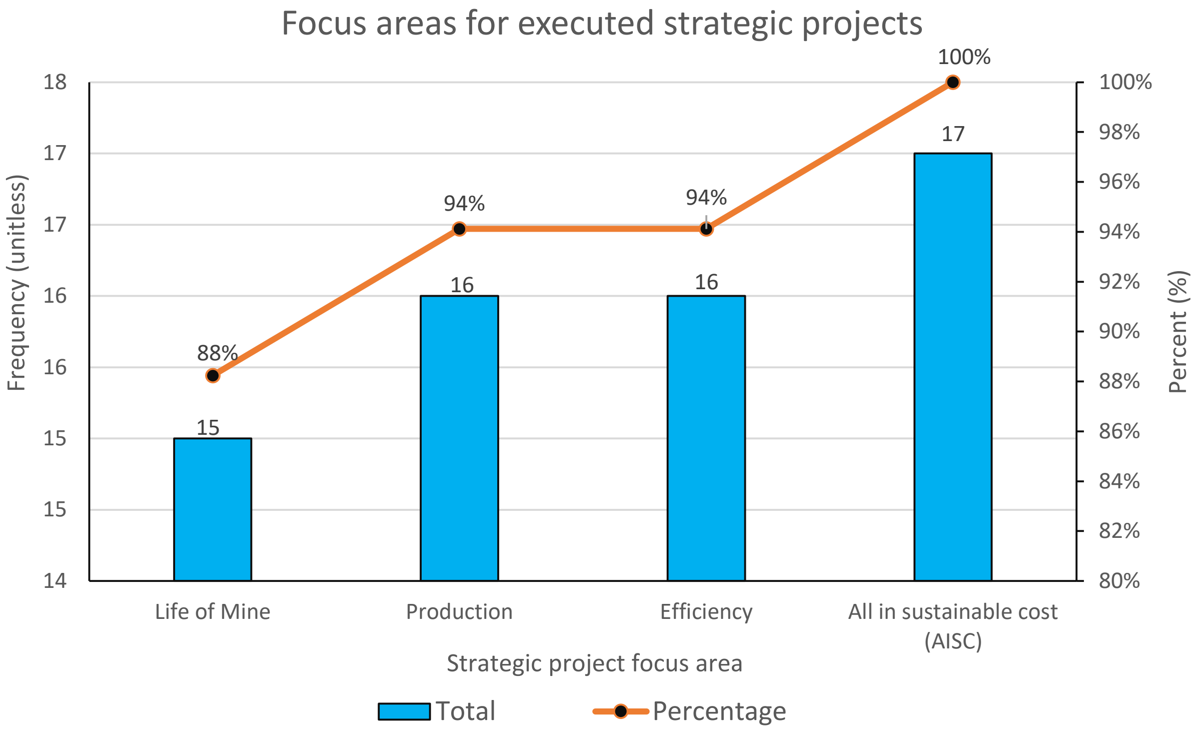


Figure 45: Focus area for implemented strategic projects

Notable strategic projects that have been executed or are in the implementation process in the Namibian industry include Debmarine Namibia, which recently (18^{th} March 2022) inaugurated the state-of-the-art diamond recovery vessel called the Benguela Gem diamond recovery vessel which costs N$7 billion and is expected to increase production by 500 000 carats annually or 35% increase in production (De Beers Group, 2022); Dundee Precious Metal Tsumeb (DPMT) smelter constructed a N$3.9 billion brand-new sulphuric acid (H_2SO_4) plant with a design capacity of 230 000 to 280 000 tonnes of sulphuric acid per year in 2015, hence adding a new strategic business venture to copper smelting (Dundee Precious Metals, 2022).

4.5.3 Critical success factors for strategy implementation

The second objective of this research is to examine the critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry. Considering that about 71% of strategic projects are feasible as discussed in the previous section, the next logical question would be about how many mining operations have successfully implemented strategic projects? Surprisingly, based on the questionnaire data as indicated in Figure 46, 35% and 6% of the respondent agree and strongly agree, respectively, that the main strategic projects have been successfully implemented in their operations. Giving a total of 41% successfully executed strategic projects which is quite low. This would include the successful strategic projects mentioned in the above section.

Meanwhile, 35% of the operations are uncertain if the execution of the main strategic projects was successful or not. On the other hand, 24% of the mining operations disagree to have implemented strategic projects successfully in all aspects. According to Li et al. (2008), it was reported that about 57% of business strategies fail due to poor strategy implementation. However, the current study found that only 24% of operations were found to have failed in the implementation of strategic projects. Assuming that the 35% of undecided strategic projects failed, a total of 59% of strategic projects could potentially fail during execution in the Namibian mining industry. This is relatively close to 57% that was reported by other researchers.

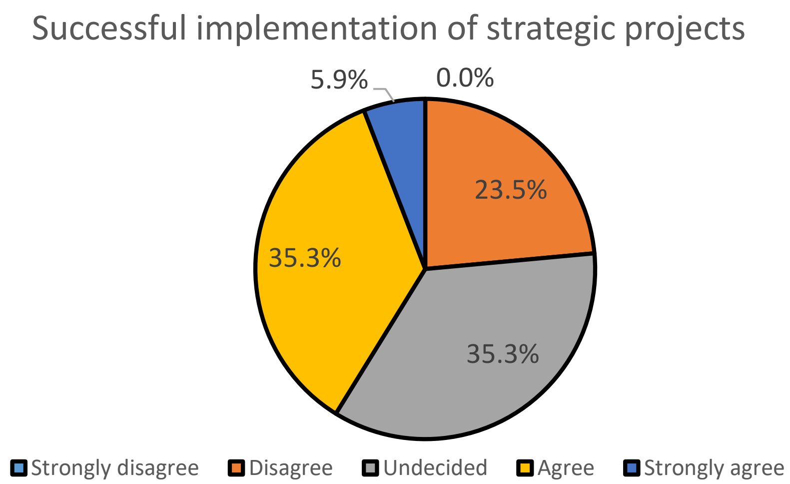


Figure 46: Successful implementation of strategic projects

Critical success factors that can influence strategy implementation in the mining industry range from commodity prices, ore grade decline, depleted mineral reserve, geotechnical risks, changes in technology, and many others. There are nine factors influencing strategy implementation; and these are: "1) the strategy formulation process, 2) the strategy executors (managers and employees), 3) the organizational structure, 4) communication activities, 5) the level of commitment to the strategy, 6) the consensus regarding the strategy, 7) the relationships among different units/departments and different strategy levels, 8) the employed implementation tactics, and 9) the administrative system in place" (Li et al., 2008, p. 11).

Based on the interviews conducted, the main critical success factors for strategic project execution that were identified as shown in Figure 47 include the following: project executor skill and experience, management support, communication, execution tactics, organizational structure, financial resource availability, commodity price, technical challenges involved in the project, and staff dedication. These factors contribute significantly to the execution of strategic projects, hence increasing the chances of improving superior sustainable performance of the mining operation. Such factors should be included in strategies for improving superior sustainable performance.

Typical strategic project examples in the Namibian mining industry that have failed or that were not implemented timely yet include Vedanta Resources' Skorpion Zinc Mine's refinery conversion project that is expected to enable the treatment of both oxide and sulphide zinc minerals. A Bankable Feasibility Study (BFS) for this project has been completed and N$6.5 billion budget has been specifically allocated to it. However, this project could not be implemented timely due to the unforeseen slope failure that was experienced at Skorpion Zinc which resulted in the mine undergoing care and maintenance in May 2020 (Vedanta, 2022).

This unanticipated geotechnical risk was later followed by renegotiation of the electrical power tariff between Skorpion Zinc Mine, South African power utility Eskom, and the Namibian power utility Nampower. Currently, the electric power tariff that can allow the project to remain profitable has not been reached, hence delaying the project further. Similar electric power renegotiations were done in 2011 as reported by Fast Markets (2022). Once the new and acceptable tariff agreement has been reached the refinery conversion project can resume with the construction phase.

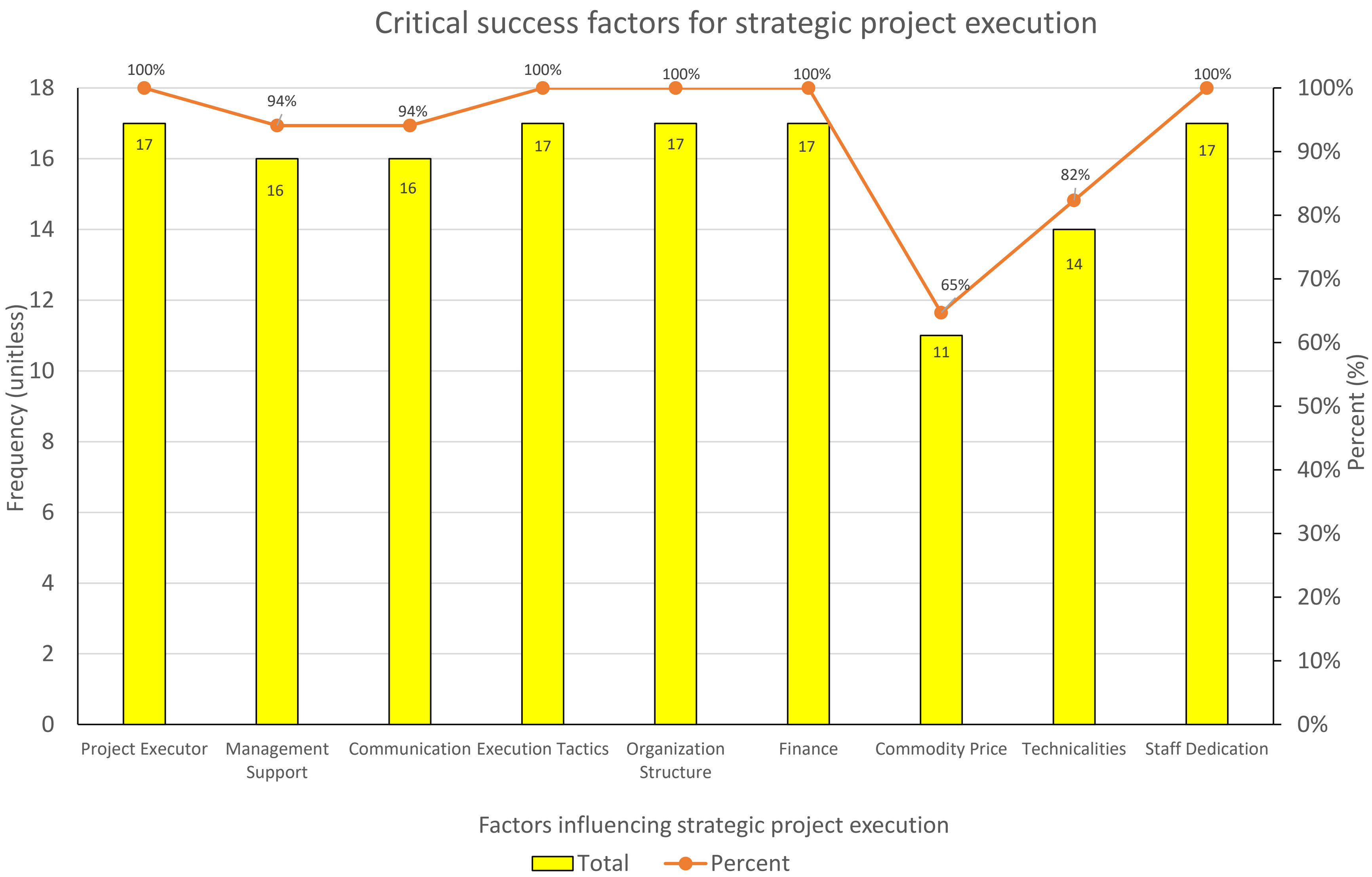


Figure 47: Critical success factors for strategic project execution

4.5.4 Existence of strategies to improve superior sustainable performance

It can be seen in Figure 48 that about 76% of mining operations have established strategies for improving superior sustainable performance to sustain their organisations. This is the focus area for this research, and it will be analysed in greater detail by examining factors affecting superior sustainable performance of the mines. This can be reflected in the projects that mining operations are executed such as those discussed in the previous sections.

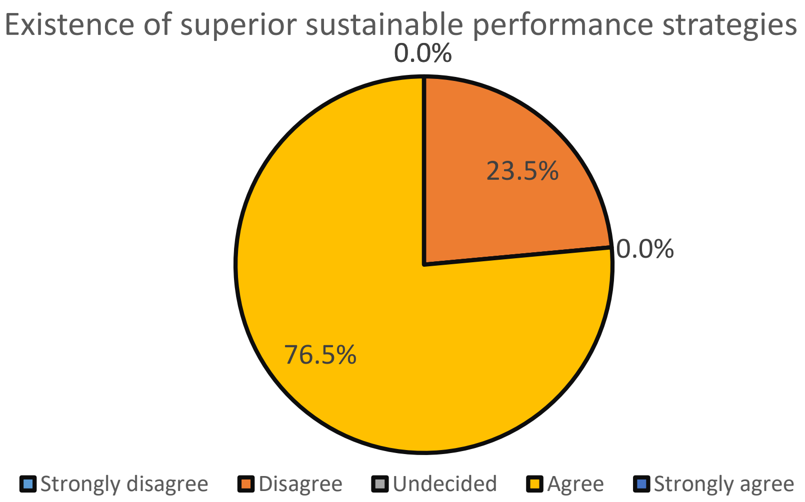


Figure 48: *Existence of superior sustainable performance strategies*

4.6 Sustainability of operations in the Namibian mining industry

4.6.1 Sustainability issues affecting the Namibian mining industry

Several sustainability issues are common in the Namibian mining industry, and these include: aggressive cost-cutting, retrenchments, care and maintenance, mine flooding, ore depletion, declined ore grade, mineralogical change, labour disputes, geotechnical risks, and declined commodity prices, just to name a few. It is crucial to note that they may seem to be normal technical and operational concerns that can directly affect production.

Similar sustainability challenges were reported at the Namibia Minerals Industry Symposium (NAMIS) held by the Department of Mining and Process Engineering (DMPE) at the Namibia University of Science and Technology (NUST) under the theme *Mining challenges impacting the local industry* in 2016. Typical sustainability challenges affecting the Namibian mining industry were reported and they include the following factors: declining ore grades, plummeting commodity prices, increased regulation, and legislation, increased corporate social responsibilities, escalating costs, water, and energy crisis (DMPE, 2022).

Several technical and operational issues that have significantly affected the sustainability of mines by shortening the life of the mines in Namibia can be arranged in the following order based on the percentage of the operations they negatively affected as follows: decline in commodity prices (35%), mine flooding due to underground water (24%), geotechnical risks (18%), depleted ore (18%), declined ore grade (12%), and mineralogical change (12%). Other sustainability factors that may also be viewed as consequences include employee retrenchment (59%), aggressive cost-cutting (53%), care and maintenance (47%), and labour disputes (29%), as shown in Figure 49 based on the questionnaire survey.

The frequency of occurrence for each of the above sustainability issues is shown in Figure 50 and it can be concluded that the operations that have experienced at least four of the above-mentioned sustainability issues were on care and maintenance at some point during their operation life. This includes approximately eight operations such as Imerys Graphite & Carbon operation, Kombat Copper Mine, Langer Heinrich Uranium Mine, Namib Lead and Zinc, Okorusu Fluorspar Mine, Otjihase Mine, Skorpion Zinc Mine, and Tschudi Copper Mine. This clearly shows that they have not successfully implemented superior sustainable strategies and the strategic risks were not managed effectively.

The Chamber of Mine of Namibia (2022) takes sustainable development seriously especially when it comes to environmental protection by partnering with the Namibia Chamber of Environment (NCE) and by dealing with social concerns. As such, the best practice guide for environmental principles was published and it enforces that the mining companies should obtain a Social License to Operate (SLO). The need for an SLO in the African mining industry was also studied by (Musiyarira et al., 2019). The Chamber of Mine of Namibia has facilitated the establishment of a mine closure framework to ensure acceptable change after operation closure and it emphasises sustainable development through economic transformation nationwide by creating a Mining Charter.

Therefore, the Chamber of Mines is facilitating the enforcement of the Environmental Management Act 7 of 2007, especially regarding the implementation of critical environmental aspects such as the Environmental Impact Assessment (EIA), the development of mine closure and rehabilitation plan, and the establishment of the Environmental Management Plan (EMP). Labour issues can also affect the sustainability of the operation by influencing staff retention, staff turnover, staff motivation, employee engagement, skills transfer, etc. Labour unrest including retrenchments and other labour-related issues is normally managed in compliance with the Labour Act 11 of 2007 in the Namibian mining industry.

Most of these sustainability actions have been revealed via the interviews and they are shown in Figure 51. The main operation sustainability initiatives and percentage of mines implementing them are as follow: establishing a mine closure and rehabilitation plan at 100%, increasing the life of mine at 88%, investing in intensive exploration at 88%, environmental protection at 100%, improving the all-in sustainable cost (AISC) at 94% and improving operation efficiency at 100%. These initiatives are very common in the industry

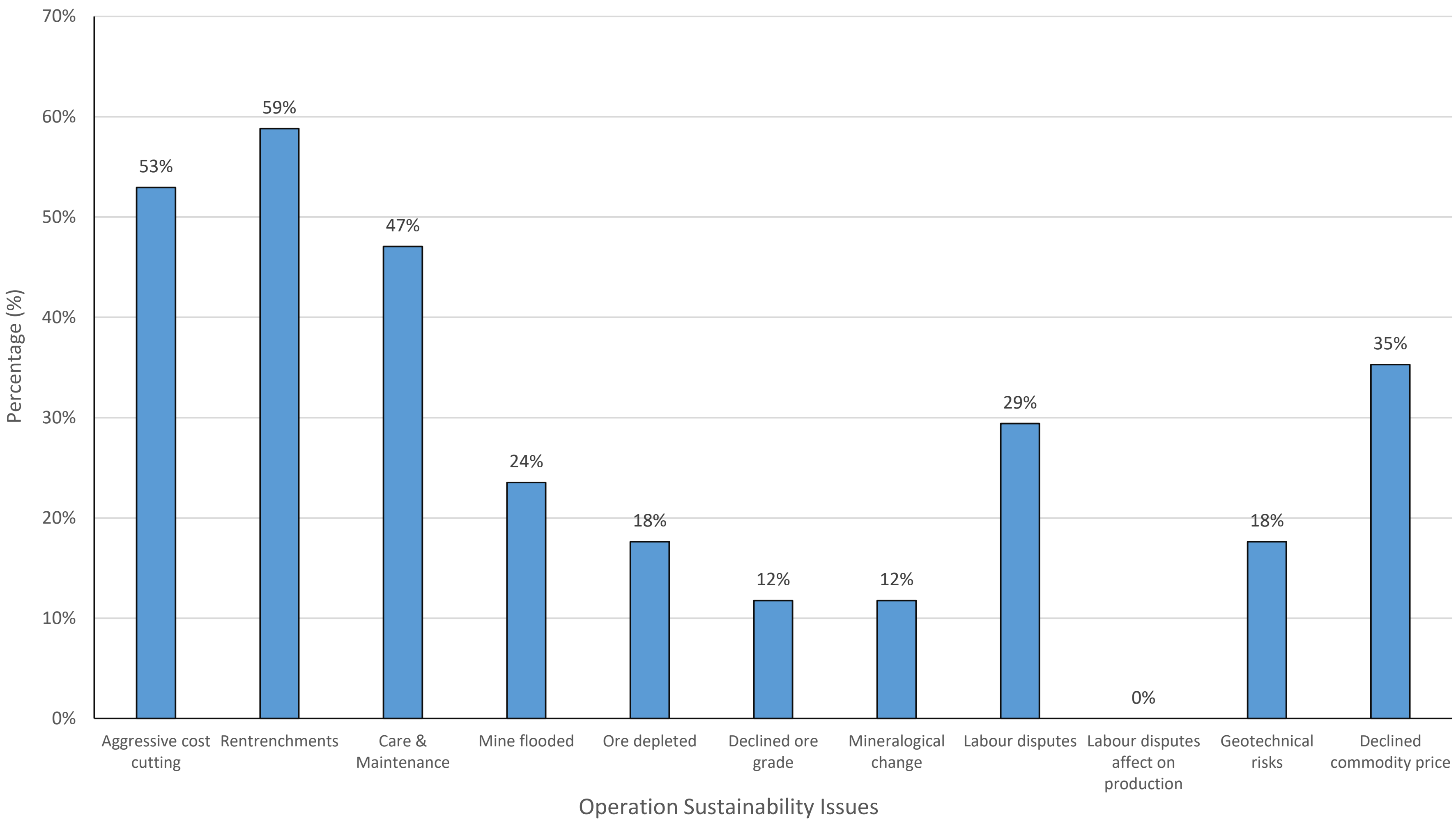


Figure 49: *Sustainability issues percentage occurrence in the Namibian mining industry*

