

https://dspace.org/

Sustainable business model innovation and ESG performance in the South African mining industry

Nhlanhla, Khulekani

2023
University of the Witswatersrand, Johannesburg
https://hdl.handle.net/10539/38531

Downloaded from a DSpace repository. https://dspace.org/



Sustainable business model innovation and ESG performance in the South African mining industry

Khulekani Nhlanhla

1281298

A research proposal submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in the field of Innovation Studies

Johannesburg, 2023

ABSTRACT

The purpose of this study is to investigate the influence of ESG (environmental, social, and governance) performance on sustainable business model innovation in the South African mining industry. The study is conducted with the aim to understand which of the ESG factors are most influential in driving sustainable business model innovation and how they either support or hinder innovation.

Due to its extractive nature, and natural resources and reserves mostly being located in countries of the global south (emerging economies) like South Africa, the mining industry has been known to have high impacts on the environment and society (Krause & Drusche, 2021). The industry therefore has a profound role to play in sustainable development and addressing social and environmental challenges (Krause & Drusche, 2021).

The nature and direction of the relationship between ESG and sustainable business models has been researched to a certain extent in industries like finance, but the studies are skewed towards regions such as Europe and generalised to other regions like Africa. In a study by Spoz et al., (2021), the authors claim that the study analysed the results from an international context (Asia, America, Africa, and Europe), but only make mention of Europe and Asia, with an emphasis on Europe in their study. Of the three ESG factors (environment, social and corporate governance), the study showed that there's a moderately strong relationship for a positive impact between social factors and sustainable business models (SBMs) in Europe (Spoz et al., 2021). In a similar study conducted by Ritala et al., (2018) on United States companies listed in the S&P (Standard and Poor's) 500 index, the researchers found that a significant number of firms adopted environmentally oriented sustainable business models (SMB) more frequently than those oriented toward society.

Available literature does not sufficiently make a link between environmental, social and governance performance and sustainable business model innovation applied in the mining industries of emerging economies like South Africa. Neglecting the link

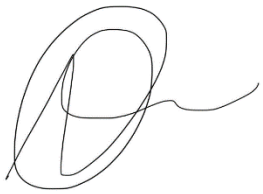
between ESG performance and sustainable business model innovation in regions like South Africa and its mining industry poses risks of environment degradation, regulatory setbacks, and missed economic opportunities (Quayson, et al., 2023).

This research has examined how ESG performance supports or thwarts sustainable business model innovation in the South African mining industry. Through the collection of data using two approaches, semi-structured interviews, and the examination of publicly available company documentation such annual ESG and sustainability reports, this study found that in the South African mining industry, the governance factor was most influential in decisions regarding innovation and sustainable business model innovation. Within the governance factor, elements such as policy and regulation stood out as elements that drove the governance factor. This came from inefficiencies caused by uncertainty in regulation and policy which in turn cause delays in issuing of licenses and permits for innovations or innovative projects needed by the mining industry.

Sustainable development and business model innovation require a systematic approach emphasizing an equal level of importance on all the three factors: social, environmental, and governance within the ESG framework. Active adaptive management can be used to implement proactive monitoring, experimentation, and iterative implementation of actions in pursuit of improved ESG performance that has a positive impact on sustainable business model innovation.

DECLARATION

I, Khulekani Nhlanhla, declare that this dissertation is my own unaided work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Innovation Studies at the Wits Business School in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other University.



Signature: ……

On this ……30…… day of ……06…2023

Khulekani Nhlanhla

Name

DEDICATION

To my beautiful son, Lwazi Nhlanhla.

ACKNOWLEDGEMENTS

First and foremost, I want to express my gratitude to Jesus Christ, who is both my Lord and my constant source of strength. I also want to express my gratitude to MBA Kekana, my fiancée, for her unfailing support and encouragement throughout my education. Additionally, I want to thank Professor Mjumo Mzyece, my supervisor, for his advice and assistance.

Thank you so much to everyone who participated in the interview for your time, patience, and invaluable contributions.

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION 1

1.1 PURPOSE 1

1.2 BACKGROUND 1

1.2.1. Sustainable Development in South Africa 3

1.2.2. ESG background and regulation 5

1.2.3 National policy on mining and legislative framework 8

1.3 RESEARCH PROBLEM 9

1.4 THE STUDY'S SIGNIFICANCE 12

1.5 DELIMITATIONS OF THE STUDY 12

1.6 ASSUMPTIONS 12

1.8 RESEARCH QUESTIONS 13

1.9 REPORT OUTLINE 13

CHAPTER 2. LITERATURE REVIEW 15

2.1 INTRODUCTION 15

2.2 THEORETICAL FRAMEWORKS 15

2.2.1 Sustainable Business Model Innovation 15

2.2.2 Business model innovation 19

2.2.3 Adaptive management 20

2.2.4 Ubuntu 24

2.3 CONCEPTUAL FRAMEWORK 24

2.4 PROPOSITIONS 26

2.5 SUMMARY 26

CHAPTER 3. RESEARCH METHODOLOGY 27

3.1 INTRODUCTION 27

3.2 RESEARCH STRATEGY AND DESIGN 27

3.3 SELECTION OF PARTICIPANTS 27

3.3.1 Avoiding bias 28
3.4 RESEARCH METHODOLOGY 28
3.4.1 Data collection and instrument 28
3.5 DATA ANALYSIS 29
3.6 LIMITATIONS OF THE STUDY 29
3.7 ETHICAL CONSIDERATIONS 29
3.8 RELIABILITY AND VALIDITY 30
3.9 SUMMARY 30

CHAPTER 4. PRESENTATION OF FINDINGS AND DATA 32
4.1 RESPONDENT'S BACKGROUND AND PROCESS TO GATHER DATA ..32

4.2. DATA PRESENTATION 33
4.2.1 ESG factors influencing innovation 34
4.2.2 How are these/this factor(s) supporting or thwarting sustainable business model innovation. 45
4.2.3 Summary of Interview Responses 60
4.2.3.1 ESG factors influencing innovation. 60
4.2.3.2 How ESG factors support or thwart sustainable business model innovation. 62
4.2.4 How might adaptive management be used in the process of SBMI. 63
4.3 CONCLUSION DATA PRESENTATION 66

CHAPTER 5: RESEARCH FINDINGS ANALYSIS AND DISCUSSION 68
5.1 INTRODUCTION 68
5.2 BACKGROUND 68
5.3 DISUCUSSION PERTAINING TO RESEARCH QUESTIONS AND HYPOTHESIS 69
5.3.1 Which of the ESG factors (Environmental or Social or Governance) is influential to innovation. 69

5.3.2 How are these factors supporting or thwarting sustainable business model innovation? 81
5.3.3 How might adaptive management be used in the process of SBMI 94
5.4 CONCLUSION....99