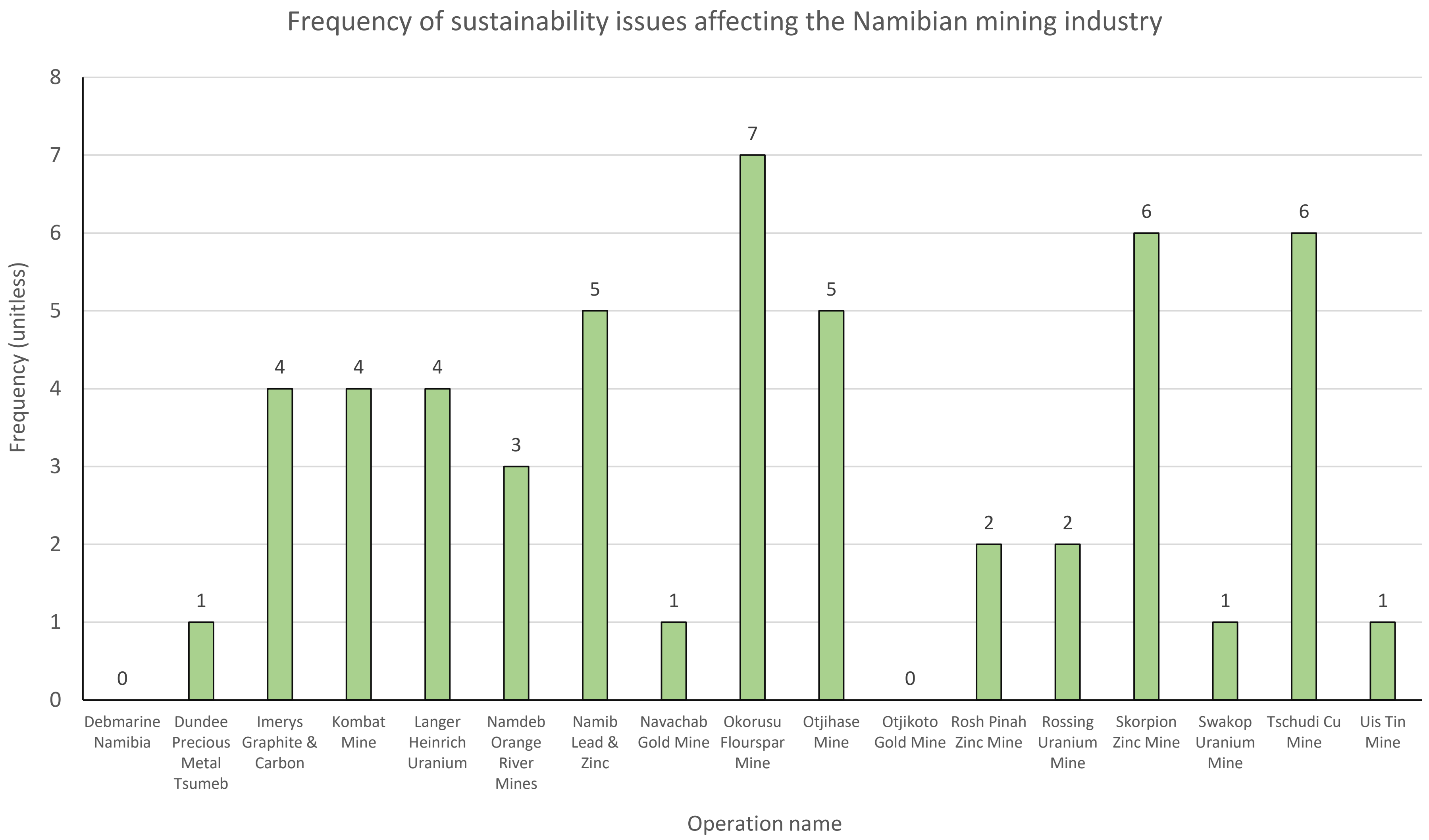


Figure 50: *Frequency of sustainability issues affecting the Namibian mining industry*

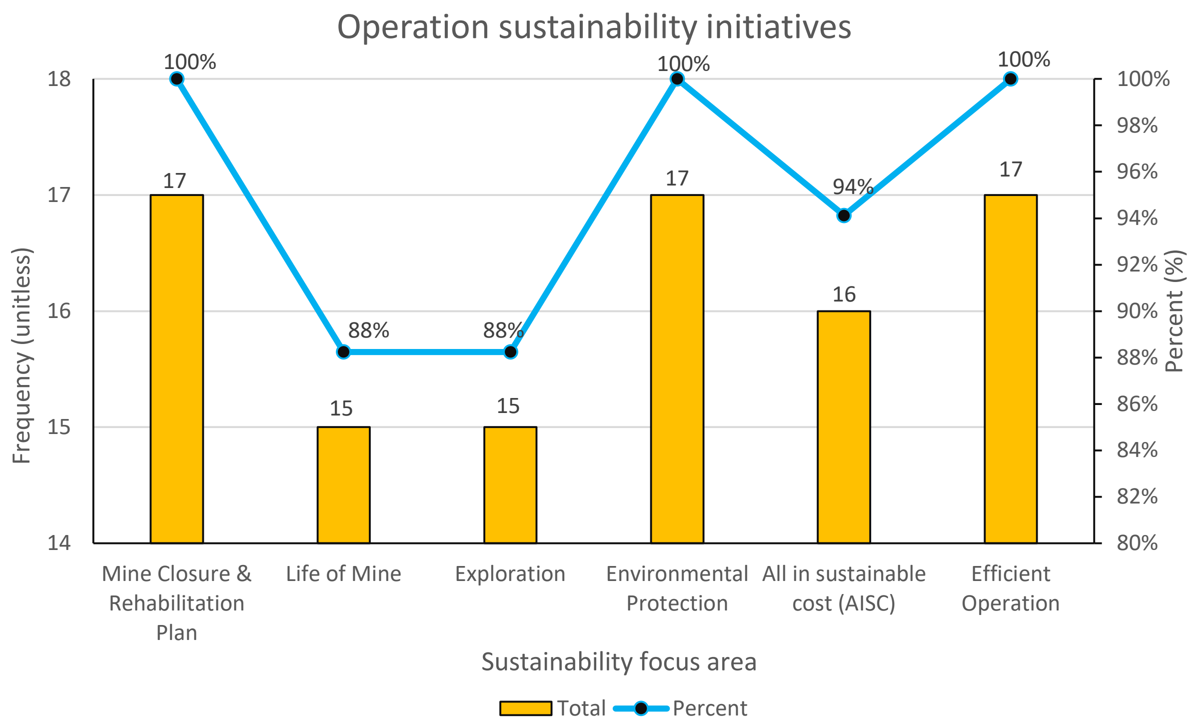


Figure 51: *Mining operation sustainability initiatives implemented*

4.6.2 Existence of plans to increase the life of the operation

Extending the life of the operation is a critical aspect to ensure that the operation remains sustainable in the long term (Wellmer & Scholz, 2018). Therefore, it is no surprise that all (100%) of the mines are having plans for increasing the life of the operations. The questionnaire survey data shown in Figure 52 shows that 65% of respondents strongly agree and 35% agree that there are plans to increase the life of mine at their respective operations. Similarly, the interviews revealed that most mining operations are implementing the life of mine extension initiatives. These strategic initiatives and the percentage of mines applying them are as follows: ore blending (100%), exploration (88%), design modification (76%), opening new mines (35%), pit pushback projects (29%), and importing ore (18%), as shown in Figure 53. In addition, Figure 54 shows that all the mining operations are applying these initiatives. However, the sustainability of the operation depends on the opportunities at the disposal of the operation. The extent to which the operation has taken advantage of these opportunities.

This is expected and it has been demonstrated when the life of mine topic was discussed above especially after observing that operations such as Okorusu Fluorspar Mine have operated for 93 years, Dundee Precious Metal smelter has been operating for 67 years, Rosh Pinah Zinc Mine has been operating for 53 years, Rössing Uranium Mine has been operating for 46 years, and Kombat Copper Mine has been operating for 46 years.

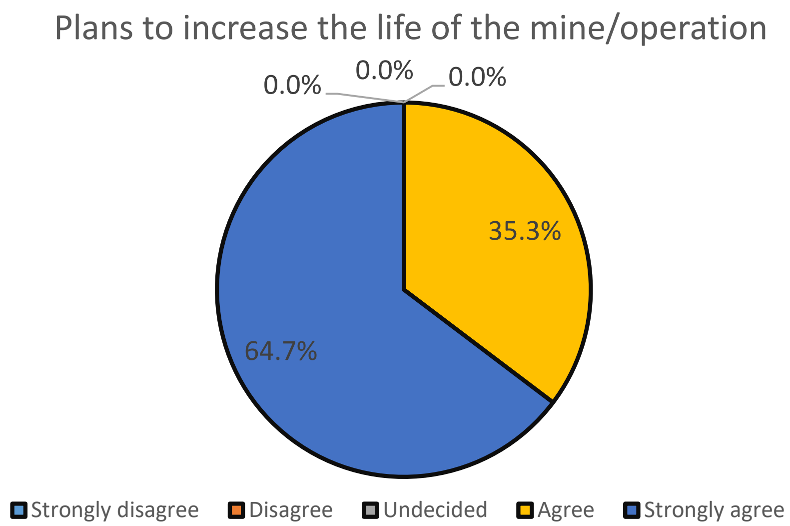


Figure 52: Plans to increase the life of the mine (LOM)

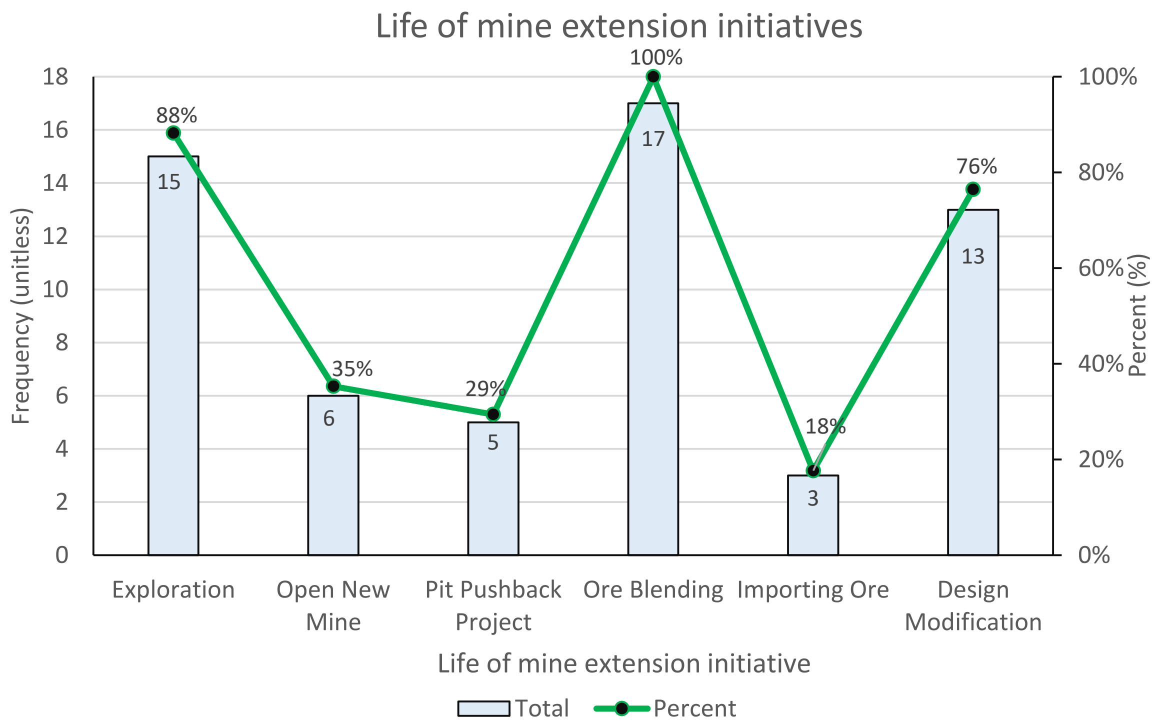


Figure 53: *Life of mine extension initiatives in the mining industry*

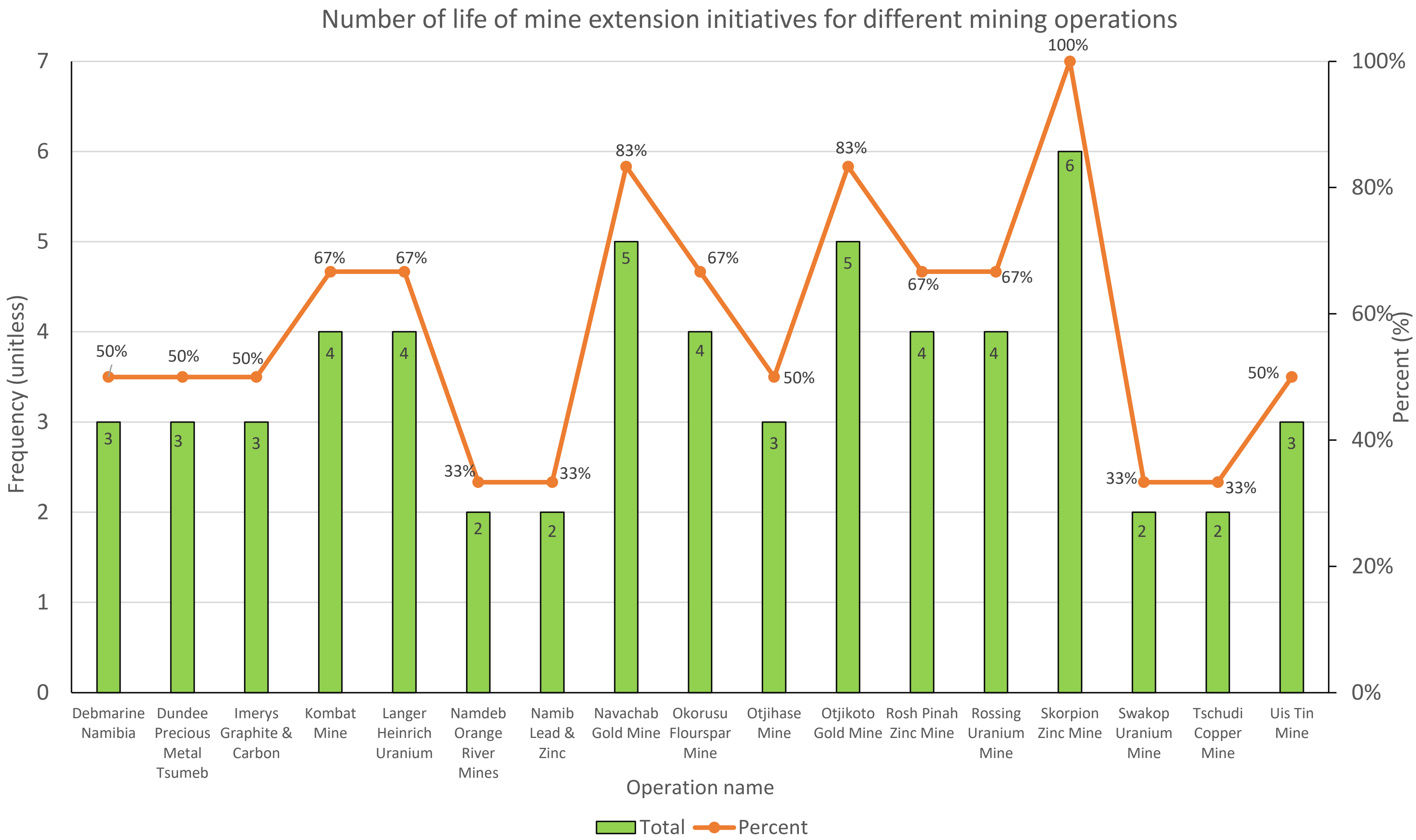


Figure 54: *Number of life of mine extension initiatives applied by different mining operations*

There are several notable plans implemented to increase the life of operations in the Namibian mining industry. Typical examples of the implementation of plans to increase the life of mining operations include: B2Gold’s Otjikoto Gold Mine which is currently embarking on starting up B2Gold’s Wolfshag zone underground mine with an approved budget of N$847.5 million in addition to its open-pit surface mine (B2Gold, 2020); QKR’s Navachab Gold Mine is working on turning-around unsustainable cashflow position by executing Project Khaima, hence developing an underground mine critical to the sustainability of the mine and it has a budget of N$160 million (Botshiwe, 2021).

The previously discussed N$6.5 billion Skorpion Zinc Mine’s refinery conversion project has a high potential to extend the life of the operation by approximately 15 years. The Skorpion Zinc Mine should have closed in 2015, however, further exploration was done that resulted in the extension of the life of the mine (LOM) to 2017 and further to 2020 after the Pit-112 project was implemented. Moreover, the exploration activities discovered additional zinc sulphide orebody in the vicinity, with a potential to be developed into the Gergarub Zinc Mine. This can extend the life of mine for Skorpion Zinc Mine further. The details of this case study including the capital expenditure (CAPEX) and exploration expenditure are shown in Figure 55.

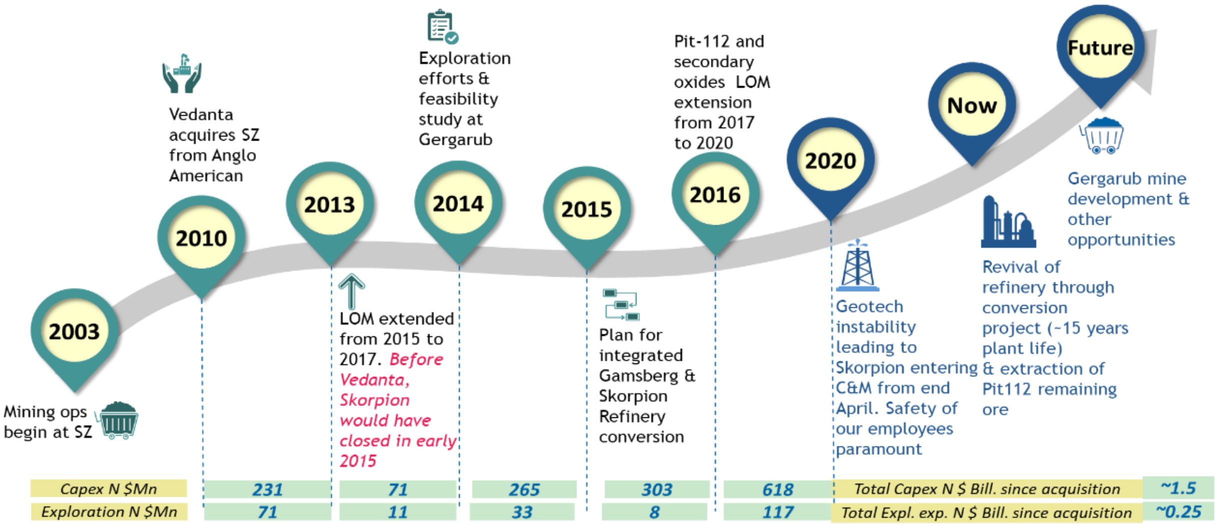


Figure 55: *Timeline of major life of mine events for Skorpion Zinc Mine*
Source: (Vedanta, 2022)

According to the study by Wolf et al. (2018), the Okorusu Fluorspar Mine closed in 2014 due to increased stripping ratio and beneficiation challenges which made the operation uneconomic. Although the operation is closed, there is approximately 6.3 Mt (7 million st) of measured resources left in the orebody at an average CaF_2 grade of 27.5%. This necessitated the researchers to study the feasibility of designing and developing an underground mine with a potential of 7.5 years of life with an annual production of 91 kt/a of 97.2% acid-grade Fluorspar. The study concluded that it is technically feasible to develop an underground mine by using a sublevel stoping method with longitudinal stopes. To make it easy, most of the equipment and buildings are already established. It was noted that no sufficient exploration has been done to understand orebody A, if in-depth exploration is conducted for this pit, it might be possible to increase the life of the mine further (Wolf et al., 2018).