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS 101
6.1 INTRODUCTION....101
6.2 MAJOR FINDINGS....103
6.2.1 Literature Findings....103
6.2.2 Findings from data collected from interviews 104
6.2.3 Findings from data collected from annual ESG and sustainability reports108
6.3 KEY CONCLUSIONS....109
6.3.1 Which of the ESG factors, Environmental or Social or Governance, is influential to innovation? 109
6.3.2 How do these ESG factors support or thwart their sustainable business model innovation? 109
6.3.3 How might adaptive management be used in the process of sustainable business model innovation? 110
6.5 LIMITATIONS OF THE STUDY....112
6.6 SUGGESTIONS FOR FUTURE RESEARCH 112
7. REFERENCES....114
APPENDIXES 136
APPENDIX A....136
APPENDIX B....137
APPENDIX C 138
APPENDIX D 140
APPENDIX E (Ethics Clearance) 141

LIST OF ABBREVIATIONS

Abbreviation	Definition
B-BBEE	Broad-Based Black Economic Empowerment
BM	Business Model
BMI	Business Model Innovation
CDA	Community development agreements
CSIR	Council for Scientific and Industrial Research
EIR	Extractive industries
ESD	Enterprise Supplier Development
ESG	Environmental, Social, and Governance
GHG	Green House Gas
GRI	Global Reporting Initiative
IBA	Impact benefit agreements
JPOI	Johannesburg Plan of Implementation
JSE	Johannesburg Stock Exchange
MPRDA	Minerals and Petroleum Resources Development Act
NEMA	National Environmental Management Act
NGO	Non-Government Organisation
SADC	South African Development Community
SBM	Sustainable Business Model
SBMI	Sustainable Business Model Innovation
SD	Sustainable development
SDM	Sustainability Development through Mining
SME	Small to Medium enterprise
SVC&DI	Sustainable Value Creation & Delivery Innovation
SVCI	Sustainable Value Capture Innovation
SVPI	Sustainable Value Propositions Innovation
UN	United Nations
VR	Virtual Reality
WCED	World Commission on Environment and Development,
WHO	World Health Organisation
WSSD	World Summit on Sustainable Development

LIST OF TABLES

Table 1. sustainable development goals from the Millennium Declaration which set to be met by 2015 (UN, 2003)..... 4
Table 2. Mining industry ESG categories and sub-category..... 7
Table 3. Taxonomy of sustainable development. Adapted from (Kates & Parris, 2003). 22
Table 4. Interview respondent's background profiles. 33

LIST OF FIGURES

Figure 1. Framework for sustainable business model innovation (Shakeel et al., 2020)..... 17
Figure 2. Adaptive management framework (Lee, 1999). 21
Figure 3. Conceptual Framework 25
Figure 4. Environmental Elements and Number of Respondents 35
Figure 5. Social Elements and Number of Respondents. 38
Figure 6. Governance Elements and Number of Respondents 41
Figure 7. Environmental Elements Supporting and Thwarting Innovation 46
Figure 8. Social Elements Supporting and Thwarting Innovation 49
Figure 9. Governance Elements Supporting and Thwarting Innovation 53
Figure 10. Top five mining companies in South Africa in 2022 by Market capitalisation (Galal, 2023). 64
Figure 11. Mining companies showing evidence of adaptive management 65
Figure 13. South Africa's water usage by industry (Askham & Van der Poll, 2017) 72
Figure 14. Adapted from adaptive management framework by Holling (1995). 97

CHAPTER 1. INTRODUCTION

1.1 PURPOSE

This qualitative study looks at how (ESG) performance supports or thwarts sustainable business model innovation in the mining sector in South Africa.
The study aim is to generate empirically based insights that could help management practitioners to better innovate in sustainable business models (SBM) in the mining sector and offer policy makers recommendations in relation to policy making. Lastly, the study looks to contribute to the theory of business model innovation and sustainable business model innovation.

1.2 BACKGROUND

South Africa has a mining history that started in the 1900s post the discovering of gold in the Witwatersrand goldfields as well as diamonds in Kimberley (Sorensen, 2012). The country had the largest known reserves of these precious resources which triggered global interest; these resources, supported by colonial cheap labour, attracted large-scale foreign capital and immigration (SAHO, 2015). The country's politics and the socio-economic landscape were drastically altered by the exploitation of its diamond and gold mines (South African History Organisation, 2015). In South Africa, the first industrial revolution was introduced through the mining industry.
In 2022, the 21st century, South Africa was home to 60.6 million people (Stats SA, 2022). According to a report published in 2021 by the Mineral Council South Africa, the mining sector employed around 458 000 people in 2020 and contributed 8.7% to the national GDP (MCSA, 2022). The industry is still leading the industrial revolution (Harvey R., 2019). It takes the lead with innovations like Anglo American's largest green hydrogen-powered mine haul vehicle (Anglo American, 2022).

Mining provides over 458 000 jobs as stated above and sees about R 500 billion of revenue annually according to Statistics South Africa (Stats SA, 2021). Although mining is a genuinely enormous business, like many developing nations, South Africa's mining corporations operate in some of the country's poorest communities,

many of which are marked by squatter camps (Kemp, 2009). For example, in a community called Marikana where a mining company called Lonmin has their mining operations, the unliveable and bad working conditions were among the major causes of the unrest that erupted in 2012 and saw 37 mineworkers losing their lives at the hands of the police (Macmillan, 2017).

Mining has a reputation for having high and disruptive effects on society (through the displacement of people, for example), the environment (by extracting resources that cannot be renewed), and both due to its extractive nature and the location of its natural resources and reserves, which are primarily in emerging economies like South Africa (Krause & Drusche, 2021).

These challenges are compounded by the global warming crisis and environmental degradation due to harmful toxins released into atmosphere, deforestation and other forms of environmental issues caused by mining in emerging economies (Krause & Drusche, 2021). Azapagic (2004) states that the industry is faced with "some of the most difficult sustainability challenges of any industrial sector" and "to secure its continued 'social licence' to operate, the industry must respond to these challenges by engaging its many different stakeholders and addressing their sustainability concerns" Listed below are some of the difficulties the industry in is facing South Africa:

- *Labour relations*. The South African country has seen its fair share of labour disputes in the mining industry which have caused disruptions in daily mine operations and production. The sector, government and other relevant bodies have struggled to effectively engage with worker to find common ground in order to curb these disputes (Karolia-Hussain & Fourie, 2021).

  Safety and health. This mining industry is by nature dangerous, and health and safety continue being a concern and priority for South Africa. Though the number of fatalities have been on a steady decline over the years, there are still accidents being reported where workers are trapped underground (MCSA, 2022).
- *Environmental impacts.* The sector can have significant adverse environmental impacts, through land degradation, air, and other pollutions, and the extinction of species. The business sector is coming under more and more pressure to

minimize its environmental footprint and the effects of its operations on nearby ecosystems and communities (Shongwe, 2018).