Another example is at AfriTin's Uis Tin Mine which restarted operations in 2018 by establishing a Phase 1 pilot plant that has achieved its design nameplate capacity of 720 tpa by November 2020. Thereafter, considering the high demand and high commodity price for tin as a battery material, Uis Tin Mine plans to expand the Phase 1 pilot plant to increase production capacity by 67%. Hence, producing 1200 tpa after expanding the operation because there is a good chance for operation scale-up. The mine can expand further to two ore bodies located at the Brandberg West and Nai-Nais. Metallurgical test work and geological mapping have begun and thus far, positive results have been obtained (Chamber of Mines of Namibia, 2022). It was also reported that Rössing Uranium Mine has embarked on a feasibility study to extend the life of mine (LOM) until 2036, but it was initially ending in 2025. This feasibility study was approved by Rössing Uranium's management (Rossing, 2023).

4.6.3 Existence of plans for operation closure and rehabilitation

Considering that the mining industry focuses on the extraction of limited non-renewable resources, it is obvious that the operation will stop as soon as the ore is depleted (Gorman & Dzombak, 2018). Therefore, the area should be left in a user-friendly state so that it can still be utilised for other activities, and it should be left in a state almost closer to its initial state. For this to be achieved, the operation needs to invest in mine closure and rehabilitation. In the Namibian mining industry, it appears that about 77% of the operations have established mine closure and rehabilitation plans. This is composed of 53% and 24% of respondents who strongly agree and agree that a mine closure and rehabilitation plan exist at their operations, respectively, as shown in Figure 56. There was no operation reported that does not have closure and rehabilitation plans.

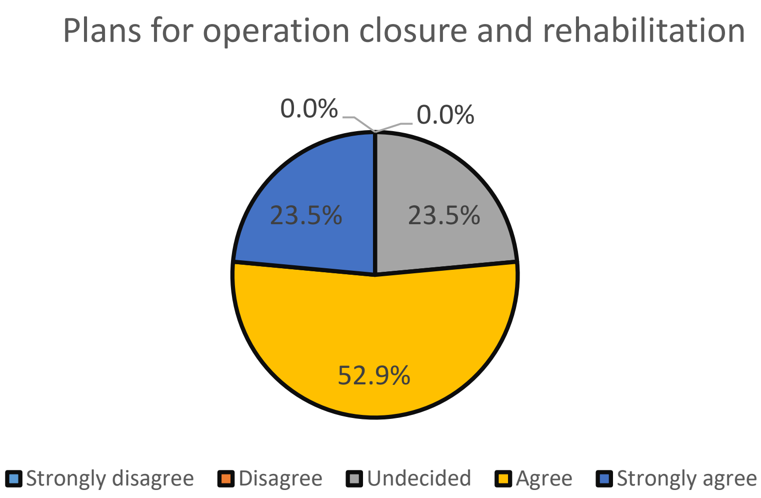


Figure 56: *Existence of operation closure and rehabilitation plans*

According to the Chamber of Mines (COM) of Namibia (2010), the Namibian government is currently liable for the rehabilitation of approximately 200 abandoned mines due to increased social and environmental impacts as a consequence of mines closed prematurely, especially when the mining companies don't exist anymore or they cannot be traced. As such, The Chamber of Mines of Namibian was tasked with establishing appropriate policies, procedures, and regulations to curb this challenge to enforce responsible mining. Unfortunately, before the mine closure framework was established, there was no single detailed policy considering aspects of mine closure. Although the established Namibian Mine Closure Framework (NMCF) does not cater for the rehabilitation of existing abandoned mines and for the closure of prospecting and exploration activities, it only guides minimum acceptable practices for the closure of operating mines in Namibia. The Chamber of Mines has also established a social fund which is meant to address social impacts that may be experienced when the mine closes.

4.6.4 The need for operation redesign or modification

The changes in the minerals and other design-related issues associated with the operation can make the operation inadequate or not capable of maintaining superior sustainable performance.

Hence, prompting that the operation should be redesigned or modified before it can continue working optimally and for it to improve its superior sustainable performance in the long term. As shown in Figure 57, approximately 35% of the respondents agree that their mines do not require any major redesign. While 53% of them disagree and 12% of respondents strongly disagree, meaning that their operations require major redesign or modification. In short, approximately 65% of the operations need a major redesign for them to operate sustainably.

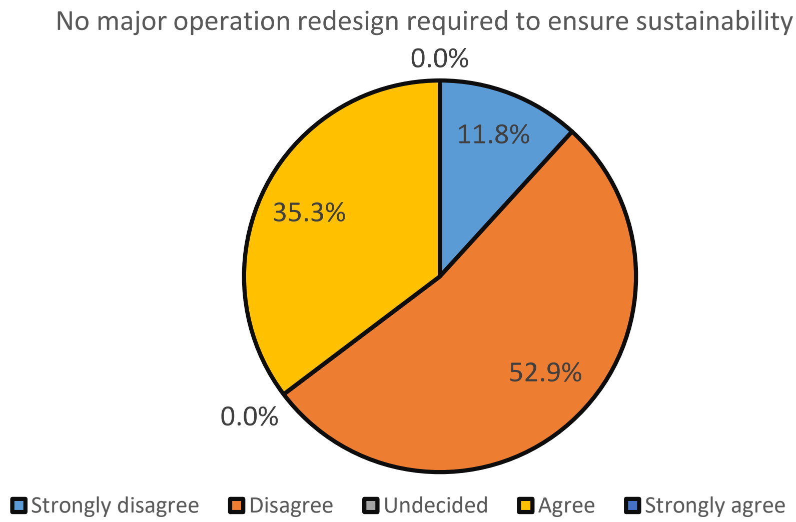


Figure 57: Summarising the need for operation redesign

For example, Skorpion Zinc Mine is planning on implementing a refinery conversion project. This will require refinery redesign/modification, hence incorporating a roaster into the current refinery design. This will then enable it to treat both oxide and sulphide zinc minerals (Vedanta, 2022). According to Tshiningayamwe (2021), the design of the current refinery flowsheet at Skorpion Zinc Mine will be modified by adding the following main unit processes: two roasters, two sulphuric acid plants (AP), three leaching circuits, one solvent extraction (SX) plant, and one electrowinning (EW) plant as shown in Figure 58.

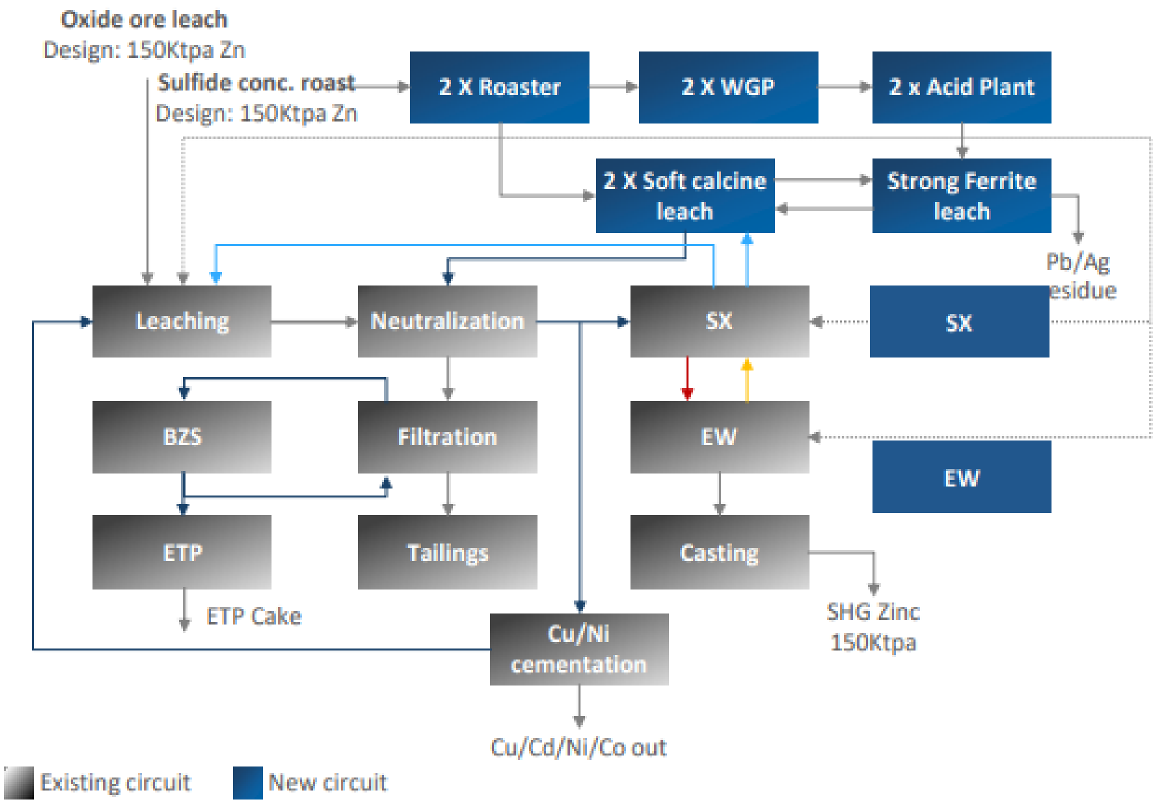


Figure 5: *Skorpion Zinc refinery conversion proposed design modification*

Source: (Tshiningayamwe, 2021)

The other example is when the Okorusu Fluorspar Mine investigated the possibility of designing a new underground mine in addition to the existing surface mine. The new mine design study concluded that it appears to be technically feasible to develop a new underground mine that has a potential for 7.5 years life of mine (Wolf et al., 2018). The designed drifts and ventilation holes for orebody A are shown in Figure 59. The design of opening excavations for orebody A and D are shown in Figure 60. The designed 3D models for orebody A and D are depicted in Figure 61 and Figure 62, respectively.

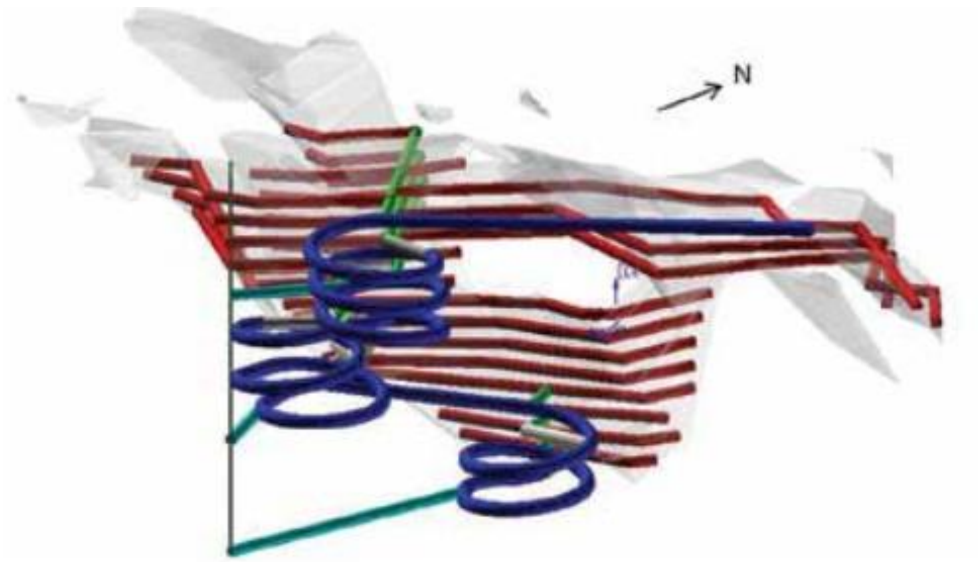


Figure 59: *Overview of the planned drifts and the ventilation hole in orebody A (turquoise: connection from ventilation hole and grey: connection from the ramp, dark blue: spiral ramp, dark green: ventilation hole, red: stope drifts, green: cross cut drifts) (Wolf et al., 2018).*

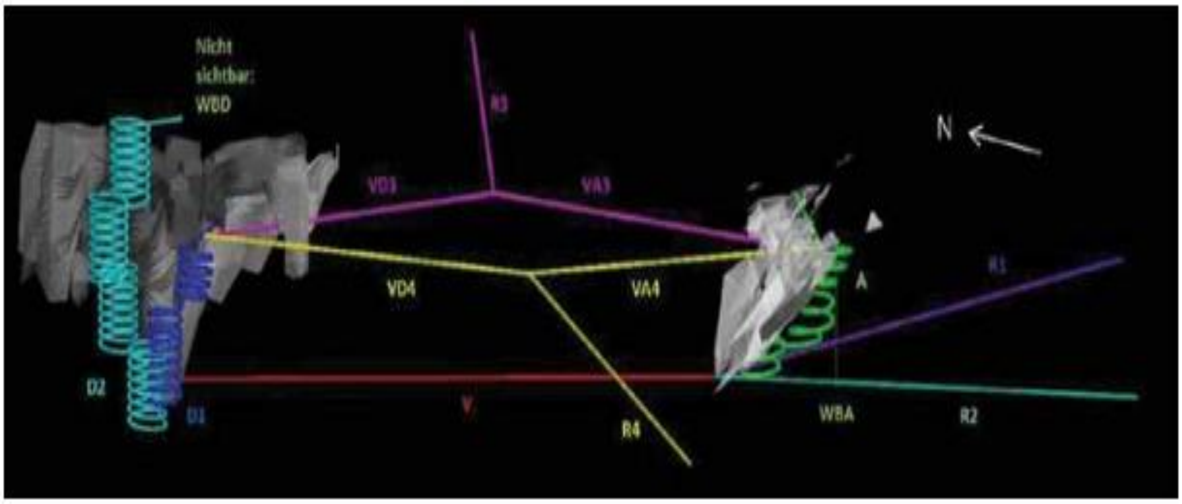


Figure 60: *The design of opening excavations for orebody A and D (Wolf et al., 2018)*

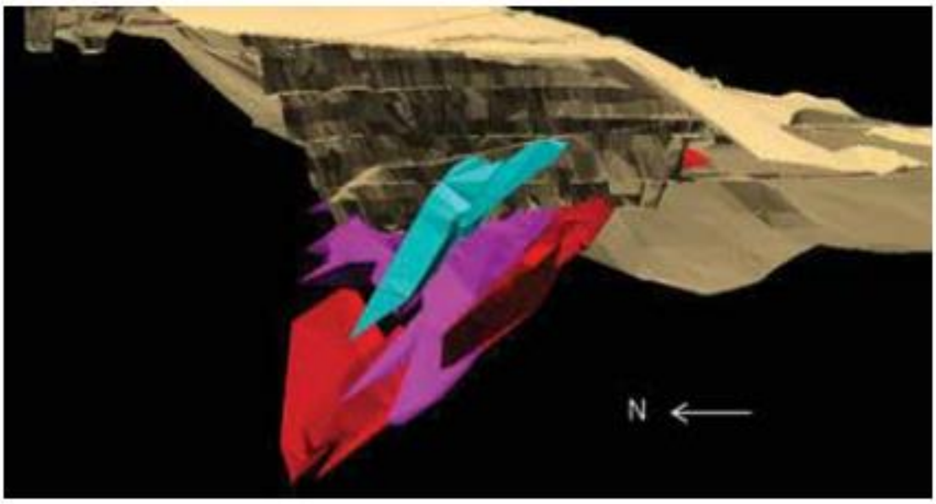


Figure 61: *The designed 3D model for orebody A in Maptek Vulcan (Wolf et al., 2018)*

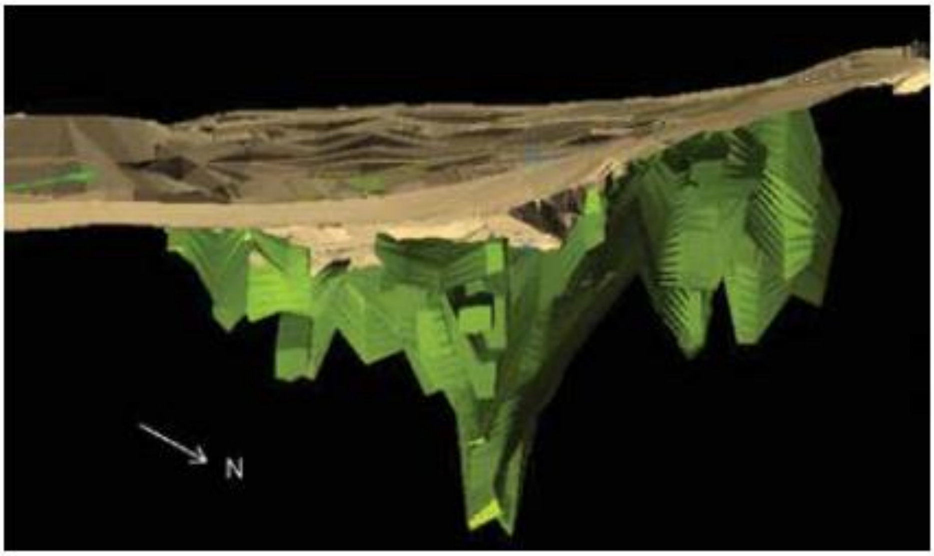


Figure 62: *The designed 3D model for orebody D in Maptek Vulcan*
Source: (Wolf et al., 2018)

The updated Langer Heinrich Mine (LHM) restart plan showed that they have considered operation redesign or design modifications to ensure that the operation will be well optimised and de-risked when they restart. There are about eight typical design considerations for the Langer Heinrich Uranium mine incorporate the following design modifications: update the current operation design documents, establish design models and engineering the proposed design modifications, work with various consultants to review and update the mineral resource model, geomodelling, and the process plant design, hydrosort #2 structure redesign, new design of steam injectors, new design for the thickener feed well, design modification of the Run of Mine (ROM) bin and chute, update open pit designs based on updated geotechnical assessments (Paladin, 2021).

The copper smelter owned by Dundee Precious Metal has worked on several smelter design modification projects aimed at upgrading and improving the smelter operation in an attempt to increase the production capacity from 240 000 to 370 000 tons per year (tpa). This was done by working on design and modification projects such as designing and constructing a 1 540 t/d sulphuric acid plant, shutting down the reverberatory furnace, adding a new Pierce-Smith (PS) converters, decommissioning the arsenic plant, constructing an additional oxygen plant, upgrading the Ausmelt circuit including its cooling system, upgrading the slag mill and classification circuit, and installing a Rotary Holding Furnace (RHF) (SLR, 2019). The proposed smelter redesign and modifications (in red and yellow) to the existing process are depicted in Figure 63.

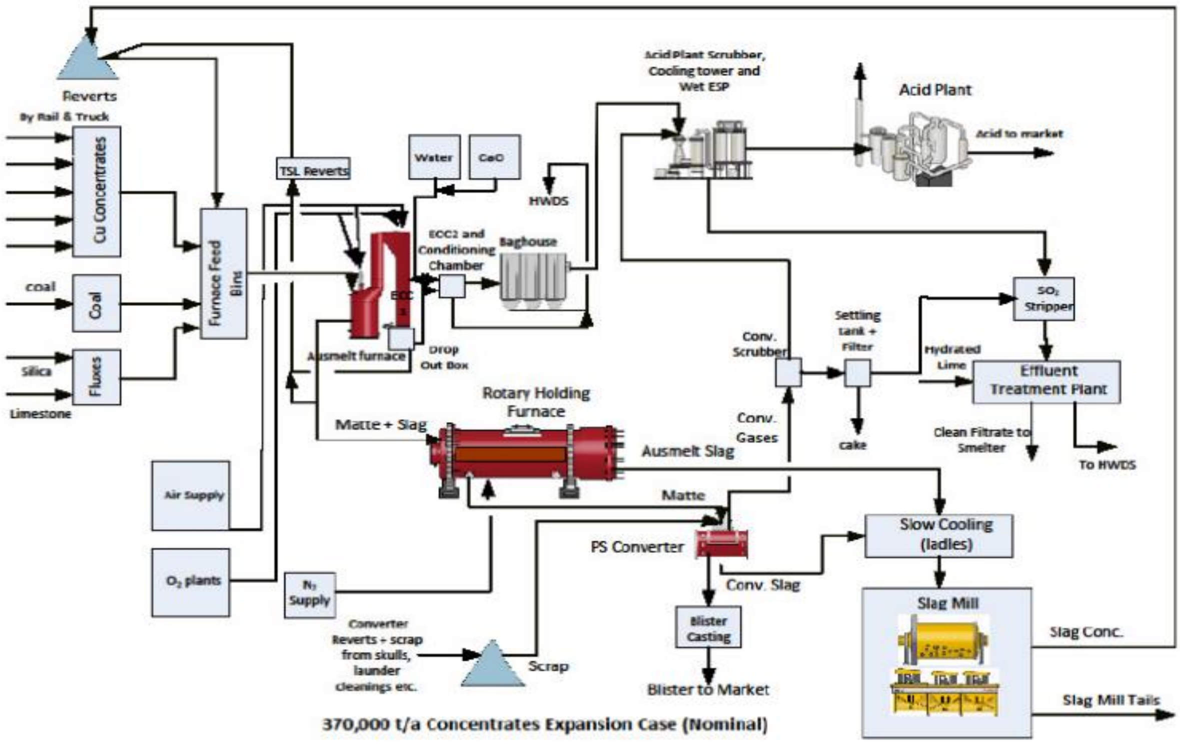


Figure 63: *Re-designed process flow diagram (PFD) for the copper smelter*

Source: (SLR, 2019)

The second last example is for Northern Graphite Corporation which is planning on restarting the high-quality graphite operation at the Okanjande Mine and Okorusu processing plant located about 78 km from the mine. This operation was recently utilised by Imerys and Gecko after the Okorusu Fluorspar Mine was placed on care and maintenance. In this case, Northern Graphite Corporation intends to decrease the capital cost required for the construction of the infrastructure by retrofitting the closed Okorusu Fluorspar plant for processing graphite ore.