- *Social responsibility.* The sector undoubtedly has the biggest impact not only on biodiversity but nearby communities as well. Almost all industries are under increasing pressure to be accountable for their negative impacts. They need to take care of matters like community development, human rights, and resource utilisation (SAHRC, 2016).
- *Infrastructure and energy*. The industry needs reliable electricity and transport infrastructure such as rail and functional ports. South Africa structures with proving reliable electricity, efficient ports and up to standard rail infrastructure (DPWI, 2022).
- *Regulatory uncertainty.* The regulatory environment for mining in South Africa is plagued by frequent changes, inconsistent enforcement, and lengthy approval processes. This has created uncertainty for investors and operators and introduces difficulty in planning longer terms (SAG, 2015).

1.2.1. Sustainable Development in South Africa

These are not challenges faced by South Africa alone, other Southern African countries face these challenges along with developmental challenges in the economy, infrastructure, and service provisioning. Meeting the needs of sustainable development in the area requires minimising these problems. To promote sustainable development (SD), the Southern African Development Communities (SADC) have established the following development goals for the area (UN, 2019):

- The bulk of the population lives in poverty, therefore improving their health, living conditions, and income is important.
- Ensuring that natural resources as well as the environment are used ethically and sustainably for the good of not only this current generation but the coming one as well.

Table 1 below summarises sustainable development goals from the Millennium Declaration which were set to be met by 2015:

Sources of Goals	Goals
Environmental	Reducing GHG emissions.
	Stop the loss of natural forests everywhere.
	Create, and then adhere to, national standards of air quality recommended by the World Health Organisation (WHO).
	Rection is overall soil erosion
	Make sure that groundwater aquifers are not pumped more than is necessary
Millennium Goals	Reduce world poverty by half.
	Decrease maternal mortality by 75 percent.
	Two thirds lower the death rates for kids under the age of five.
	Obtain universal primary education completion and gender parity in educational access.
	Stop and halt the spread of severe illnesses like AIDS and malaria.
Economic	Take away the subsidies that promote the mining and use of fossil fuels and new materials.
	Discourage the use and extraction of virgin materials.
	Work with industrialised nations to reduce their material use by a factor of four to ten.
	Create and put into place national accounting systems that internalize environmental costs.

TABLE 1. SUSTAINABLE DEVELOPMENT GOALS FROM THE MILLENNIUM DECLARATION WHICH SET TO BE MET BY 2015 (UN, 2003).

The South African Sustainability Development through Mining (SDM) program has sparked significant activities targeted at enhancing mining sustainability. These initiatives have contributed to a significant reduction in mining-related fatalities, with the industry adopting a zero-harm policy and prioritising the well-being of its employees. Since the mid-1990s, the government has worked to advancement of black economic empowerment (BEE) in the sector, which has led to nee mining

behemoths. Larger policy goals outlined in the Petroleum Resources Development Act are supported by these activities (United Nations, 2017).

A number of programs are in place for supporting sustainable development, such as the South African Cyanide Directive for gold mining. From mining to retail, the Responsible Jewellery Council advocates for morally upright, socially just, and environmentally sound business practices. Investors can distinguish between businesses depending on their “triple bottom line” as set out by or on the Johannesburg Securities Exchange-Social Responsibility Index. The Chamber of Mines is a pioneer in the private sector when it comes to reporting on sustainable development, and it has released Transformation and Sustainability Reports that monitor the mining industry's advancement on issues related to sustainability and its indicators like occupational health and safety, the environment and transformation (United Nations, 2017).

By 2010, South Africa set a goal for the industry's sustainable development. The Sustainable Development for Mining (SDM) program's four pillars served as its foundation. The majority of the poor's living situations must be improved. Economic growth must be accelerated with greater fairness. Natural resource use must be equitable and sustainable for the current and coming generation (DMRE, 2009).

One of the SDM's objectives is to make decisions that are fair and informed regarding the extracting and using of mined resources. The creation of tools and systems for better regulatory compliance, enhancing poverty reduction, and fostering growth and competitiveness to narrow the gap between South Africa's first and second economies are some additional goals (DMRE, 2013). Other goals include monitoring and assessing development progress towards sustainability, minimizing adverse effects and risks (including improving health and safety), increasing poverty reduction, and enhancing environmental sustainability.

1.2.2. ESG background and regulation

The United Nations (UN) founded the World Commission on Environment and Development (WCED), also known to as the Brundtland Commission, in 1983 with the intention of addressing significant issues connected to environmental preservation and sustainable development (Eccles et al., 2019). In its 1987 report, the panel defined sustainable development as "meeting present needs without compromising the ability of future generations to meet their own needs." The study paved the way for the development of ESG (Eccles et al., 2019). Several projects were started after the report's release by the UNEP and Nathanson (2008) in an effort to promote the incorporation of ESG issues in business decision-making.

The mining industry generally uses the sub-categories listed in Table 2 below to measure their impact on environment, society and governance. Under the environmental category, they monitor emissions and resource use, under the social category they monitor the workplace, human rights patient-focus and community contribution then under governance they monitor structures such as ownership, governance, and reporting of the overall ESG impact. See Table 2 below for full description of each sub-category.

Category	**Sub-category**	**Description**
Environmental	Emissions reduction	Reducing environmental emissions directly in operations and indirectly through purchased energy and through a company's supply chain
	Resource use	Environmental impact management through efficient use of energy and water and responsible waste disposal, including impact on biodiversity and animal welfare.
Social	Workplace	A setting that is safe and healthy and offers chances for growth, variety, and great jobs.
	Human rights	Adherence to international labour standards and promotion of human rights through supply chain.
	Patient-focus	Products and services of the highest calibre, combining the integrity, privacy, and safety of the consumer.

	Community contribution	Community involvement and public trust with accessible products, and a commitment to protecting the public health.
Governance	Ownership Structure	Equal treatment of shareholders and well-structured capital to enable long-term decision making.
	Corporate Governance	Commitment to corporate governance procedures and running an ethical business.
	Reporting	Transparency and accuracy in the reporting of financial health and other business metrics.

TABLE 2. MINING INDUSTRY ESG CATEGORIES AND SUB-CATEGORY

1.2.2.1 ESG Regulation

South Africa has several compliance and regulatory measures in place that aim to promote (ESG) practices and sustainability. Here are some of the key regulations and frameworks:

- *King IV Report.* According to the King IV report, businesses must make decisions and work for the good of all stakeholders (van Zyl, 2020).
- *Companies Act of 2008.* It puts a requirement on all South Africa companies to disclose ESG risk which includes climate change and social issues (Singhania & Sania, 2023)
- *Carbon Tax Act.* The Act was introduced to the country in 2019 and looks to curb greenhouse gas (GHG) emissions by industry in the country. Under the act, companies are required to pay carbon tax if they exceed a certain threshold of emissions (Ntombela et al., 2019)
- *National Environmental Management Act.* Under this act, all companies working whose operations involve extracting resources from the environment and involve with the environment in a capacity need to apply for a permit with allows them to compliant with the act (SA Gov, 2015).
- *Integrated Resource Plan.* The South African government produced the Integrated Resource Plan, a document that details energy mix in the country and plans for the switch to renewable energy sources (Pegels, 2010).

- *Index for socially responsible investments from the JSE.* A socially responsible investing (SRI) index has been created by the Johannesburg Stock Exchange for performance tracking of businesses that have high ESG targets (Maubane, 2014).
- *Global Reporting Initiative.* African businesses utilize the GRI, an international framework for sustainability to report on ESG matters (Maubane, 2014).

1.2.3 National policy on mining and legislative framework

Decisive steps were taken after the (WSSD) to change policies in favour of sustainable development. These steps saw South Africa being aligned with other counties that produce minerals in the world by releasing all unused mining rights to the state (Limpitlaw, 2004).

The minerals and mining policy review started in 1995, participants included officials from the government, business, small-scale mining industry, trade unions, communities, and environmental organisations. The Minerals and Petroleum Resources Development Act (MPRDA) is the result of this legislative revision. The MPRDA, which was adopted in 2002, lays a strong foundation for the country to respond to the Johannesburg Plan of Implementation (JPOI) mining targets.

Regarding laws, including broad legislation, the mining industry's environmental sustainability has been emphasized. It also reaffirms the State's dedication to environmental preservation in order to ensure environmentally sound resource development and to advance social and economic advancement.

Environmental regulation under the MPRDA has substantially helped to ensure environmental best practices in the mining sector and that the sector is moving toward environmental sustainability. According to the MPRDA, mining enterprises must adhere to the following rules:

- Put into practice the principles of sustainable development outlined in the National Environmental Management Act (NEMA) and other generally accepted principles of sustainable development by taking environmental and

socio-economic factors into consideration during the planning, execution, and closure of mines, as well as activities after closure.

- Perform all activities related to environmental impact assessment, the bring forward or hand in a sound environmental management program.
- Consult interested and impacted parties as well as state and federal agencies, as well as local, provincial, and federal governments.
- Set aside enough money for rehabilitation, repairing environmental harm, and managing unfavourable environmental effects. The means for financial supply and a thorough description of all costs are specified in the MPRDA regulations.

Planning to close mine closure will assure environmental and socio-economic viability once the mine has closed. Decommissioning planning must also be taken into consideration as a continuing effort (Limpitlaw, 2004). In addition, an environmental risk assessment must be completed. New and existing mining operations must take into account comprehensive South African legislation that addresses socio-economic sustainability of mining operations which will also include conserving agricultural resources, protection as well as the giving back of land rights to those who didn't previously have (Limpitlaw, 2004).

The mining industry like other industries and sectors, measures and assesses its sustainability performance (impact to the environment and society) and illustrates continuous improvements using non-financial indicators of ESG. SA Mining companies are already incorporating sustainability goals, concepts and principles into their business models. In their quest to innovate, how does ESG performance support or thwart their sustainable business model innovation.

1.3 RESEARCH PROBLEM

Mining has a reputation for having significant negative effects on the environment and society due to its extractive character and the fact that the majority of its natural resources and reserves are found in developing nations like South Africa (Krause & Drusche, 2021). These negative effects include the exploitation and depletion of resources that cannot be generated, extinction of biodiversity, the clearance of forests,

and health and safety risks of not only workers but the local community members as well (Azapagic, 2004). Ritala et al. (2018) discovered that there was a lack of innovation in sustainable business models or their adoption among S&P (Standard and Poor's) 500 companies they studied. They found that a large numbers of firms in this index adopted environmental-oriented categories of sustainable business models (SMB) ore than they did ones that are oriented towards society.

Challenges of the firm’s external environment (both ecological and social) present opportunities for competitive advantage that can been exploited via sustainable business model innovation (Spieth & Schneider, 2013). These advantages can be created by forming strategies that are ahead of legislation and regulation.

In some sectors, such as banking, the relationship between ESG and sustainable business models have been studied, however the findings are biased toward Europe and generalized to other locations, such as Africa. A by Spoz et al. (2021), asserts that the study assessed the outcomes of a global setting (Asia, America, Africa, and Europe), however they only make reference of Europe and Asia with a focus on Europe. The objective of this whole study was to pinpoint the most notable trends in what motivates businesses to change from conventional to sustainable business models and to connect those trends to ESG categories. The study found that there is a reasonably substantial association for a beneficial influence between social aspects and sustainable business models (SBMs) across Europe (Spoz et al., 2021) among the three ESG categories.

A study by Bak et al. (2022) further supports these conclusions. In this study, in addition to examining how ESG elements affected a company's sustainability business model, researchers also looked at if there were any regional variations in how ESG factors affected business models in various continents.

The study found that more publications on ESG factors are produced in European countries than in Asia. The study demonstrated that influence of ESG on a company’s business model was stronger in firms located in Europe than in firms located in Asia. But this is not an empirical finding, the results were from the studies analysed. Africa did not seem to appear in the studies analysed except for when the study results were

generalised. Because different countries have different levels of ESG risk, sustainable business models will differ among them; extreme climate and extreme social conditions will present different risks and therefore different sustainable business models (Bak et al., 2022). As such, a study in the African context is needed.

Krause and Drusche (2021) looked at a variety of types of sustainable business model in a study on the opportunities for value-based management and business model innovation in the mining industry in Germany. They state that sustainable business models give a reflection of whether or not companies are creating value while keeping their total impact to the environment and society constant. Endl et al. (2021), although concurring with Krause and Drusche (2021) regarding the impacts of mining, wrote to show the contribution that mining innovations in Europe may make to achieving sustainable development goals (SDGs). Liu and Chen (2022) conducted research in China on the effects and metrics of increasing ecological efficiency through the circular economy in coal mining.

Then Hamann (2004) wrote a journal article on mining companies in South Africa looking at institutional change brought about corporate social responsibility (CSR) and partnerships. He stated that CSR initiatives by mining companies have in the past predominately been shaped by charitable donations but have not necessarily directed much effort to changing the country's social ills around mining communities. He further stated that this is due to the fact that these efforts are not being rooted in the business' core practices and have not had any contribution to cross-sectional collaborations.