This is because the closed Okorusu Fluorspar plant has an electric power grid and tailings storage facility (TSF) onsite. It was established that an investment of US$10 million will enable the production of 30 000 tpa of high-quality graphite (Northern Graphite Corporation, 2022).

Imerys had invested US$60 million into this plant, unfortunately, they experienced start-up challenges and corporate problems that consequently resulted in putting the operation on care and maintenance again in 2018. The design issues that Northern Graphite Corporation should consider include, incorporating Rio Tinto's pilot plant design, benchmarking with a graphite operation in Lac des Iles (LDI), avoiding incorporating unsuitable/unreliable equipment in the process design, applying the latest technologies for processing graphite ore, considering the use of a new crushing and grinding circuit, designing an efficient process plant and focusing on fine grinding by utilising stirred media mills (Northern Graphite Corporation, 2022).

The last example is R*ö*ssing Uranium Mine which recently designed and commissioned an additional 60 000 m^3 corrosion-resistant storage facility for water. The project had a total investment cost of N$102 million and N$66 million was spent locally and 100 people were employed onsite at the peak of the project. The storage facility can enable R*ö*ssing Uranium Mine to operate for at least 7 days without stopping production whenever there is a water shortage. This was done because R*ö*ssing Uranium depends on freshwater from the Orano desalination plant which is utilising an outdated technology that does not have a second pass in its process. To prevent damage to the reverse osmosis (RO) membranes, the desalination plant is stopped whenever excessive algae bloom is experienced due to the formation of hydrogen sulphide from decaying plants on the seafloor. The water shortage has resulted in the R*ö*ssing Uranium losing at least 59 production days and 464 tonnes of uranium production between 2017 and 2020 (Tjiriange & Moody, 2022).

Other operations in the Namibian mining industry which are considering redesigning or modifying their operation design to remain sustainable are B2Gold's Otjikoto Gold Mine and QKR's Navachab Gold Mine. These two gold mines are considering designing new underground mines as previously discussed (Dawe, 2014; Botshiwe, 2021).

4.6.5 The need for aggressive cost-cutting or austerity measures

The financial performance of mining operations is critical for its sustainability and for it to make necessary investments for expansion. Aggressive cost-cutting can be achieved by decreasing the cost of production (COP), all-in sustaining cost (AISC), improving operation efficiency, investing further in exploration, outsourcing some operations, working on the expansion project, and many other initiatives. The cost of production (COP) and all-in sustaining cost (AISC) are normally dependent on the production capacity, and it influences the profitability of the mining operations.

The data collected through the questionnaire survey shown in Figure 64 suggests that a total of 59% of mining operations did not apply aggressive cost-cutting measures. This total comprises 12% and 47% of respondents who agree and strongly agree that no serious cost-cutting measures are applied in their organisations. On the other hand, 29% of operations have applied aggressive cost-cutting measures and 12% of operations are neutral in this aspect.

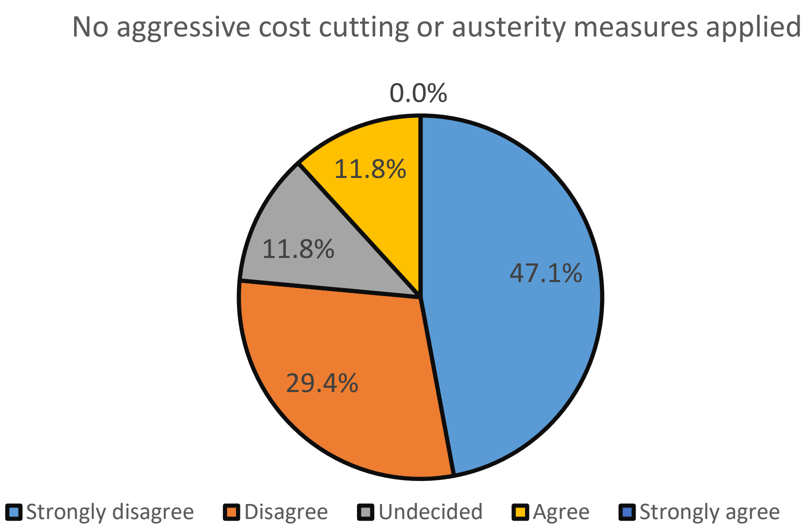


Figure 64: *Status of aggressive cost-cutting measures applied*

One of the case studies from the Namibian mining industry related to the reduction of the cost of production (COP) and maintaining a healthy all-in sustaining cost (AISC) can be taken from Trevali's Rosh Pinah Mine. This mine is currently working on a Rosh Pinah Expansion "RP2.0" Feasibility Study (FS) project that is expected to decrease the cost of production by approximately 26% per ton of ore milled. The mining method is expected to change by including paste fill. This has the potential to decrease mining dilution, increase ore recovery, improve ground stability, and decrease the quantity of tailings removed from the mine since it will be utilised as paste fill. On the one hand, the cost of mining operations might decrease as a consequence of increased material handling efficiency and decreased cycle times which have beneficial effects from the dedicated underground decline to the WF3 deposit. Moreover, the mine will consider purchasing more efficient large-scale underground trucks and load-haul dump (LHD) trucks (Trevali, 2022).

On the other hand, the cost of production (COP) and all-in sustaining cost (AISC) for processing the ore will most likely be healthier when increased ore throughput to 1.3 Mtpa is treated especially after upgrading the process (see Figure 65 and Figure 66). The upgrades to the processing plant incorporate upgrading the comminution circuit by adding a new semi-autogenous (SAG) mill and a pebble crusher, upgrades to the primary crushing and homogenization area, improvement to flotation, filtration and the capacity of pumping, and design modifications.

Further, Rosh Pinah Zinc Mine has established a renewable solar energy power purchase agreement (PPA) with EMESCO. This will result in Rosh Pinah Zinc Mine acquiring 30% of its electrical power from renewable energy and it will be charged at a fixed rate which is 8% lower (at N$1.43/kWh instead of N$1.54/kWh) for the next fifteen (15) years (Trevali, 2022). The feasibility study is expected to have a pre-tax net present value (NPV) of US$256M and post-tax NPV of US$156M at an 8% discount rate and an internal rate of return (IRR) of 58% post-tax over 12 years of operating life considering corporate tax rate at 37.5%. All these expansion projects are summarised in Figure 67. The cost components are summarised in Figure 68 and Figure 69.

Figure 65: *An expected increase in annual ore production due to Rosh Pinah Expansion "RP2.0".* Source: *(Trevali, 2022).*

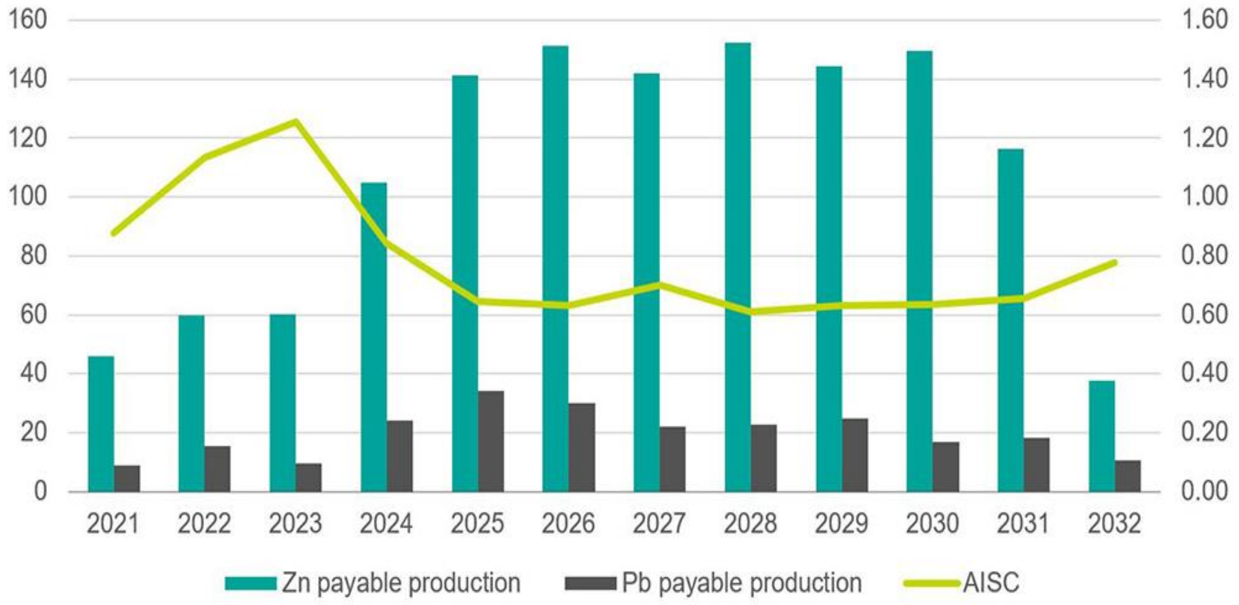
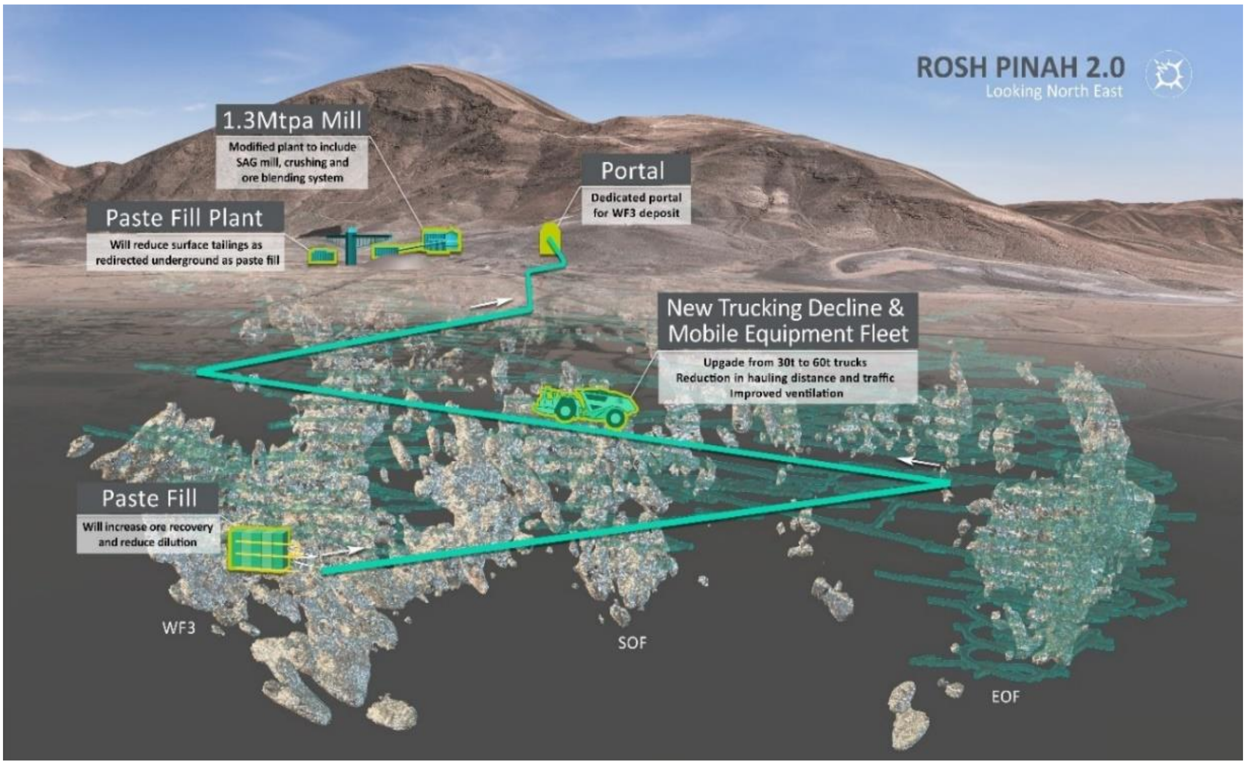


Figure 66: *Annual payable metal production due to Rosh Pinah Expansion "RP2.0"*

Source: (Trevali, 2022)



Source: (Trevali, 2022)

Figure 67: *Overview of the Rosh Pinah Expansion "RP2.0" feasibility study*

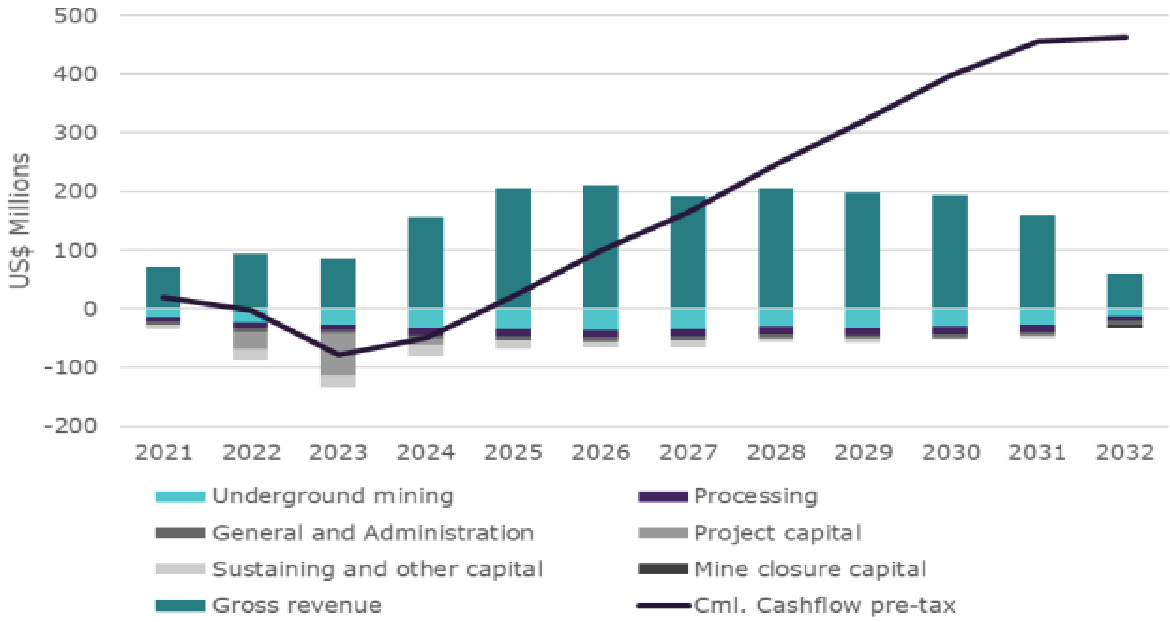


Figure 68: *Capital and operating costs, and cumulative pre-tax cash flow*
Source: (Trevali, 2022).

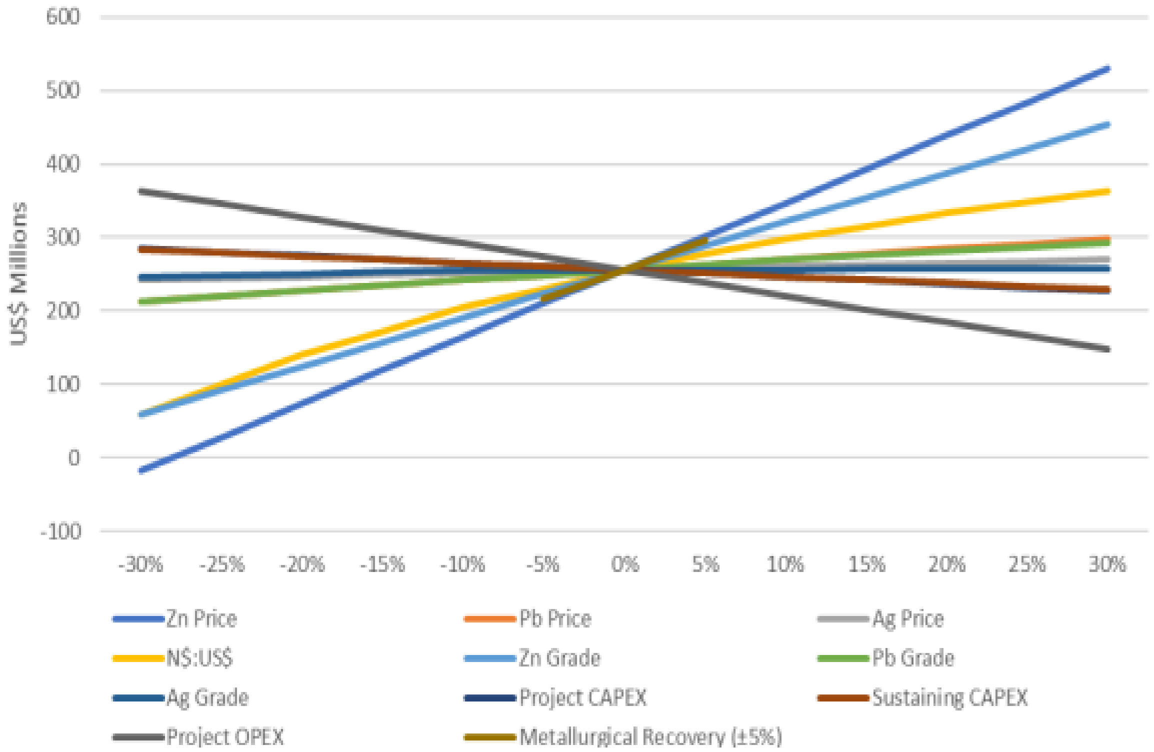


Figure 69: *Economic sensitivity analysis – pre-tax NPV at an 8% discount rate*

Source: (Trevali, 2022).

Another notable cost of production (COP) and all-in sustaining cost (AISC) strategic initiatives in the Namibian mining industry can be observed at Rössing Uranium Mine. The typical cost of production and all-in sustaining cost (AISC) projects executed include: designing a desalination water plant which is aimed at supplying water to Rössing instead of buying from other suppliers (Figure 70), the extension of the SJ open pit mining activity, new mining activity in SK area, establishment of the acid heap leaching facility and many others. All these projects are meant to decrease the cost of production and maintain all-in sustaining cost (AISC) healthy (RioTinto, 2015).