Available literature does not sufficiently make a link between ESG performance and sustainable business model innovation in mining industries of emerging economies, South Africa, in this context. This research examines how ESG performance supports or thwarts sustainable business model innovation in the mining industry in South Africa. The study also aims to generate empirically based insights that could help management practitioners to better innovate in sustainable business models (SBM) in the mining sector and offer policy makers recommendations in relation to policy making. Lastly, the study looks to contribute to the theory of business model innovation and sustainable business model innovation.

1.4 THE STUDY'S SIGNIFICANCE

Generate empirically based insights that could help management practitioners innovate with purpose in the area of sustainable business models and help make positive impact to the society and environment and while helping their companies to grow sustainably.

On the academic front, the study looks to adding to the existing literature on the impact of ESG on developing sustainable business models in regions of the global south. While studies have been undertaken in places of the global north, such as Europe, the global south has lagged behind.

1.5 DELIMITATIONS OF THE STUDY

- This study was restricted to the opinions and experiences of the interview subjects and data gathered for yearly ESG and sustainability reports
- It was solely undertaken in the South African setting and its mining industry
- Interviews were performed in 2023; the industry outlook may change in future.
- Not all mining-related phenomena were studied, the study was restricted to ESG factor's performance and sustainable business model innovation.

1.6 ASSUMPTIONS

- All participants are experts in their fields through acquired experience and/or training.
- The assumption is that all participants are fully open and give honest answers according to their experience of the industry.
- The responses received from participants and information from company documentation of various companies in the industry will be considered as accurate sources of information.
- Inaccurate or untruthful responses from participants will have an impact on the findings of the study.

- The availability of participants and willingness to participate within the timeline of the project will have a direct impact on the ability of the researcher to submit the research on time.

1.8 RESEARCH QUESTIONS

ESG is currently the non-financial measure used to report the mining companies' impact to the environment and society (De Silva & Ediriweera, 2015).

i. Which of the ESG factors (Environmental or Social or Governance) is influential to innovation?
ii. SA Mining companies are already incorporating sustainability goals, concepts and principles into their business models. In their quest to innovate, how does ESG performance support or thwart their sustainable business model innovation?
iii. How might adaptive management be used in innovating sustainable business models?

1.9 REPORT OUTLINE

A quick summary of each of the six (6) chapters is provided below.

First Chapter: Introduction

The aim statement, the study's background, the research problem, the study's relevance, the delimitations, the assumptions, and the research questions are the seven sections that make up this chapter, which acts as an introduction.

Second Chapter: Literature Review

An examination of the literature is the focus. The theory of adaptive management, the theory of business models, and the notion of sustainable business model innovation will all be covered by the researcher. The African theory of Ubuntu will also be covered. These four theories make up the theoretical framework. The author goes on to

elaborate on two of these theories: the theory of adaptive management and the idea of innovation. The two theories are combined to create the conceptual framework: Adaptive Management and Sustainable Business Model Innovation

Third Chapter: Research Methodology

In Chapter 3, the study methodology is presented, along with a discussion of how the technique selected aids in data collection for the researcher's understanding of ESG performance and sustainable business model innovation.

Fourth Chapter: Presentation of Results

Data from semi-structured interviews with mining industry participants, mining industry consultants, expert commentators, and business document analysis are presented.

Fifth Chapter: Analysis of Results

This chapter reviews the findings of an analysis of the data that was acquired and compares them to current literature to get understanding from the comparison.

Sixth Chapter: Conclusions and Recommendations

Each of the three research premises and questions is addressed in this chapter along with a review of the key results. It also offers guidance and suggestions for further research.

CHAPTER 2. LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is a review of the literature on theories of sustainable business model innovation, business model innovation, adaptive management, and Ubuntu which are the four chosen relevant theories for this research. A literature review is a critical examination and writing on existing research and academic work relevant to a research topic being investigated (Mohammed & Ahmed, 2018). The review will typically involve a comprehensive analysis scholarly articles, books, and other academic sources with an aim to identify themes and gaps in the knowledge base of the research in question. Not only does it help the researcher identify themes and gaps in the knowledge base of the research in question but also allow the researcher to demonstrate of the body of knowledge and the field being reviewed.

The objective of this section is to review literature on the theories of sustainable business model innovation, business model innovation, adaptive management, and Ubuntu as part of the theoretical framework with the aim to create and conceptual research for the research. The conceptual framework is made up of elements of sustainable business model innovation and adaptive management, both of which will be covered in this part. These make up the theoretical framework.

2.2 THEORETICAL FRAMEWORKS

2.2.1 Sustainable Business Model Innovation

By altering the elements influencing growth and competitiveness, the socioeconomic crisis and global warming are redefining the economic environment (Shakeel et al., 2020). Innovation is increasingly necessary for growth as cost-cutting and "business transformation" initiatives that just improve efficiency are no longer sufficient (Schwab, 2018). To address the needs of social, environmental, and economic concerns, business models and operating methods must work together with sustainable innovation (Boons & Ludeke-Freund, 2013). Businesses must change the way they

approach business model innovation (BMI), according to Clinton and Whisnant (2019), because even the business model demands sustainable innovation, giving rise to the field of sustainable business model innovation (SBMI). Since its initial introduction roughly 12 years ago, the term SBMI has been evolving (Stubbs & Cocklin, 2008). According to a theory put forth by Ludeke-Freund and Dembek (2017), SBMI should be considered a separate area or sub-field from other, more established fields like business models and business model innovation.

According to Teece (2010), the business model is the firm's value proposition, which includes how it develops, delivers, and captures value. The demand for businesses to change their value proposition, development, delivery, and capture is a step toward business model innovation (Geissdoerfer et al., 2018). Due to the demands of social, environmental, and economic challenges, business model innovation must occur in the framework of sustainability or sustainable innovation. Aghion et al. (2009) states that sustainability cannot be fully embraced outside innovation. SBMI is a process underpinned by a new development of business models where firms transform their existing business models with an aim to achieve sustainable development (Roome & Louche, 2015).

According to Shakeel et al. (2020), the theory of SMBI is founded on the logic of business model value creation while also embracing sustainable value and value innovation. They define SBMI as a concept that combines sustainable business models (SBM) with business model innovation (BMI). They go on to say that this justification is based on BMI and SBM components, including environmental changes, economic value, developing new business models, incorporating stakeholders, and caring about the environment. For instance, a company's BM may need to be changed to connect environmental, economic, social value with a strategic purpose. However, not all of the elements that make up an ideal BMI and/or SBM must be included in order to produce SBMI. As depicted in Figure 1 below, The SBMI framework, which consists of three sections—sustainable value proposition innovation, sustainable value creation and delivery innovation, and sustainable value capture innovation—was introduced by Shakeel et al. in 2020.

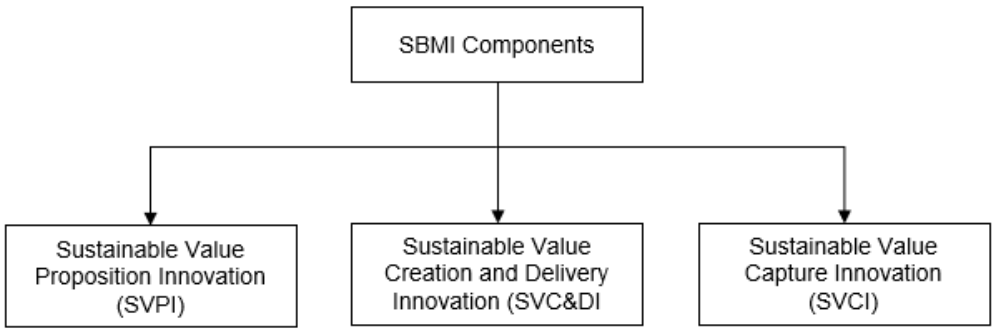


FIGURE 1. FRAMEWORK FOR SUSTAINABLE BUSINESS MODEL INNOVATION (SHAKEEL ET AL., 2020**)**

2.2.1.1 Sustainable Value Propositions Innovation (SVPI)

The core of Sustainable Value Proposition Innovation (SVPI), according to Shakeel et al. (2020), is a company's ambition to open up new opportunities and establish enduring relationships with both society and its customers. Businesses today give great importance to sustainability, aiming to satisfy current needs while also safeguarding potential in the future (Seelos & Mair, 2005). A sustainable value proposition (SVP) integrates economic, social, and environmental elements in order to produce value for customers, society, and the environment. Creating value for stakeholders is the ultimate goal of adopting creative sustainable value proposition thinking when building new business models, products, or services (Baldassarre et al., 2017).

Businesses' capacity to create long-term value propositions is a critical determinant of their performance in the current market. Schaltegger and Wagner (2011) assert that shifting attention from immediate financial gains to long-term environmental and societal benefits is necessary for the expansion of the sustainable value proposition. Companies must redesign their business strategies, products, and services in accordance with sustainable principles in order to bring about this shift.

The creation of economic value with a simultaneous address of societal and environmental needs is the shared value approach to sustainable value proposition innovation (Porter & Kramer, 2018). Not only does this approach improve productivity and enhance reputation, but new markets can also be created through its adoption according to Porter and Kramer (2011).

Firms operating in the present business landscape must champion sustainably value proposition innovation if they hope to succeed (Brown et al., 2018). This refers to designing fresh goods, services, or business models that integrate sustainability principles, in turn producing value for stakeholders.

2.2.1.2 Sustainable Value Creation & Delivery Innovation (SVC&DI)

The ability to successfully organize a firm's value chain networks via efficient resource management, activities, capabilities and partnerships, customers, collaborators, as well as competitors is referred to as Sustainable Value Creation & Delivery Innovation (Shakeel et al., 2020). Modern businesses are required not merely to create shareholder value yet do so in a way that is sustainable (Porter & van der Linde, 1995). To achieve this objective, companies must prioritise adopting innovative tools for sustainable value creation and delivery. This entails developing products or services that simultaneously cater to customer needs while tackling societal issues along with environmental concerns (Elkington,1997). Creating sustainable value is feasible through deploying eco-friendly raw materials for production processes, minimising carbon footprint (CO2) emissions along with supporting social causes like education programs or poverty eradication as well (Qureshi et al., 2022).

Sustainable value delivery innovation focuses on how companies can deliver their products and services sustainably (Hart & Milstein, 1999). Sustainable value creation and delivery innovation in essence places an importance on companies like mining companies to move beyond business models that focus on business as usual and to ones that consider long-term effects or impact to the environment and society. In general, corporations need to look outside of traditional business models and take into account the long-term effects of their actions on the environment and society (Schaltegger & Wagner, 2011). Embracing sustainability as a core business principle helps companies to create values not only for stakeholders but for the entirety of society as well.

2.2.1.3 Sustainable Value Capture Innovation (SVCI)

Sustainable Value Capture Innovation (SVCI), according to Shakeel et al. (2020), is when a business innovates in the areas of its revenue models and cost structures to capture societal and environmental value. It can take many forms. For example, in the mining industry companies can develop new services such as being a supplier of renewable energy to a municipality or another company or move to selling. Additionally, they can implement new pricing strategies that give incentives for customers who go an extra mile of employing sustainable behaviour such as recycling or mined materials such as copper (White, 2019). This leads to another approach to sustainable value capture innovation which is the adoption of circular business models. These models aim to minimize waste by designing products for durability, repairability, and reuse. There's been a trend of companies collecting and reselling of used products or harvesting precious minerals from use electronics as a secondary source of minerals, thereby creating new revenue streams while reducing their environmental impact (Stahel, 2016).

Overall, sustainable value capture innovation can provide numerus benefits to companies such growth in brand reputation, increased customer loyalty, employee retention, and increased profitability (Schaltegger & Wagner, 2011).

2.2.2 Business model innovation

George and Bock (2011) assert that the corporate sector is where the idea of a business model first appeared. There hasn't been a widely agreed definition of business models, despite the idea receiving more attention from academia and practice (Zott et al., 2011). The main way to commercialise innovation is through business models (Chesbrough, 2010). He argues that any development or innovative idea is of no value to the company until commercialised through a business model. Though acknowledged as crucial enablers or drivers of innovation business models are now more than ever subject to innovation giving rise to business model innovation.

In industries such as mining, the increased demand for resources due to an increase in population, expectations from society and many other disruptive forces is raising questions on the validity of their business models (Dunbar et al., 2020). To earn economic value for collecting value produced for the environment and society, mining

business models must change. Dunbar et al. (2020) contend that there hasn't been much innovation in mining's business models. The use of techniques to placate and manage the expectations of the host government and society to acquire a "social licence" has been occurring on a large scale (Joyce & Thompson, 2000). These tactics, which include corporate social responsibility (CSR) efforts, training for locals, employment, capacity building, local procurement, and more, are an effort to align themselves with the criteria of sustainable development.

Nothing in the current economic paradigm, according to Dunbar et al. (2020), ensures that the community will continue to profit long after the mining activity has finished. Although it is not required by law, mining corporations must provide benefits to the community in order to carry out the given resource's extraction activities. Little to no accountability takes place to ensure the delivery of benefits to the community or that they are in alignment with sustainable community development. As a result of expectations from communities and governments to provide benefits to the community and avoid negative environmental and societal impacts, community development agreements (CDAs) or impact benefit agreements (IBAs) are increasing globally. O'Faircheallaigh (2013) contends that these factors—along with others—prevent community sustainability over the long run and deprive the community of the income that these capital assets may otherwise provide.