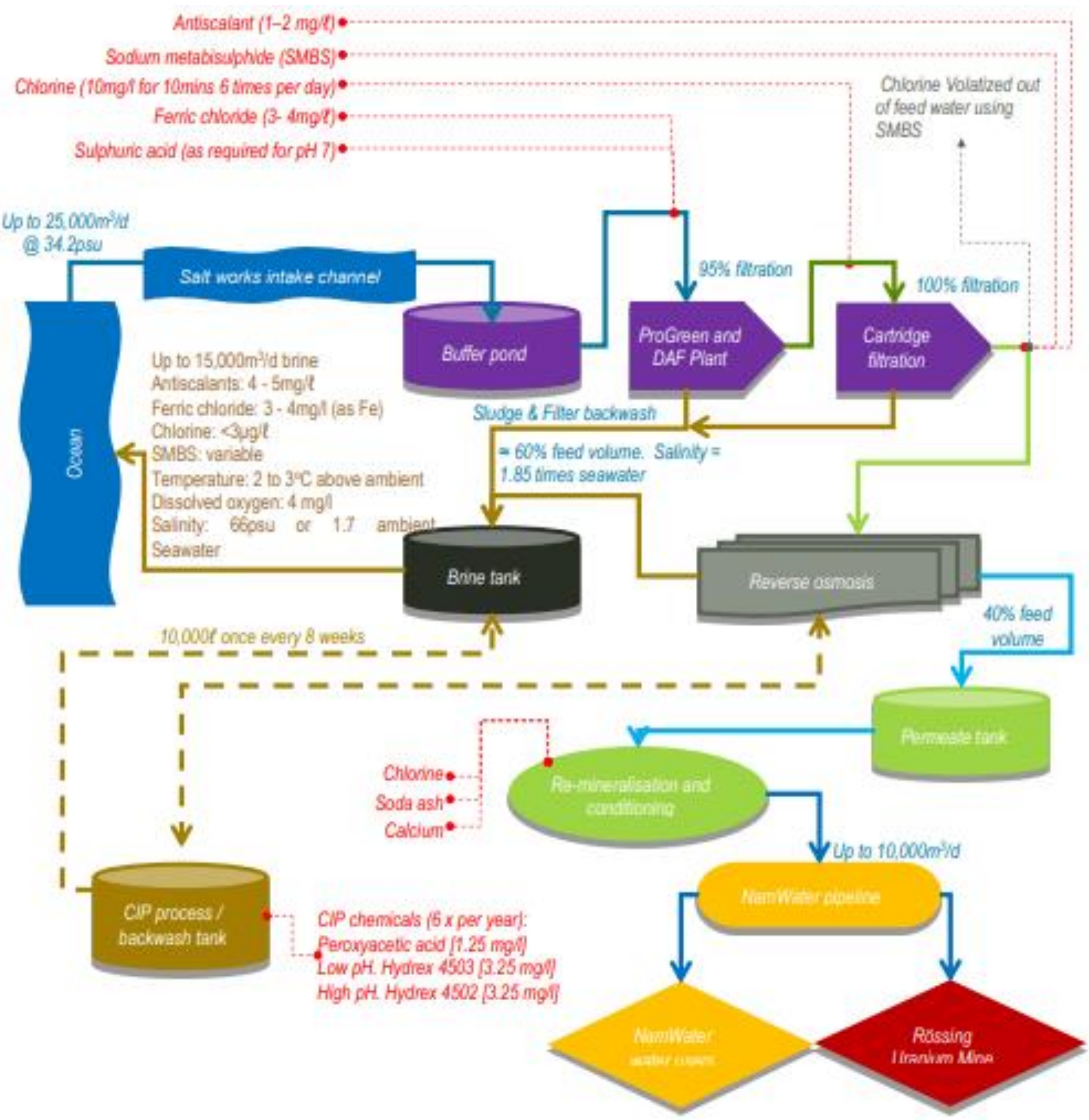


Figure 70: Proposed design of a desalination plant *Source:* (RioTinto, 2015)

4.6.6 The effect of slope failure or geotechnical risks in the mining industry

The failure of slopes or geotechnical risks have the potential to do worse than mere production interruption, it can result in the mine being placed under care and maintenance. Therefore, it has a drastic effect on the sustainability of the mine. In the case of the Namibian mining industry, geotechnical risks have significantly contributed to some mines going on to care and maintenance. Figure 71 below presents data collected from the Namibian mining industry after confirming if geotechnical issues have not been a problem at the mines where respondents work. A total of 24% of mines in the Namibian mining industry appear to have geotechnical risks. This is because 12% of the mines have experienced drastic effects due to slope failure. Hence, the respondents strongly disagreed that there were no geotechnical risks. The other 12% of the respondents also confirmed that there are slope failure risks in their operations. About 29% of respondents were not sure while a total of 47% (29% plus 18%) indicated that slope failure is not a big concern at their mines.

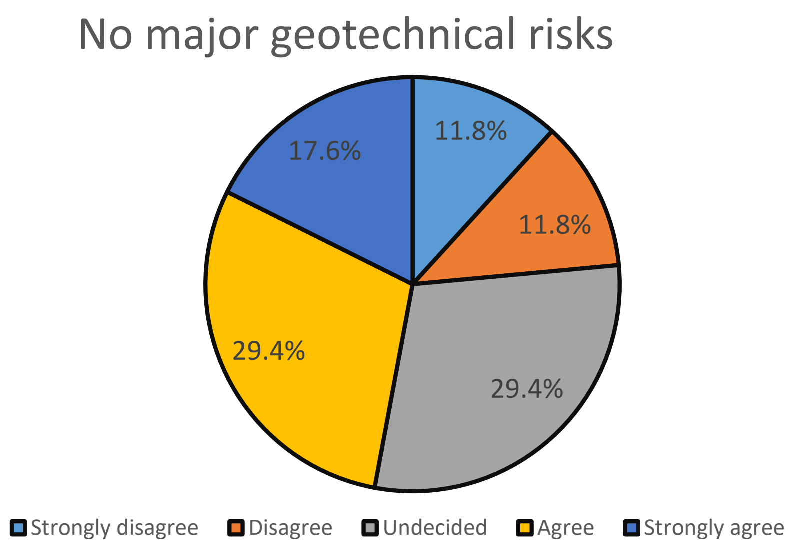


Figure 71: *Occurrence of geotechnical risks in the mining industry*

Major cases of extreme slope failures or landslides in the Namibian mining industry were recently experienced at Skorpion Zinc Mine and Tschudi Copper Mine. Skorpion Zinc Mine went on care and maintenance on the 1st of May 2020 due to the unforeseen geotechnical slope failure in the pit as shown in Figure 72 and Figure 73. Geotechnical pit instabilities pose a danger to the employees and mining operations in general. Therefore, the entire mining operation was placed on care and maintenance, leaving only 35 employees while retrenching almost 1800 people in total. This clearly shows that slope failure can have a significant devastating effect on the sustainability of the mine. To mitigate the landslide risk, Skorpion Zinc Mine has installed a mesh wire as shown in Figure 73. They have invested heavily in pit stability monitoring systems for both the western and eastern margins of the pit to detect any pit land motions to an accuracy of less than 1 mm by using the Ground Probe (SSR-XT), Reutech (MSR), Optron (Geomos), Time Domain Reflectometry (TDR), and Ground Probe (Agilis). In order to safely extract the remaining ore from the pit, the pit designs were updated by considering a safety factor (Tshiningayamwe, 2021).

Figure 72: The slope failure spot at Skorpion Zinc Mine

Source: (Tshiningayamwe, 2021)

Figure 73: *Wire mesh installed to minimise the risk to Skorpion Zinc Mine employees Source:* (Tshiningayamwe, 2021)

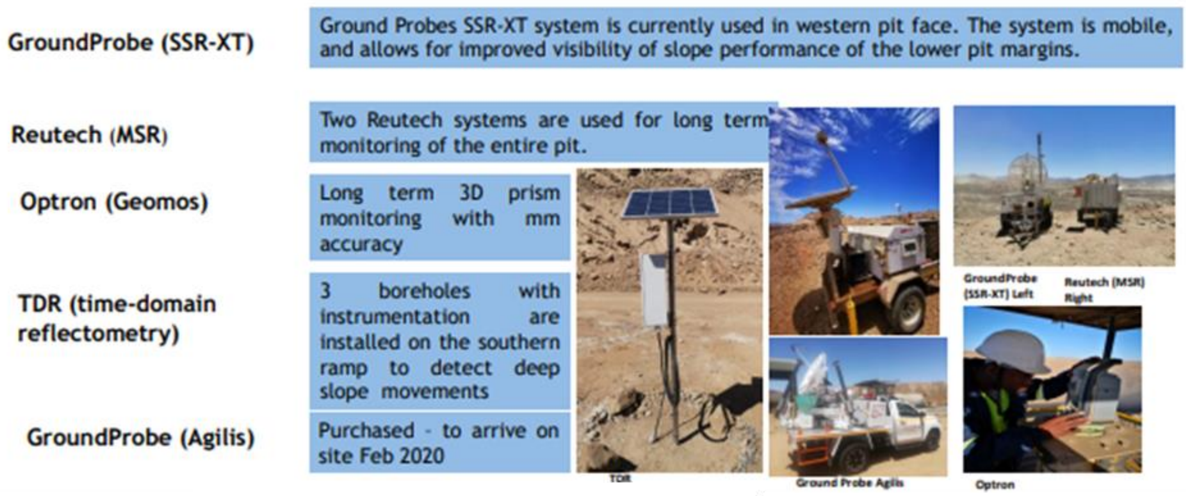


Figure 74: Improved slope monitoring system devices at Skorpion Zinc Mine
Source: (Tshiningayamwe, 2021)

4.6.7 The effect of commodity prices on the mining industry

The commodity prices can directly affect profitability, and it can be a threat to mining operation survival if the commodity price is lower than the cost of production (COP) or the all-in sustaining cost (AISC). The commodity prices are not decided by mining companies, but they are regulated by organisations such as the London Metal Exchange (LME) and it depends on factors such as market conditions, technological drive, supply, demand, etc.

Figure 75 shows that a total of 59% of the mining operations have been negatively affected by the decline in commodity prices. About 24% and 35% of the respondents indicated that they strongly disagree and disagree with the statement that states that commodity price did not negatively affect their operation. This makes a total of 59% of mining operations that have been negatively affected by the decline in commodity prices.

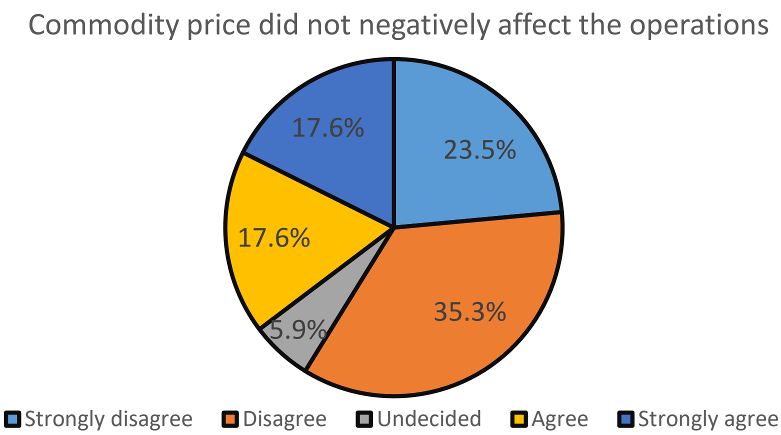


Figure 75: Effect of commodity price on mining operations

Operations affected significantly by the decline in commodity prices include the Langer Heinrich Uranium Mine, Namib Lead and Zinc Mine, Okorusu Fluorspar Mine, and Rössing Uranium Mine. Interestingly, all these operations except the Rössing Uranium Mine have ceased operations because they are currently on care and maintenance. This shows the impact the commodity price has on the sustainability of mining operations.

One of the severely affected commodity prices in the Namibian mining industry is the price of uranium. The price of uranium has decreased significantly ever since the Fukushima nuclear disaster occurred in 2011. Nonetheless, the uranium price has been fluctuating significantly as shown in Figure 76 (Trader Ferg, 2022). The decline in the spot price for uranium has contributed significantly to the Langer Heinrich Uranium Mine going on care and maintenance and the development of many other uranium mines being put on hold. However, it appears that the uranium price is increasing again as shown in Figure 77 (Trading Economics, 2022). This is an indication that most of the uranium mines are placed on care and maintenance, and those not yet developed might re-start or start with operation soon if the uranium price keeps increasing or if it remains constant.

Should the increase in the uranium price remain consistently high for a longer period, at least five uranium mines that may be developed or re-started soon include the following: Paladin Energy’s Langer Heinrich Mine with 17 years life of mine, Orano’s Trekkopje Mine with 11 years life of mine, Bannerman Resource’s Etango Project that will submit a bankable feasibility study (BFS) in 2023, Norasa’s Valencia Mine with 15 years life of mine, Deep Yellow’s Reptile Project at the Tubas deposit and Tumas deposit with 11 years life of mine (Aipanda & Nampweya, 2022).

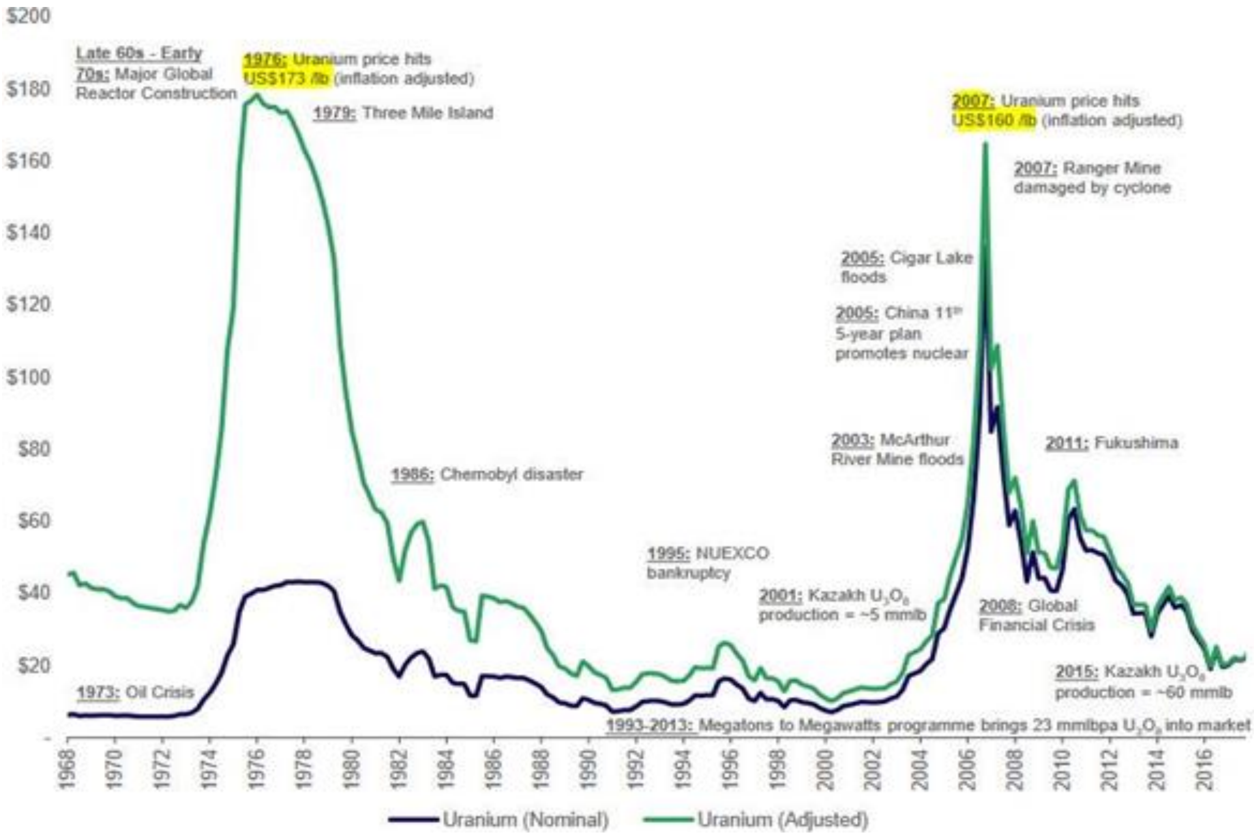


Figure 76: *Historical inflation adjusted uranium price from 1968 to 2016*

Source: (Trader Ferg, 2022)

Figure 77: Recent Uranium spot prices showing an increasing trend

Source: (Trading Economics, 2022)

The increase in the uranium price is necessitated by institutional investors such as Sprott Physical Uranium Trust (SPUT). In this case, SPUT is the world's largest physical uranium fund which is a closed-ended trust that was created on the 19th of July 2021 to invest and hold all its assets in the form of physical uranium in the form of U_3O_8 (Aipanda & Nampweya, 2022; Sprott, 2022). Moreover, the price of uranium has also been positively affected due to the war between Ukraine and Russia. Most of the European countries relied on gas and oil power supplied by Russia which has been drastically disrupted due to a negative relationship with the North Atlantic Treaty Organization (NATO) and the reaction to sanctions imposed on Russia. Therefore, most European countries are pushing for alternative energy sources. Renewable energy sources such as solar energy have limitations, however, nuclear energy is one of the best options with the highest energy capacity factor of 92.5%, followed by geothermal energy with 74.3%, and solar energy with a capacity factor of 24.9% (Aipanda & Nampweya, 2022).

It is worth noting that uranium mines such as Swakop Uranium Mine sells yellowcake directly to the majority shareholder China General Nuclear Power Group and China Africa Development Fund. Therefore, Swakop Uranium (SU) has not been negatively affected by the decrease in the uranium price (Swakop Uranium, 2022). However, if the uranium price continues increasing, it means SU might lose out on this advantage if they are only supplying uranium to the mother company. But they can also consider selling uranium to the open market at the high spot price.

Considering that Namibia is the third biggest uranium producer worldwide after Kazakhstan and Australia, it is possible that Namibia can improve further in the world ranking for being one of the biggest uranium producers worldwide if all the above-mentioned projects are developed or re-start. Namibia also stands a good chance of transforming its economy via uranium exploitation during the uranium boom. However, more initiatives should be done to generate nuclear power locally in addition to the green hydrogen project and possibly the Kudu gas project (Aipanda & Nampweya, 2022; World Nuclear Association, 2022).

In general, commodity prices have a significant impact on the Namibian mining industry. It was reported that a profit of N$928.4 million was realised mainly due to increased commodity prices. However, this profit was low compared to previous years, as such, corporate taxes by mining companies decreased from N$2.203 billion to N$1.553 billion in 2020 and 2021 respectively. Similarly, the paid royalties and export levies decreased by 3.65% and 0.57%, respectively (Mbako, 2022).

4.7 Superior sustainable performance aspects in the Namibian mining industry

4.7.1 Factors influencing superior sustainable performance

Superior sustainable performance is critical for the long-term survival of mining operations. Superior sustainable production at the mine can only be achieved if the above-mentioned sustainability factors are addressed concurrently with factors influencing production. This can enable operations to improve superior sustainable performance in the overall organisation. Based on the interviews conducted, the main factors influencing superior sustainable production and the percentage of operations applying them are as follows: improved operation/machine availability (100%), increased ore grade (88%), improved operation efficiencies (100%), enhanced staff competence (100%), high staff motivation (94%), timely reagent supply (100%), and improved safety (100%). This can be seen in Figure 78. These factors should also be part of the strategy for improving superior sustainable performance and they should be incorporated into the strategy map that will ensure the sustainability of the business.

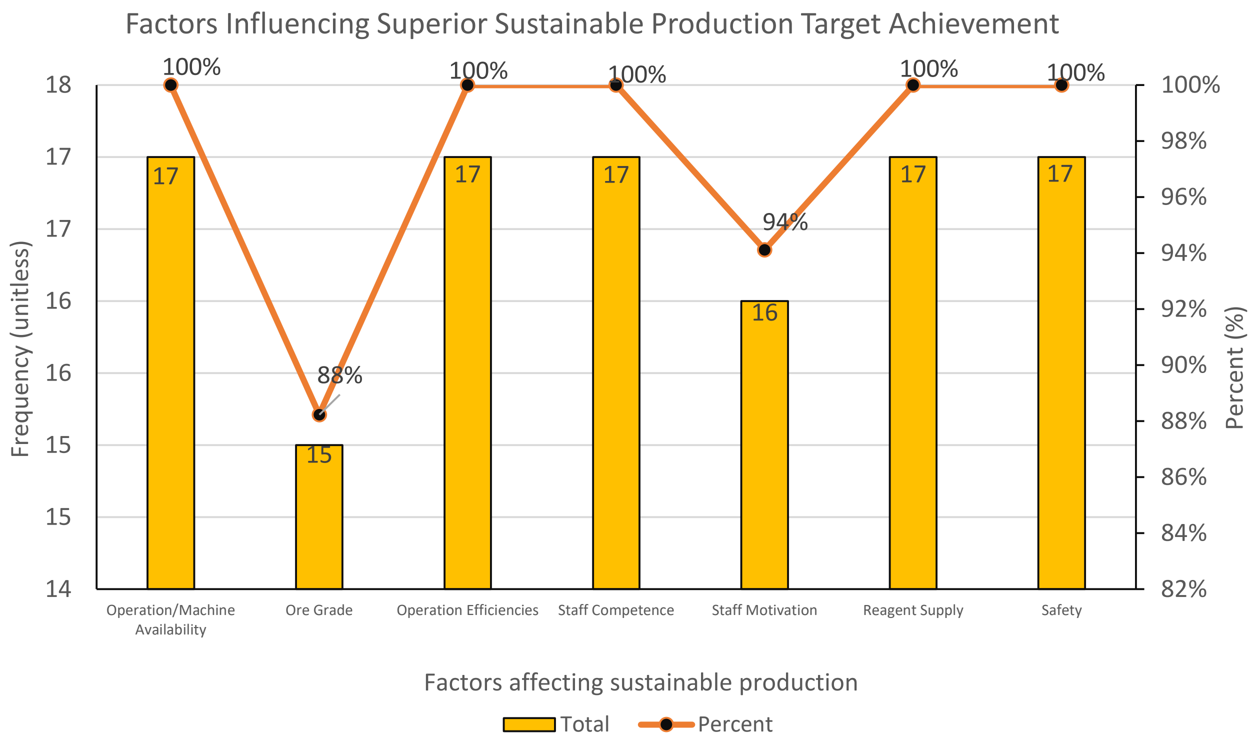


Figure 78: *Factors influencing superior sustainable production target achievement*

4.7.2 Best practices for improving superior sustainable performance

The interviews also revealed that several best practices have given some operations a strategic advantage regarding superior sustainable performance, especially the best practices that are not commonly applied by many operations. The applied best practices and the percentage of operations utilising them were obtained via interview sessions. They are presented in Figure 79 as follows: research and development (R&D) (100%), ore blending (100%), staff motivation (88%), staff training (94%), staff retention (88%), benchmarking (94%), vertical integration (12%), best available technology (BAT) (59%), and renewable energy (35%).

Figure 80 shows that 5/17 (29%) of the operations have applied approximately 89% of these best practices for example Swakop Uranium Mine, Rössing Uranium Mine, Otjikoto Gold Mine, Kombat Copper Mine, and Dundee Precious Metal Tsumeb smelter. Interestingly, except for Kombat Copper Mine, all these operations have been sustainably operated for a long and their performance is quite remarkable. A similar trend can also be seen in operations such as Debmarine Namibia. The interview candidates also revealed other best practices including good operation support from top management, prioritising safety (zero-harm), dump trucks and shovels that run on a combination of electrical power and diesel.

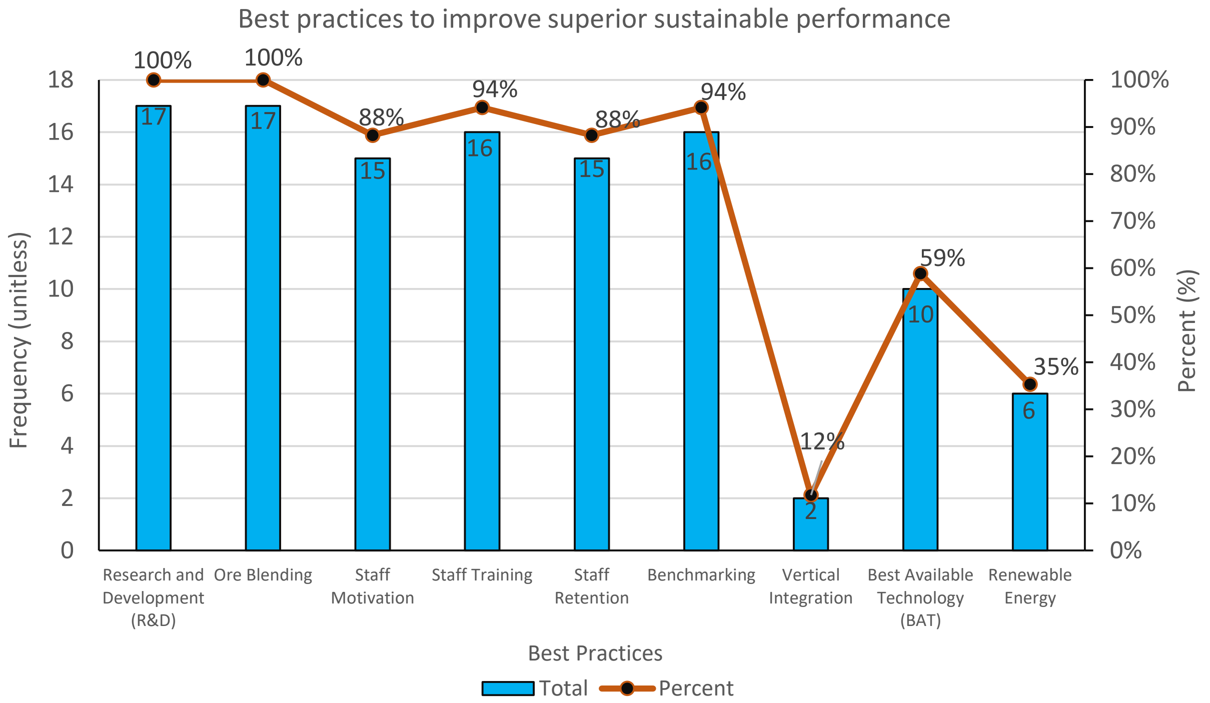


Figure 79: Best practices to improve superior sustainable performance

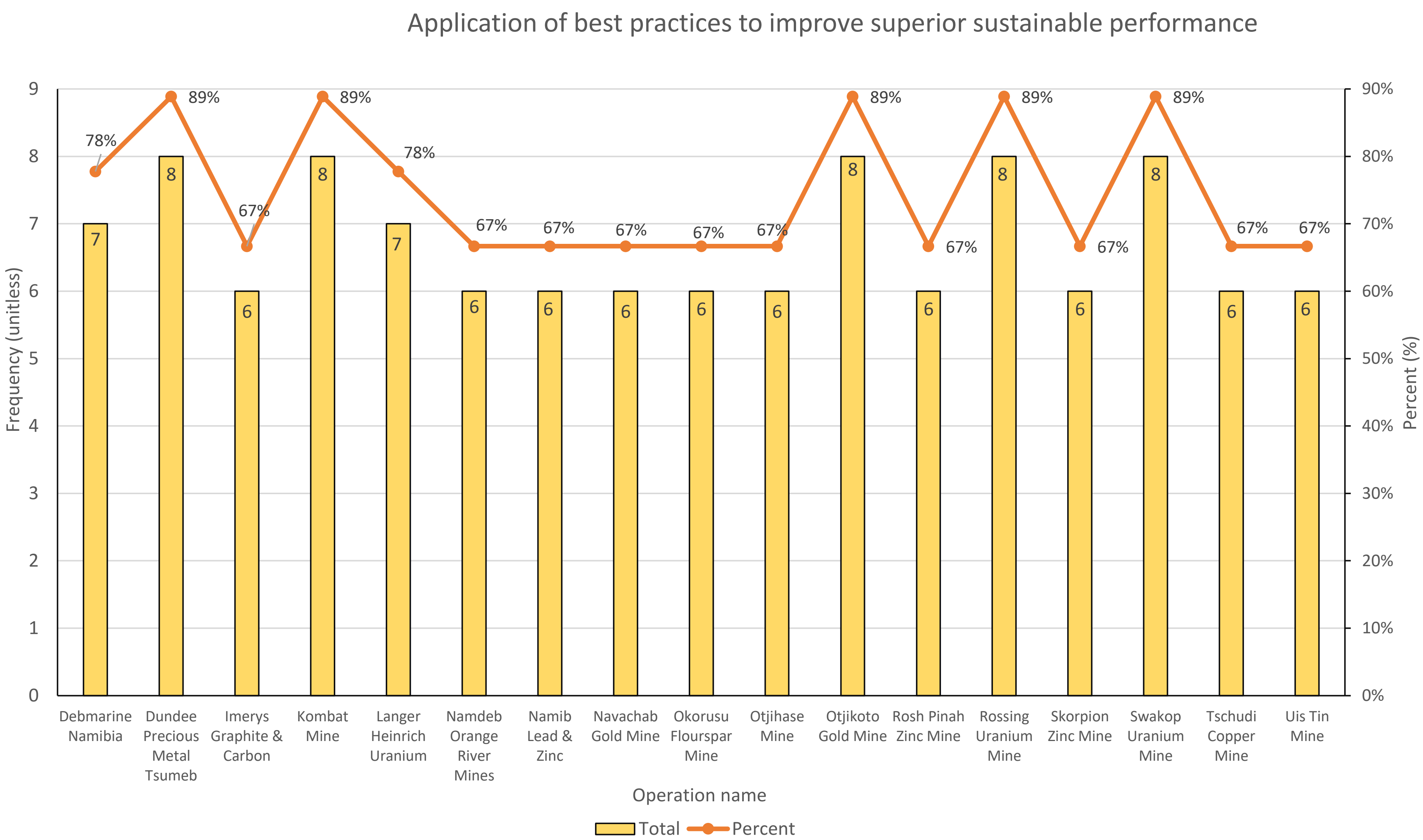


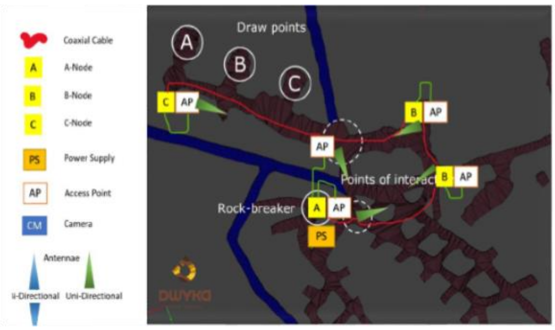
Figure 80: *Application of best practices to improve superior sustainable performance*

Best practices such as vertical integration, investment into renewable energy, and the application of the best available technologies (BAT) have only been utilised by 12%, 35%, and 59% of the operations in Namibia. Vertical integration is practised by mining companies such as Swakop Uranium Mine which supplies about 80% of the produced U_3O_8 to China General Nuclear Power Corporation (CGN) and the balance (20%) is sold to international markets (CGN, 2022). This means that the company owns or controls the distributors or suppliers. In this case, the supply chain is integrated, and it is owned by the same company (Beckman & Rosenfield, 2008; Shavarini et al., 2013). As a result, the operation is not significantly affected by the decrease in the uranium price, unlike operations that are only selling uranium cake on the open market. However, if the uranium price increases significantly, it will be better to sell it to the open market.

Renewable energy (RE) integration into the mining industry is also a good step toward providing this energy-intensive industry with affordable electrical power and ensuring sustainability by investing in clean energy (Zharan, 2018). As discussed above, Rosh Pinah Zinc Mine has established a renewable solar energy power purchase agreement (PPA) with EMESCO. This will result in Rosh Pinah Zinc Mine acquiring 30% of its electrical power from renewable energy and it will be charged at a fixed rate which is 8% lower (at N$1.43/kWh instead of N$1.54/kWh) for the next 15 years (Trevali, 2022). Swakop Uranium Mine has designed a steam turbine that can generate up to 15 megawatts and an additional 12 megawatts solar photovoltaic (PV) power plant (Swakop Uranium, 2019). Dundee Precious Metal Tsumeb has also invested approximately N$300 million in the development of an 18.5-megawatt solar plant (Dundee Precious Metal, 2020).

Examples of the application of the best available technology have been observed for operations such as Trevali's Rosh Pinah Zinc Mine which is embarking on a digital transformation project. This is an innovative and different modus operandi that is more advanced than conventional methods. The Digital Technology Programme (DTP) currently applied at Rosh Pinah Zinc Mine has the potential to enhance business fundamentals and it can enable them to achieve world-class operational performance. It is most likely that this project will have a significant influence on the superior sustainable performance of the mine.

The digital transformation programme is integrated into the strategy of Trevali, and it involves four digital technology programme initiatives (Trevali, 2022). These digital technologies are depicted in Figure 81 and they are as follows: uninterrupted underground network connectivity, drone surveying that will increase surveying frequency (this will enhance the control of dilution and head grade thereby decreasing the cost of production), drilling telemetry will also be applied. In this case, automated drill rigs will be utilised, hence reducing dilution and the cost of production this can increase metal production and the accuracy of drilling will improve, and Plant Control Systems (PCS) that will employ Artificial Intelligence (AI) and Machine Learning Functionality (MLF) to provide cost-effective process control solutions (Trevali, 2022).



1. Underground Connectivity

2. Drone Surveying

3. Drilling Telemetry

4. Plant Control System (PCS) Upgrade

Figure 81: *Digital Technology Programme (DTP) initiatives at Trevali Rosh Pinah Zinc Mine*

Source: (Trevali, 2022)

4.7.3 Superior sustainable performance for tonnages of ore mined

The respondents were asked questions related to superior sustainable performance at their respective mines. The first question is focused on whether the quantity of ore mined per month has been consistently on or above target for the past two years. As can be seen in Figure 82, approximately 18% and 35% strongly agree and agree, respectively. This means a total of 53% of the operations were able to sustainably mine ore tonnages on or above the target consistently. While 47% of the operations could not mine ore tonnages sustainably on or above the target consistently. This can be a consequence of any of the previously discussed challenges that the mines are facing.

A good example of superior sustainable performance for tonnages of ore mined from the Namibian mining industry is B2Gold's Otjikoto Gold Mine which is expected to increase in the second half of 2022 because the mining schedule will reach higher-grade portions of Phase 3 of the Otjikoto Pit and there will be increased ore production from the Wolfshag underground mine. In this case, the tonnage of ore mined, ore processed, ore grade and recoveries were slightly higher than the budget (B2Gold, 2022).

The ore grade increased in Q1 from 0.82 g/t to 1.31 g/t in 2021 and 2022, respectively, while the budgeted ore grade was 1.26 g/t. Although the mill throughput has decreased from 0.89 million tonnes to 0.85 million tonnes in Q1 2021 and 2022, respectively, as compared to a budget of 0.84 million tonnes, this did not have a major negative impact because the grade has increased. The gold recovery was also above the target in Q1 of 2022 at 98.5% against a budget of 98.0% while in Q1 of 2021, the gold recovery was 97.6% (B2Gold, 2022).

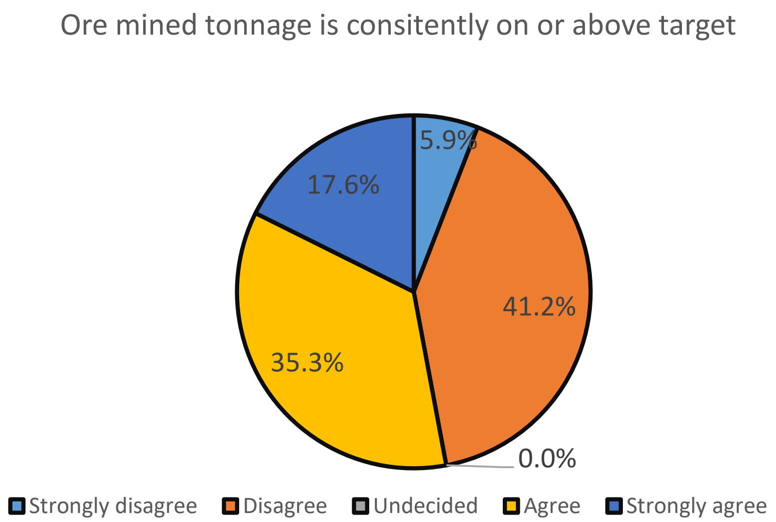


Figure 82: *Superior sustainable performance for ore mined tonnages*

4.7.4 Superior sustainable performance of final product produced

The final product tonnage is critical for the financial survival of any operation. Figure 83 shows that about 12% and 35% of the respondents strongly agree and agree that their final product tonnage has been consistently on and above target. This is a total of 47% of the operations within the Namibian mining industry. Therefore, the balance of 47% and 6% of the operations are not achieving the final product target and others are undecided, respectively. Clearly, 47% of the operations not achieving the final product is made up of 18% and 29% operations due to respondents who strongly disagree and disagree, respectively, that their operations do not achieve the final product target sustainably. This can be due to different reasons, and it depends on the processes and technologies applied.

A good example is for B2Gold's Otjikoto Gold Mine which had a first quarter (Q1) gold production of 35 061 ounces of gold which is 5% (1 803 ounces) above budget. The production is expected to increase in the second half of 2022. In the first quarter (Q1) of 2021, gold production was 52% (12 019 ounces). The gold recovery was also above the target in Q1 of 2022 at 98.5% against a budget of 98.0% while in Q1 of 2021 the gold recovery was 97.6%. Gold production is expected to increase further from 65 000 – 70 000 ounces to 110 000 – 115 000 ounces of gold which is budgeted for the first and second half of 2022, respectively (B2Gold, 2022).

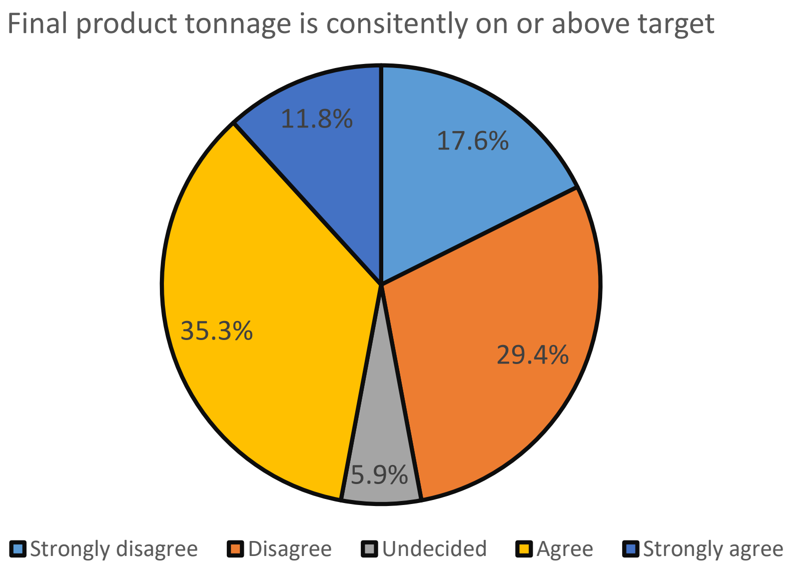


Figure 83: *Final product superior sustainable performance*

4.7.5 Superior sustainable performance for COP and/or AISC

Ideally, the cost of production (COP) should be maintained on or below the target to ensure improved profitability. The all-in sustaining cost (AISC) should also be managed appropriately to ensure the sustainability of the operation. The concept of all-in sustaining cost (AISC) enables a consistent format of reporting the direct cost of mining and processing for the gold mining companies which is critical to both mining professionals and investors. The World Gold Council (WGC) established a consistent cost of production format that accurately reflect the cost of production which is including the all-in sustaining cost (AISC) and all-in cost (AIC). The Cost of production (COP) only focuses on production (mining and processing) costs, but it does not consider critical aspects such as sustaining capital, operation closure and rehabilitation capital, and general and administrative expenses. This won back the confidence of investors and it increased a better understanding of gold economics (Yapo & Camm, 2017).

As shown in Figure 84, approximately 24% and 41% of the operations strongly disagree and disagree that their cost of production is not on or below target consistently. This is a total of 65% of the mining operations in Namibia. Only 18% of the operations have the cost of production on or below target while the other 18% of them are undecided. Cases regarding the cost of production have been discussed already under the section for cost-cutting or austerity measures. B2Gold's Otjikoto Gold Mine is expected to have a cash operating cost ranging from US$740 – US$780 per ounce and an all-in sustaining cost (AISC) ranging between US$1 120 – 1 160 per ounce. The cash operating cost is forecasted to significantly improve from US$960 – US$1000 per ounce to US$620 – US$660 per ounce for the first and second half of 2022 respectively. The all-in sustaining cost (AISC) is also expected to improve from a range of US$1 460 – US$1 500 to US$930 – US$970 per ounce for the first and second half of 2022, respectively (B2Gold, 2022). This clearly shows that the Otjikoto Gold Mine has superior sustainable performance in terms of cost of production. According to Mr Willy Mertens, the CEO of Debmarine Namibia, diamond production for the year 2022 has increased by 52% because of the newly inaugurated state of the art N$7 billion investment into MV Benguela Gem vessel. This resulted in an increase by 168% for the earnings before interest, taxes, depreciation and amortization (EBITDA) and a record of 1.725 million carats of diamonds which constituted 80% of the total diamond production in Namibia (Mertens, 2023). This also clearly shows that the Debmarine Namibia has superior sustainable performance.