To recognise the necessity for business and industry (such as mining) to create value for external stakeholders like the environment and society in addition to shareholder value, sustainability experts like Schaltegger et al. (2016) suggested broadening the definition and perspective of the business model. A business model that describes sustainability as the organization's guiding principle is described as the result of the decision to produce environmental, social and economic value today (Dunbar et al., 2020). According to them (Dunbar et al., 2020), rather than creating new markets or cutting-edge technologies, mining enterprises need to reform their value proposition and simultaneously deliver outcomes/value to all of these stakeholders.

2.2.3 Adaptive management

According to Lee K. N. in his 1999 book Appraising Adaptive Management, adaptive management is founded on the realization and acknowledgment that humans lack the knowledge necessary to govern ecosystems. Resources from the natural environment are exploited by industries like mining, however according to Lee (1999), managing and exploitation differ in that the former is more like to capture or harvesting and the latter is more akin to cultivation. In the context of a firm, adaptive management would involve being collaborative in governance coupled with the sustainability focused pursuit of business development and innovation through equal pursuit of social development and environmental conservation. The collaborative governance, social development and environmental conservation of the adaptive management theory operationalise ESG in the context of this research. Figure 2 below depicts the equal pursuit of all the components of adaptive management.

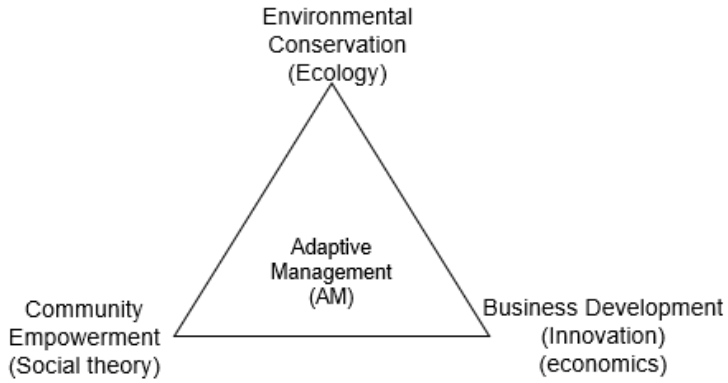


FIGURE 2. ADAPTIVE MANAGEMENT FRAMEWORK (LEE, 1999).

A crucial element of adaptive management is learning by doing; through this process, managers can gain knowledge of the ecosystem or value chain in which they operate and use that knowledge to create better strategies, policies, and methods for pursuing growth. Lee (1999) emphasizes that the goal is of adaptive management is learning, but it does not delay action until enough is known, it acknowledges the essence of time and resources and that they are in too short a supply to delay action, specifically action to address urgent social and environmental issues.

Sustainable development is made possible by adaptive management, particularly in light of these social and environmental problems. In their search for a definition of sustainable development, Kates and Parris (2003) considered what needed to be

supported and what needed to be developed. As shown in Table 3 below, they claim that nature, community, and life support systems must be sustained before people, the economy, and society must be developed.

What is to be sustained:	What is to be developed:
Nature	**People**
	Education
Biodiversity	Equity
Ecosystems	Equal opportunity
Life support	**Economy**
	Wealth
Resources	Productive sectors
Environment	Consumption
Community	**Society**
Culture	Institutions
Groups	Social capital
Places	States
	Regions

TABLE 3. WHAT TO SUSTAIN AND DEVELOP UNDER SUSTAINABLE DEVELOPMENT. ADAPTED FROM (KATES & PARRIS, 2003).

2.2.3.1 Environmental Conservation

Sustainability must be achieved without endangering the capacity of future generations to satisfy their own needs in order to meet current demands, whether they be social, economic, or environmental (Verma, 2019). As a result, protecting the environment is crucial to ensuring sustainability. Environmental conservation, according to Cairns and Lackey (1992), entails safeguarding the environment while preserving and managing its natural resources, such as biodiversity, land, and air. Lack of environmental conservation causes the loss of natural resources, which has a detrimental effect on both the biodiversity and ecology as a whole as well as human health and wellbeing (Singh & Singh, 2016).

Environmental conservation is crucial in solving the climate change dilemma because it is one of the largest crises and threats facing both the environment and the entire biodiversity (Jhariya et al., 2022). Through the execution of initiatives like reforestation, the use of clean renewable energy, and the installation of energy efficiency measures, it combats climate change by lowering GHG emissions.

2.2.3.2 Community Empowerment

Community empowerment is crucial for sustainability because of its focus on building people's skills and knowledge needed to sustain themselves and the environment they live in (Ansari, 2012). This in essence is a process of is giving people the ability to contribute towards their own livelihoods, the livelihood of others, and the environment (Fraser et al, 2006). NGOs (Non-Governmental Organisations) can empower communities in a variety of ways, including through educational and training initiatives (Grimley et al., 2022). These are the initiatives needed for the knowledge and skills needed to make meaning contributions towards sustainability.

People who feel empowered have a sense of ownership over their surroundings (Harley et al., 2000). In conclusion, community empowerment is a crucial component of sustainable development, much like environmental protection. It gives people the knowledge and skills needed to make choices that will positively impact their environment's sustainability over the long term. Education and training are crucial for empowering people.

2.2.3.3 Economic development

In accordance with Verma (2019), achieving sustainable economic growth entails growing the economy to meet current demands without endangering the ability of future generations to do the same. In essence, it must be accomplished by safeguarding the ecosystem components that sustain economic growth, including all natural resources. It can be accomplished using strategies like the green circular economy, which takes spent materials back into production to eliminate waste from the value chain (Lekan et al., 2021). It can also be accomplished via social companies.

According to Stjepanovic et al. (2017), the Gross Domestic Product (GDP) approach of calculating economic development is ineffective for determining sustainable economic growth since it ignores the costs and impacts of economic activity on society and the environment. Examples of economic growth metrics that take into account social and environmental factors are the Genuine Progress Indicator (GPI) and the Human Development Index (HDI) (Kubiszewski et al., 2013).

2.2.4 Ubuntu

The African philosophy of Ubuntu is a relevant theory in the context of this research because innovation cannot be done in the pursuit of profits while neglecting the needs of living humans, the generation to come and respect for those who have passed on. The philosophy is grounded on sayings such as “feta kgomo o tshware motho” which is a Sotho saying, which translates to “reach for the needs to humans before profits”; the philosophy puts emphasis on the relatedness and interdependence between all that lives and the immediate natural environment upon which it depends.

It is possible to exhibit compassion, empathy, dignity, humanity, reciprocity, and mutuality when one practices the Ubuntu philosophy, whether from a corporate or individual standpoint (Poovan et al., 2018).