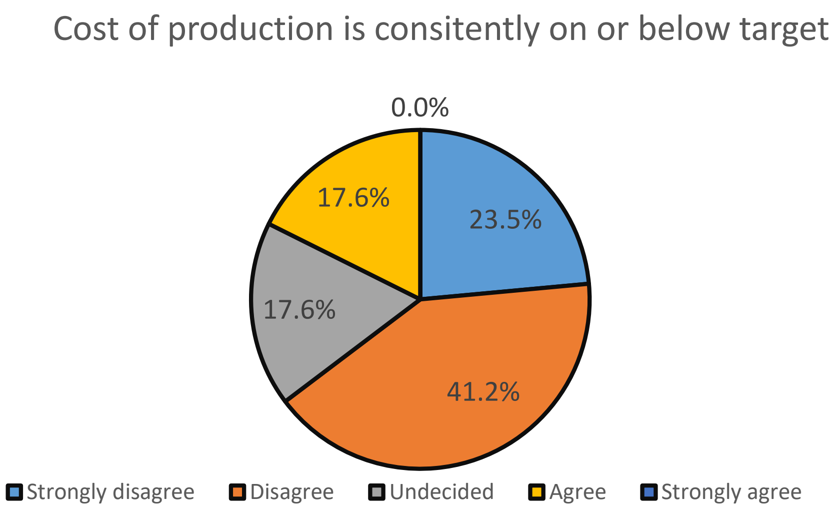


Figure 84: Cost of production superior sustainable performance

4.7.6. Effect of government regulations and policies on superior sustainable performance

The third objective of this research is to assess the effect of regulatory frameworks and policies on the superior sustainable performance of mining operations. This was one of the recommendations for further studies by Boikanyo et al. (2016) as discussed in the introduction of this research. The main government regulations and policies that were identified during interviews are as follows: minerals (prospecting and mining) act 33 of 1992, labour act 11 of 2007, electricity act 4 of 2007, environmental management act 7 of 2007, public enterprises governance act 1 of 2019, and the water resources management act 11 of 2013. The interview data shown in Figure 85 indicates that the environmental management Act 7 of 2007 has been complied with by 100% of the operations. This act is aimed as a guiding and decision-making act that promotes the sustainable management of the environment and the utilisation of natural resources. Mining companies comply with this act by ensuring that they have hired environmental officers, they protect the environment by monitoring and controlling potential negative environmental impacts, they complete environmental impact assessment (EIA) for strategic projects, etc. A typical example of environmental consideration is when a moratorium was placed on marine phosphate mining in Namibia due to fears that it might negatively affect the fishing industry.

The minerals act is mainly influencing exploration of the orebodies, especially outside the mining license areas which is not common to all mines. The labour act regulations affect the employer-employee relationship, however, its effect on operations is not significant unless there are labour unrests. The electricity act, public enterprises act and water resources management act have an effect on the supply of water and electricity to the mining operations, especially via Nampower and Namwater. A typical example of the effect of electrical power supply that is affecting strategic projects is the case of the Skorpion Zinc Mine's refinery conversion project that got delayed and somehow turned uneconomic until the parties agree on a favourable electrical power rate charge. Operations such as the Rosh Pinah Zinc Mine, Dundee Precious Metal Tsumeb, and Swakop Uranium Mine have invested in renewable energy to improve their superior sustainable performance and to minimise the cost of production and/or all-in sustainable cost (AISC).

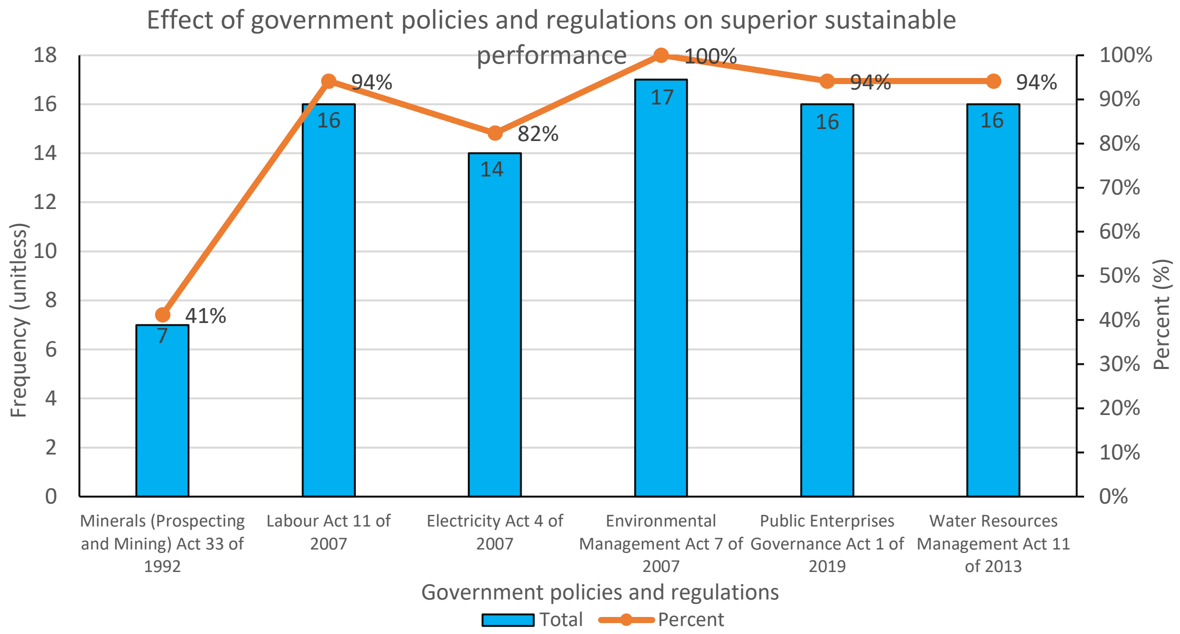


Figure 85: *Effect of government policies and regulations on superior sustainable performance*

4.7.7. Developing strategies for improving superior sustainable performance

The second last objective of this research aims is to develop strategies for improving superior sustainable performance for mines in the Namibian mining industry. The strategies were developed by conducting strengths, opportunities, weaknesses, and strengths analysis (SWOT/TOWS analysis) for the entire Namibian mining industry. The SWOT/TOWS analysis model was developed to establish a prioritised set of strategies that will leverage the strengths and opportunities and minimise weaknesses and threats, hence, maintaining improved superior sustainable performance in the mining industry. In general, the developed strategic options fall under the following categories: maxi-maxi strategy, maxi-mini strategy, mini-maxi strategy, and mini-mini strategy. A schematic diagram in Figure 86 shows the SWOT/TOWS analysis model that was applied to establish strategies to improve superior sustainable performance in the Namibian mining industry. The SWOT/TOWS analysis developed (see Figure 87) shows the strategies that should be applied to improve superior sustainable performance. The analysis was done by using the findings from both the questionnaire survey and the interview especially by considering the sustainability factors that were discussed.

		External Environmental Factors	
		Opportunities (O) O1 02 03 O4	**Threats (T)** T1 T2 T3 T4
Internal Environment Factors	**Strengths (S)** S1 S2 S3 S4	**“Maxi-Maxi Strategy”** ***(SO Strategies)*** S1,O1 S2,O2	**“Maxi-Mini Strategy”** ***(ST Strategies)*** S3,T1 S4,T2
	Weaknesses (W) W1 W2 W3 W4	**“Mini-Maxi Strategy”** ***(WO Strategies)*** W1,O3 W2,O4	**“Mini-Mini Strategy”** ***(WT Strategies)*** W3,T3 W4,T4

Figure 86: *SWOT/TOWS analysis model schematic utilized for establishing the strategies*

		External Environmental Factors	
		Opportunities (O) 01 – High investment in the best available technology (BAT) via intensive research and development (R&D). 02 – Negotiate final product and raw material supply short-term and long-term contracts with multiple external companies to counter commodity price changes. O3 – Increase in the price of uranium, metals required for electric vehicles (EVs) and other commodity prices. O4 – Increased pressure on European and other countries to acquire alternative sources of energy instead of relying on natural gas and oil from Russia.	**Threats (T)** T1 – Factors influencing commodity price and adjustments to the commodity prices. T2 – Poor benchmarking and collaboration between countries for mutual benefit that is rendering some strategic projects delayed and uneconomic especially when it comes to electrical power supply tariffs i.e., in the case of the Skorpion Zinc Mine and Namibia marine phosphate mining. T3 – Other countries produce enormous quantities of some commodities, and they have economies of scale advantage for certain minerals/metals than Namibia making it uneconomic to set up upstream beneficiation industries in Namibia.
Internal Environment Factors	**Strengths (S)** S1 – Intensify the drive towards research and development (R&D) to increase operation efficiencies, improve recoveries, minimise dilutions, blend the ores, efficient use of reagents, redesign operation, etc. S2 – Optimise the cost of production (COP) and all-in sustainable cost (AISC) by investing in renewable energy sources, increasing by-products production, etc. S3 – Invest in the life of mine extension projects i.e., exploration, open new mines, pit pushback projects, etc. S4 – Increased compliance to government regulations and policies hence improving sustainability of the industry via environment protection, mine closure and rehabilitation plans, water and electricity supply, labour law compliance, etc.	**"Maxi-Maxi Strategy"** ***(SO Strategies)*** S1,O1 – Produce more with less input (efficiently) by maximising investment into research & development (R&D) so that there is sufficient capital for investing into best available technology (BAT) and other initiatives. S2,O2 – Optimise the cost of production (COP) and maintain a healthy all-in sustainable cost (AISC) by investing into renewable energy, by-product production, establishing vertical integration, negotiating contracts etc. S4,O4 – Establishment of sustainable, yet investor-friendly laws and policies can contribute to the enticement of European investors to seek alternative energy sources that can potentially energise the entire industry for their countries especially by investing into the startup of more uranium mines and subsequently nuclear power plants locally.	**"Maxi-Mini Strategy"** ***(ST Strategies)*** S3,T1 – Invest in life of mine extension projects by focusing on minerals or metals in high demand and by considering the commodity price. S4,T2 – Benchmark and improve collaboration and sustainability regulations and policies with other countries for mutual benefit and to ensure regional (i.e., within SADC via SACU) growth and sustainability of the mining industry.
	Weaknesses (W) W1 – Declining ore grades and depleting ore reserves. W2 – Utilisation of old and inefficient technology and unreliable equipment that makes the operation inefficient and less productive. W3 – Lack of financial resources and inability to attract investors to invest in all strategic projects that could expand the life of the operation and for local beneficiation. W4 – Poor benchmarking and information sharing between companies due to confidentiality reasons.	**"Mini-Maxi Strategy"** ***(WO Strategies)*** W1,O1 – Conduct research and development (R&D) projects to find appropriate solutions i.e. via ore homogenisation, exploration, utilisation of new equipment, best available technology (BAT) and other initiatives based on predicted commodity price trends. W3,O3,O4 – Increase transparency that will enhance trust by conducting regular and independent audits by competent companies to improve trust by investors.	**"Mini-Mini Strategy"** ***(WT Strategies)*** W4,T1,T3 – Establish memorandum of agreement (MOA) that will enable information sharing and benchmarking to enhance sustainability of operations.

Figure 87: *Developed strategies for improving superior sustainable performance for mines in the Namibian mining industry*

4.7.8. Creating an integrated strategy map for improving superior sustainable performance

The last objective of this research aims is to create an integrated strategy map focused on improving superior sustainable performance for the Namibian mining industry. An integrated strategy map is a visual tool (a map) that shows the cause-and-effect relationship between strategic objectives, which are allocated measures, and targets and they are translated into strategic initiatives or strategic projects which can be put into action. The strategy map is therefore part of the strategic planning process, and it is usually depicted in terms of the balanced scorecard (BSC). The BSC considers the following four perspectives, namely, financial perspective, customer perspective, internal process perspective, and organisational capacity (learning and growth) (Kaplan & Norton, 2006). As discussed in the literature review chapter, the BSC is a strategic planning and management system that provides a balanced view of strategic performance by considering not only financial performance but other perspectives also.

The strategy map can be created after completing certain activities. First, study the external and internal environment by using techniques such as PESTLE and/or SWOT analysis. For this research, a SWOT/TOWS analysis model was applied. Second, vision and mission statements are set. Third, created strategic objectives are developed, and last, measures and targets which are the key performance indicators (KPIs) and strategic initiatives which are basically strategic projects that should be executed in order to realise the strategic objectives (Kaplan & Norton, 2006).

The created strategy map for improving superior sustainable performance in the Namibian mining industry is shown in Figure 88. It has been created with input from the data collected via the questionnaire survey and the interviews as discussed in the previous sections. A typical vision and mission of the industry focused on superior sustainable performance was created. The created vision is to be a mining industry global leader with superior sustainable performance and the biggest contributor to the long-term prosperity of Namibia. While the mission is to effectively promote sustainability and long-term growth of the mining industry in Namibia for the benefit of all stakeholders. The established strategic themes include superior sustainable performance, operational effectiveness, and efficiency, and a high-performance team culture.

The strategic objectives established for the above-mentioned balanced scorecard (BSC) perspectives include the following: improving performance culture, improving knowledge and skill, enhancing health and safety, improving sustainability, increasing operation efficiencies, increasing best available technology use, increasing production capacity, improving strategic project execution, increase effective benchmarking, enhance customer value, enhance vertical integration, improve customer satisfaction, improve long-term revenue, increase long-term profitability and optimize costs.

The measures and targets were also suggested. However, any operation that would consider using this integrated strategy map should establish them specifically for their operation. The researcher believes that this integrated strategy map can serve as a guide for the operation to be focused on superior sustainable performance because it covers critical aspects of this concept.

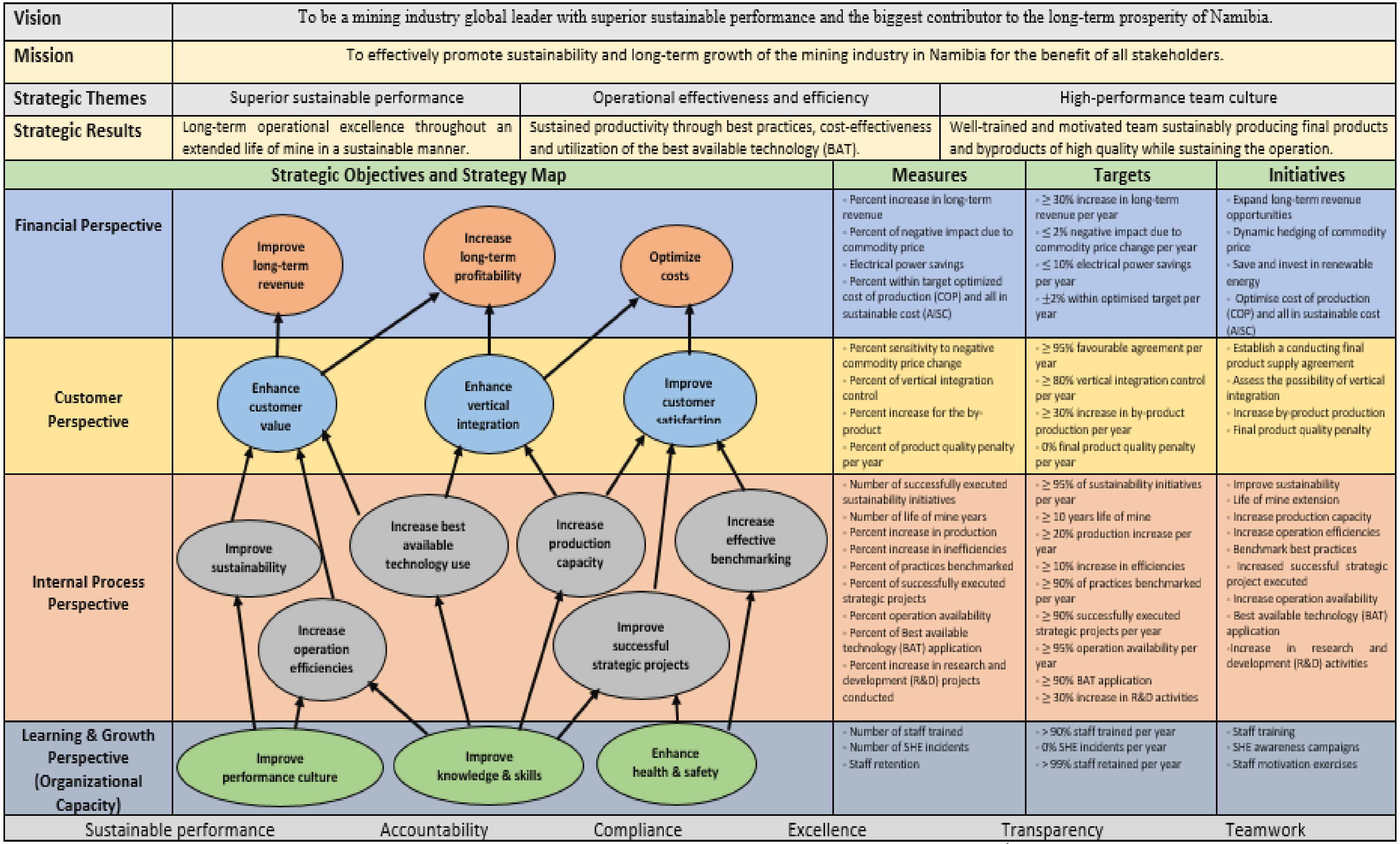


Figure 88: *The created integrated strategy map for improving superior sustainable performance in the Namibian mining industry*

4.8. Chapter Summary

This chapter discussed the quantitative data and qualitative data collected by utilising the questionnaire survey and interviews. The response rate of 68% of the operation in the Namibian mining industry was achieved. The chapter focused on the objectives of the research by assessing the application of strategic management, examining critical success factors for the implementation of strategies, evaluating the effect of governmental regulations on strategy implementation, developing strategies for improving superior sustainable performance, and finally creating an integrated strategy map for improving superior sustainable performance in the Namibian mining industry. These objectives were achieved after critically assessing factors influencing the sustainability of the mining industry.

It was found that 65% of the operations make use of strategic management as a tool to improve operation sustainability. However, all (100%) of the operations establish strategic plans, and they monitor and control their implementation. This was also evident in the number of strategic projects executed, although only 41% of them were implemented successfully. Most of the strategic projects are focused on extending the life of mine, increasing production, improving efficiency, decreasing the cost of production (COP) and/or improving all-in sustainable cost (AISC). The main critical success factors for the successful implementation of strategies and strategic projects are as follows: project executor skill and experience, management support, communication, execution tactics, organisational structure, financial resources availability, commodity price, and technical challenges involved in the project, and staff dedication.

The main factors influencing the sustainability of mines by shortening their life can be arranged in the following order based on the percentage of the operations they negatively affected as follows: decline in commodity prices (35%), mine flooding due to underground water (24%), geotechnical risks (18%), depleted ore (18%), declined ore grade (12%), and mineralogical change (12%). Other sustainability factors that may also be viewed as consequences include employee retrenchment (59%), aggressive cost-cutting (53%), care and maintenance (47%), and labour disputes (29%). In terms of the effect of governmental regulations and policies on strategy implementation, it is mainly the environmental management act 7 of 2007, Labour Act 11 of 2007, and the minerals (prospecting and mining) act 33 of 1992 which are influencing most of the strategic projects. The strategies for improving superior sustainable performance were developed by applying the SWOT/TOWS analysis model and finally, an integrated strategy map was created by considering sustainability aspects in the mining industry.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The principal aim of this research was to investigate strategies that may potentially assist with improving superior sustainable performance in the Namibian mining industry. The researcher asserts that once the mining industry improves superior sustainable performance, the implementation of the Mineral Beneficiation Strategy (MBS) may be more realistic, and Namibia may attain its vision of becoming an industrialised country. Once all the specific objectives of this research have been successfully met it means the overall aim of this research has been achieved and they have all been successfully met. The conclusions of this research for the respective specific objectives are summarised below.

5.2 Summary of Key Research Findings

5.2.1 Application of strategic management as a tool for improving sustainable performance

The first objective of this research was to assess the application of strategic management as a tool for improving superior sustainable performance in the Namibian mining industry. Based on the questionnaire survey, it was found that 65% of the mines in Namibia are applying strategic management. This percentage is quite low as compared to 80% that was found by Boikanyo et al. (2016) for mining companies in South Africa, Africa, and globally. Nonetheless, 100% of the operations in Namibia have established executable plans which are implemented. It is most likely that some of the operations do not refer to it as a strategy but as annual planning in which the developed plan is implemented throughout the year.

This is evident because 77% of the strategic projects in the industry are feasible in all aspects. The questionnaire data also showed that 76% of mining companies have existing strategies to improve superior sustainable performance. The interview data revealed that the resultant strategic projects are mainly focused on strategic areas such as the life of mine extension, increasing production, improving efficiencies, and improving all-in sustainable cost (AISC) and/or cost of production for 88%, 94%, 94%, and 100% of the mining operations in Namibia, respectively. This means that both the questionnaire survey and interviews are aligned in this case. Therefore, the Namibian mining industry is aware of the importance of utilising strategic project management to improve superior sustainable performance.

5.2.2 Critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry

The second objective of this research was to examine the critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry. The questionnaire survey revealed that only 41% of strategic projects have been successfully executed, while 35% and 24% of the respondents are uncertain and disagree that their strategic projects were successfully implemented, respectively. This gave a total of 59% of strategic projects that have potentially failed, assuming the uncertain strategic projects also failed. According to the study by Li et al. (2008), it was reported that about 57% of business strategies fail due to poor strategy implementation. This is almost equivalent to the value obtained in this research. It is, therefore, important to understand the critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry.

Based on the interviews conducted, the main critical success factors for the implementation of strategies to improve superior sustainable performance in the mining industry especially the execution of the established strategic projects include the following: project executor skill and experience, management support, communication, execution tactics, organisational structure, financial resources availability, commodity price, technical challenges involved in the project, and staff dedication.

The questionnaire survey showed several technical and operational issues that have significantly affected the sustainability of mines by shortening the life of the mines in Namibia. These factors are affecting the superior sustainable performance of the operations and they can be arranged in an order based on the percentage of the operations they negatively affected. The order is as follows: decline in commodity prices (35%), mine flooding due to underground water (24%), geotechnical risks (18%), depleted ore reserve (18%), declined ore grade (12%), and mineralogical change (12%). Other sustainability factors that may also be viewed as consequences include employee retrenchment (59%), aggressive cost-cutting (53%), placing the operation under care and maintenance (47%), and labour disputes (29%).

The interviews revealed that the main factors influencing superior sustainable production and the percentage of operations applying them are as follows: improved operation/machine availability (100%), increased ore grade (88%), improved operation efficiencies (100%), enhanced staff competence (100%), high staff motivation (94%), timely reagent supply (100%), and improved safety (100%). As such, mines are implementing several best practices to curb the drastic effects of most of these factors. The applied best practices and the percentage of operations utilising them were obtained via interviews as follows: research and development (R&D) (100%), ore blending (100%), staff motivation (88%), staff training (94%), staff retention (88%), benchmarking (94%), vertical integration (12%), best available technology (BAT) (59%), and renewable energy (35%).

Similar findings were also found in the reviewed literature, according to the Namibia Minerals Industry Symposium (NAMIS) held by the Department of Mining and Process Engineering (DMPE) at the Namibia University of Science and Technology (NUST) under the theme *Mining challenges impacting the local industry* in 2016, typical sustainability challenges affecting the Namibian mining industry were reported and they include several factors. These are: declining ore grades, plummeting commodity prices, increased regulation, and legislation, increased corporate social responsibilities, escalating costs, water, and energy crisis (DMPE, 2022).

The Chamber of Mines of Namibia (2022) and other researchers such as Musiyarira et al. (2019) have recognised the need to intervene in these factors, especially regarding sustainability issues. It is on this basis that the Chamber of Mine of Namibia partnered with the Namibia Chamber of Environment (NCE) and established the best practice guide for environmental principles. It enforces that the mining companies should obtain a Social License to Operate (SLO) which was also studied by Musiyarira et al. (2019). The Chamber of Mines of Namibia has facilitated the establishment of a mine closure framework to ensure acceptable change after mining operation closure and it emphasises sustainable development through economic transformation nationwide by creating a Mining Charter.

The interviews showed that several sustainability actions have been implemented by mining operations which are also aligned with the above-mentioned factors. The main operation sustainability initiatives implemented and the percentage of mines implementing them are as follows: establishing a mine closure and rehabilitation plan at 100%, increasing the life of mine at 88%, investing in intensive exploration at 88%, environmental protection at 100%, improving the all-in sustainable cost (AISC) at 94%, and improving operation efficiency at 100%. Moreover, strategic initiatives applied to increase the life of the mine and the percentage of mines applying them were found as follows: ore blending (100%), exploration (88%), design modification (76%), opening new mines (35%), open pit pushback projects (29%), and importing ore (18%). In addition, 12% and 59% of the mines have experienced drastic effects due to slope failure (geotechnical failure) and have been negatively affected by the decline in commodity prices, especially the uranium mines.

5.2.3 The effects of governmental regulatory frameworks and policies on the implementation of strategies to improve superior sustainable performance

The third objective of this research was to evaluate the effect of governmental regulatory frameworks and policies on the implementation of strategies to improve superior sustainable performance. The interviews conducted established that the most influential government regulations and policies for the implementation of strategic projects are as follows: minerals (prospecting and mining) Act 33 of 1992, labour act 11 of 2007, electricity Act 4 of 2007, environmental management Act 7 of 2007, public enterprises governance Act 1 of 2019, and the water resources management Act 11 of 2013.

The environmental management Act 7 of 2007 has been complied with by 100% of the operations. This act is aimed as a guiding and decision-making act that promotes the sustainable management of the environment and the utilisation of natural resources. Mining companies comply with this act by ensuring that they have hired environmental officers, they protect the environment by monitoring and controlling potential negative environmental impacts, they complete environmental impact assessment (EIA) for strategic projects, and they have established an environmental management plan (EMP), etc. As discussed above the Chamber of Mine of Namibia partnered with the Namibia Chamber of Environment (NCE) in this regard and this is emphasising the significance of environmental protection across the entire mining industry.

The minerals act is mainly influencing exploration of the orebodies, especially outside the mining license areas which is not so common in all mines. The labour act regulations affect the employer-employee relationship, however, its effect on operations is not significant unless there are labour unrests. The electricity act, public enterprises act and water resources management act have an effect on the supply of water and electricity to the mining operations, especially via parastatals such as Nampower and Namwater. Water and electricity have affected strategic project implementation in the Namibian mining industry also.

For example, the lack of quality water due to excessive algae bloom affecting the Orano desalination plan has resulted in the Rössing Uranium Mine losing at least 59 production days and 464 tonnes of uranium production between 2017 and 2020. This forced the Rössing Uranium Mine into investing N$102 million into the construction of a 60 000 m^3 corrosion-resistant water storage facility (Tjiriange & Moody, 2022). Another strategic project by the Skorpion Zinc Mine, in which they are prepared to invest N$6.5 billion in the refinery conversion project is currently being delayed and rendered uneconomic due to the availability and affordability of electrical power (Vedanta, 2022). These are good examples to indirectly illustrate the effect of the electricity act, public enterprises act, and water resources management on strategic projects because they are regulating electrical power and water supply nationwide.

5.2.4 Strategies for improving superior sustainable performance for mines in the Namibian mining industry

The fourth objective of this research was to develop strategies for improving superior sustainable performance for mines in the Namibian mining industry. The strategies were developed by applying a SWOT/TOWS analysis model after considering and integrating various strategic management concepts, mine sustainability and production-related issues similar to those discussed in the first three objectives of this research. This was done by utilising data from both the research questionnaire and the interviews. The established strategies can be categorised into the following groups, namely, maxi-maxi strategy, maxi-mini strategy, mini-maxi strategy, and mini-mini strategy.

The developed maxi-maxi strategies maximise the internal strengths and external opportunities. The established maxi-maxi strategies are as follows: The first strategy involves producing efficiently by investing in research and development (R&D) so that there are sufficient funds for investing in the best available technology (BAT) and other critical strategic initiatives. The second strategy involves optimising financial-related aspects i.e., cost of production (COP) and all-in sustainable cost (AISC) by investing in renewable energy, improving by-product production, establishing vertical integration, and negotiating long-term and short-term supply chain contracts etc. The last strategy involves establishing sustainable yet investor-friendly laws and policies that can contribute to the enticement of European investors to seek alternative energy sources that can potentially energise the entire industry for their countries especially by investing in the startup of more uranium mines and subsequently nuclear power plants locally.

The mini-maxi strategies will seek to minimise the negative impact of the internal weaknesses while maximising external opportunities. The first mini-maxi strategy involves conducting research and development (R&D) projects to find appropriate solutions i.e., via ore homogenisation, exploration, utilisation of new equipment, best available technology (BAT) utilization and other strategic initiatives based on predicted commodity price trends. The second one involves increasing transparency that will enhance trust by conducting regular and independent audits by competent companies to improve trust by investors. In addition to that, transparency can also be increased by establishing whistleblower protection, having effective anti-corruption, and anti-bribery policies.

The maxi-mini strategies take advantage of the internal strengths and then minimise the impact of external threats. The two maxi-mini strategies established are investing in the life of mine extension projects by focusing on minerals or metals in high demand and by considering the commodity price, and benchmarking and improving the collaboration and sustainability regulations and policies with other countries for mutual benefit and ensuring regional growth and sustainability of the mining industry i.e., within the Southern African Development Community (SADC) via the Southern African Customs Union (SACU).

The mini-mini strategy was developed by minimising both the internal weaknesses and the external threats. The mini-mini strategy established has to do with establishing a memorandum of agreement (MOA) that will enable information sharing and benchmarking to enhance the sustainability of operations.

5.2.5 An integrated strategy map for improving superior sustainable performance for the mining industry

The fifth objective of this research was to create an integrated strategy map for improving superior sustainable performance for the mining industry. The integrated strategy map was created by incorporating the above-mentioned and developed strategies for improving superior sustainable performance. Essentially, the integrated strategy map was created by considering and integrating various strategic management concepts, mine sustainability, and production-related issues similar to those discussed in the first four objectives of this research above. This was done by utilising data from both the research questionnaire and the interviews. The integrated strategy map incorporates a vision, mission, values, strategic themes, strategic results, strategic objectives, strategic map, measures, targets, and strategic initiatives.

The created vision is to be a mining industry global leader with superior sustainable performance and the biggest contributor to the long-term prosperity of Namibia. The established mission is to effectively promote sustainability and long-term growth of the mining industry in Namibia for the benefit of all stakeholders. The values of the mining industry focused on superior sustainable performance are as follows: sustainable performance, accountability, compliance, excellence, transparency, and teamwork.

The strategic themes created and the resultant strategic results are as follows: a superior sustainable performance that will result in long-term operational excellence throughout an extended life of mine in a sustainable manner; operational effectiveness and efficiency that can consequently result in sustained productivity through best practices, cost-effectiveness and utilization of the best available technology (BAT); and high-performance team culture that can contribute to well-trained and motivated team sustainably producing final products and by-products of high quality while sustaining the operation.

The established strategic objectives for the respective perspectives are as follows: 1) learning and growth perspective strategic objectives which are a) improve performance culture, b) improve knowledge and skills, and c) enhance occupational health and safety. The second strategic objectives are 2) internal process perspective strategic objectives which include a) improving sustainability, b) increasing operation efficiencies, c) increasing best available technology (BAT) utilization, d) increasing production capacity, e) improving successful strategic project execution, and f) increase effective benchmarking. The third ones are 3) customer perspective strategic objectives which comprise a) enhance customer value, b) enhance vertical integration possibility, and c) improve customer satisfaction, and the last ones are 4) financial perspective strategic objectives which include a) improve long-term revenue, b) increase long-term profitability, and c) optimise costs.

The strategic initiatives which will be implemented as strategic projects as a result of the created integrated strategy map for the respective balanced scorecard are as follows: 1) learning and growth perspective strategic initiatives strategic initiatives are as follows: a) staff training, b) occupational safety (safety first), health and environment protection awareness campaigns, and c) staff motivation exercises, 2) internal process perspective strategic initiatives include a) improve sustainability, b) life of mine extension, c) increase production capacity, d) increase operation efficiencies, e) benchmarking with best practices, f) increased successful strategic project executed, g) increase operation availability, h) best available technology (BAT) application, and i) increase in research and development (R&D) activities, 3) customer perspective strategic initiatives include a) establish a conducive final product supply agreement, b) assess the possibility of vertical integration, c) increase by-product production, and d) final product quality penalty, and 4) financial perspective strategic initiatives include a) expand long-term revenue opportunities, b) dynamic hedging of commodity price, c) save and invest in renewable energy and d) optimise cost of production (COP) and all-in sustainable cost (AISC).

5.3 Recommendations

5.3.1 Policy/Mine Operations recommendations

The researcher recommends that there should be more effort into improving the cost of production (COP) and/or the all-in sustainable costs (AISC) for the mining industry to ensure superior sustainable performance in the long term. The researcher recommends that the Chamber of Mines of Namibia and mining companies, in general, should advocate for a greener yet cheaper electrical energy supply which is more sustainable in the long term. This can be achieved by strategically aligning to the internal strengths and external opportunities. The advantage of advocating for cheaper electrical power is that the mining industry is an electrical energy-intensive industry and if this can be decreased, it means that the mines will make a substantial profit and they will remain sustainable.

For example, the Skorpion Zinc Mine which uses the electrowinning process consumes an equivalence of 25% of Namibia's total electricity consumption, and its refinery conversion project that will ensure its sustainability has been placed on hold because of the electrical power price rendering it uneconomic (Vedanta, 2022; GCS, 2015; Tshiningayamwe, 2021). Therefore, electrical energy is one of the biggest bottlenecks for sustainability in the mining industry. Once this challenge is resolved, there might be sufficient financial resources to invest in superior sustainable performance strategic projects such as exploration, research and development (R&D), operation design modification, pit dewatering, production of by-products, staff retention, staff training, countering changes in the commodity price, investing in the best available technology (BAT), and many other strategic initiatives mentioned in the integrated strategy map.

A practical solution would be to support the idea of the design and construction of a nuclear power plant in Namibia. As such, Namibian-based mining companies can enjoy the benefit of having cheaper electrical power, and the rest of the power can be exported or sold to other countries. Similarly, the green hydrogen project and Kudu gas project might also yield similar results, and they can even be implemented simultaneously.

5.3.2 Recommendations for Further Research

The researcher has recognised the need for further research into the policy regarding tax relief for mining companies that are struggling to remain sustainable. Further research should be done by investigating the improvement of the investment attractiveness for Namibia. This can be done by looking into the policy perception index (PPI) points that have decreased. Special attention should be given to the implementation of the new value-added tax (VAT) act because it requires a 12-month period for proving that there will be production. The manufacturing companies which are struggling due to unsustainable supply of raw materials from the unstable mining should also be supported appropriately. Further study should be done to determine the best approaches to supporting the infant manufacturing industry for example by making it easy for them to acquire bank loans, government subsidy, regional memorandum of agreements etc. Further studies should also focus on collecting data from mines that have closed down. This is because it was extremely difficult to collect and analyze data from such operations.

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Appendix A: Research Questionnaire

QUESTIONNAIRE

My name is Mr. Thomas Moongo, and I am completing my research project for a Master of Business Administration (MBA) specializing in Management Strategy at the Namibia Business School (NBS), University of Namibia (UNAM). I would like to sincerely request you to participate in this research which is aimed at investigating strategies to improve superior sustainable performance in the Namibian mining industry. The study will address an identified knowledge gap regarding the application of strategic management, and it stems from the fact that about 52% of the operations in the Namibian mining industry have been on care and maintenance from 2000 to 2021. Therefore, the research attempts to provide significant academic and practical solutions in terms of improving superior sustainable performance.

Please complete this voluntary 15 minutes survey in which your privacy, anonymity, and confidentiality will be maintained. The participants have the right to withdraw from this research for any reason(s) without explaining themselves. You also do not have to answer any question(s) that make you uncomfortable. Feel free to ask for clarity, express yourself, and answer the questions to the best of your knowledge. Please return the questionnaire to the researcher within 1 week via this e-mail address: tmoongo@gmail.com or via any other suitable means that will not compromise ethical considerations. In case of questions, feel free to call or SMS the researcher via this cell phone number: +264 81 286 1202. Thank you for your participation.

General instructions for filling the questionnaire

- ❖ The questionnaire may be completed by managers (all levels), superintendents, metallurgists, geologists, and mining engineers only.
- ❖ Answer the questions by considering within the past 2 years for operations that are currently producing and/or within 2 years before production stopped for operations that are currently closed or on care and maintenance.
- ❖ If you have worked at more than one operation in the mining industry, feel free to complete multiple questionnaires for different operations.

BASIC INFORMATION

Operation/mine Name:

Participant's position (optional):

Remaining years of operation/mine life:

Section A: Application of strategic management in the mining industry

May you kindly indicate by ticking or marking with an X the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Q1: A formal strategy formulation session is conducted in your department/operation.	☐	☐	☐	☐	☐
Q2: Strategic projects at your operation are feasible in all aspects i.e., technically, economically, legally etc.	☐	☐	☐	☐	☐
Q3: All major strategic projects have been timely implemented successfully.	☐	☐	☐	☐	☐
Q4: Your operation has strategies in place to improve superior sustainable performance.	☐	☐	☐	☐	☐

Section B: Sustainability of operations in the mining industry

May you kindly indicate by ticking or marking with an X the extent to which you agree or disagree with the following statements	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Q1: There are plans to increase the operation/mine life i.e., via exploration, operation expansion projects etc.	☐	☐	☐	☐	☐
Q2: Appropriate operation closure and rehabilitation plans have been established.	☐	☐	☐	☐	☐
Q3: No major operation redesign is required to ensure operation sustainability.	☐	☐	☐	☐	☐
Q4: No serious cost-cutting or austerity measures have been implemented.	☐	☐	☐	☐	☐
Q5: There are no major geotechnical risks.	☐	☐	☐	☐	☐
Q6: Commodity prices did not drastically (negatively) affect the operation.	☐	☐	☐	☐	☐

May you kindly indicate by ticking or marking with an X the extent to which you agree or disagree with the following statements	Yes	No
Q1: The operation has not retrenched employees recently.	☐	☐
Q2: The operation has never been on care and maintenance.	☐	☐
Q3: The mine was never flooded and there is no need for dewatering initiatives.	☐	☐
Q4: There is sufficient ore supply for ≥5 years from the orebody reserves or external suppliers in the case of the smelter/refinery.	☐	☐
Q5: The ore grade has not declined significantly.	☐	☐
Q6: There is no change in the mineralogy of the ore which makes it a challenge to process the ore efficiently.	☐	☐
Q7: Have there been labour disputes recently at your operation?	☐	☐
Q8: If there were labour disputes, did they affect production significantly?	☐	☐

Section C: Superior sustainable performance aspects of the mine

May you kindly indicate by ticking or marking with an X the extent to which you agree or disagree with the following statements	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
Q1: The ore mined has been consistently on or above target.	☐	☐	☐	☐	☐
Q2: The final product tonnages have been consistently on or above target.	☐	☐	☐	☐	☐
Q3: The cost of production has been consistently on or below target.	☐	☐	☐	☐	☐

Which strategies are applied to improve superior sustainable performance at your operation?

Strategies applied (*mark the appropriate*)	**Yes**	**No**
1. Production cost optimisation	☐	☐
2. Improving efficiencies and production throughput	☐	☐
3. Operation redesign or modification or expansion	☐	☐
4. Cost cutting or austerity measures	☐	☐
5. Appropriate ore blending	☐	☐
6. Outsourcing some of the operations	☐	☐
7. Exploring for new orebodies or new ore suppliers	☐	☐
8. Producing byproducts	☐	☐
9. Organisation restructuring	☐	☐
10. Supplying final product to the 'mother' company (vertical integration)	☐	☐
11. Long-term contracts for supplying final products	☐	☐
12. Successful implementation of strategic projects	☐	☐
13. Rewarding safe production with a bonus	☐	☐
List any additional strategies applied at your operation**:** - - -		

Thank you again for your participation.

Appendix B: Research Interview Guide

INTERVIEW GUIDE

My name is Mr. Thomas Moongo, and I am completing my research project for a Master of Business Administration (MBA) specializing in Management Strategy at the Namibia Business School (NBS), University of Namibia (UNAM). I would like to sincerely request you to participate in this interview which is aimed at investigating strategies to improve superior sustainable performance in the Namibian mining industry. The study will address an identified knowledge gap regarding the application of strategic management, and it stems from the fact that about 52% of the operations in the Namibian mining industry have been on care and maintenance from 2000 to 2021. Therefore, the research attempts to provide significant academic and practical solutions in terms of improving superior sustainable performance.

Please allow me to interview you for about 15 minutes and your privacy, anonymity, and confidentiality will be maintained. Please note that the interview will be recorded with your permission and transcribed later. The participants have the right to withdraw from this research for any reason(s) without explaining themselves. You also do not have to answer any question(s) that make you uncomfortable. Feel free to ask for clarity, express yourself, and answer the questions to the best of your knowledge. Thank you for your participation.

BASIC INFORMATION

Operation/mine Name:

Participant's position (optional):

Section A: Application of strategic management in the mining industry

1. How are strategies formulated and implemented at your operation?

2. What are the main strategic projects executed and will they have a long-term impact on the operation?

3. What are the critical success factors influencing strategic project execution at your operation?

Section B: Sustainability of operations in the mining industry

1. In what way would you consider the practice at your operation sustainable?

2. What plans does your mine have to increase its life of mine?

Section C: Superior sustainable performance aspects of the mine

1. Which factors influence the achievement of production targets at your mine?

2. Do the government policies and regulations have any negative or positive effects on the implementation of your strategic projects?

3. What are the best practices applied to improve superior sustainable performance at your operation?