2.3 CONCEPTUAL FRAMEWORK

The sustainable business model innovation and adaptive management theories are two of the four described in the literature review under "Theoretical Frameworks" and are combined in the conceptual framework used in this study (see Figure 3 below).

Adaptive management is learning through experience. Innovation, specifically innovation in a sustainable business model, advocates for continual collaboration with the community (mining communities) and management of environmental resources as opposed to exploitation. Instead of chasing ESG performance only, in the conceptual framework, the mining companies will have collaborative governance, conservation of the environment and development of society all through learning, exploration,

experimentation and collaboration (without neglecting or deferring action) in the centre sustainable business model innovation efforts. The success of the corporation in ecological and social aspects of adaptive management will subsequently be utilized to gauge ESG performance; in essence, the theory of adaptive management is used to mobilise ESG.

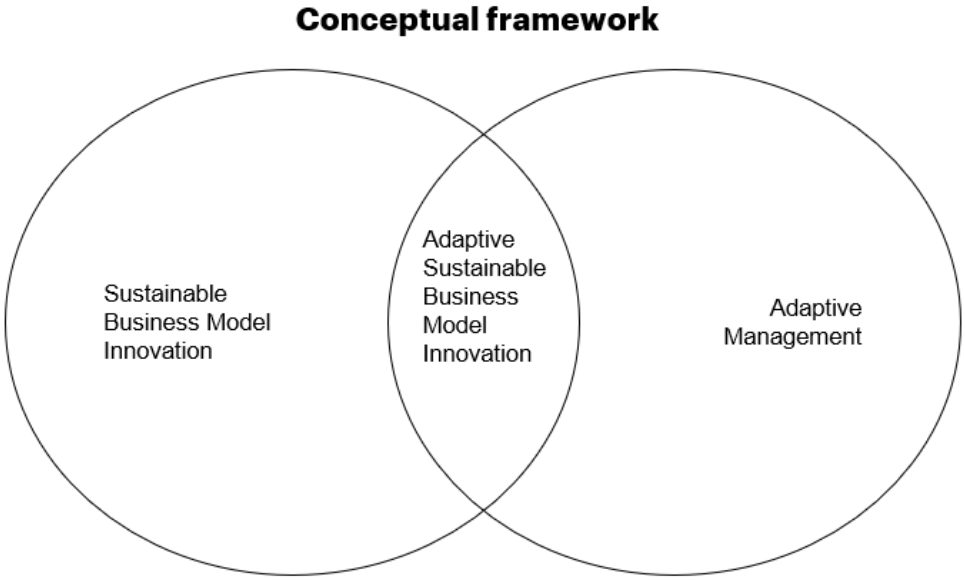


FIGURE 3. CONCEPTUAL FRAMEWORK

The two theories selected forming the conceptual framework (sustainable business model innovation and adaptation management) are most relevant to this research because they draw from diverse disciplines within the mining industry such as environmental management and conservation, business management, economics and ESG (Blinova et al., 2022). They are also chosen because of their relevance to the significance of this study, which is to generate empirically based insights that could help management practitioners innovate with purpose in the area of sustainable business models and help make positive impact to the society and environment and while helping their companies to grow sustainably.

Management practitioners are faced with two pressing challenges First is to continuously innovate and change how they create value for customers and the company, and second is the need to achieve growth without harming the environment in the face of the global warming crisis (Hart & Milstein, 2003).

On the academic front, the study looks to adding to the existing literature on the impact of ESG on developing sustainable business models in regions of the global south.

2.4 PROPOSITIONS

i. As evidenced by the research topic, some authors found a high relationship between environmental factors and SBMI, whereas others observed social factors to have a stronger impact. The researcher hypothesizes that social factors may have a greater impact on SBMI in the South African mining industry because corporate social responsibility (CSR) programs are so prevalent in the sector (Hamann 2004).
ii. ESG in most mining companies is reduced to CSR initiatives shaped by charitable donations with not much effort directed toward changing business' core practices and have limited meaningful collaboration with external stakeholders (Hamann, 2004)
iii. Adaptive management can be used to explore and experiment with new ways of managing resources, conserving the environment, and developing society while achieving economic growth.

2.5 SUMMARY

Performing literature review helps the researcher identify themes and gaps in the knowledge base of the research in question but also allow the researcher to demonstrate of the body of knowledge and the field being reviewed. In this section, a review of the literature on theories of sustainable business model innovation, business model innovation, adaptive management, and Ubuntu was performed. Out of these theories sustainable business model innovation and adaptive management were found to be more relevant to the research being undertaken and used to for a conceptual framework.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 INTRODUCTION

This research adopts a pragmatist paradigm for this study. Because the researcher does not seek mere understanding of the phenomenon being investigated, but to generate knowledge that can be put into practice by sustainability business model innovation practitioners and policy makers, the pragmatist paradigm proves to be the relevant one to adopt (Dewey, 2007).

This chapter covers the research strategy and design, the pool from which participants will be chosen, the tools utilised for data collecting, the analysis of the data, the study's limitations, reliability, and validity.

3.2 RESEARCH STRATEGY AND DESIGN

The qualitative research performed in this study uses the South African mining industry as its analytical unit. Although for the purposes of triangulation, data was also acquired from corporate materials such as sustainability reports and expect commentator interviews, semi-structured interviews were used as the main mode of data collection. The qualitative approach helps with gaining a view on motivations such as business or individual motivation to pursue a particular growth direction as well relationship and direction of relationship between studied factors (Cooper & Schindler, 2011).

The availability of participants had a significant impact on the study's scope and the number of participants interviewed for South African mining companies; 20 participants from the mining industry as well as researchers and retired specialists were interviewed.

3.3 SELECTION OF PARTICIPANTS

The researcher has connections in the consulting sector with experts who have worked and provided consultation to the majority of the South African mining

businesses in operation, and so these individuals, through purposive sampling, formed the first sample and a snowball sampling method was used from there on where interviewees gave referrals for people to interview in the mining industry. Twenty (20) interviews were conducted, largely dependent on the interviewee's availability, time, and willingness to participate.

3.3.1 Avoiding bias

Avoiding bias is essential in maintaining the integrity and validity of the research. To avoid bias with the first set of participants whom the research has connections with from the industry before employing the snowball sampling method, the researcher constantly reflected on their role as a researcher and how their background might influence data collection, interpretation, and analysis thereof, as suggested by Tracy (2010).

3.4 RESEARCH METHODOLOGY

3.4.1 Data collection and instrument

Data was collected using two approaches; the first is semi-structured interviews, which were done virtually through Microsoft Teams and face-to-face in prescheduled meetings. The second method was through company documentation such as quarterly and annual reports, available to the public.

According to de Lacey et al. (2016), in-depth interviews seek to understand the condition and experience from a personal standpoint and analyse text and documentation such as reports, media articles, company websites, and event strategy information, as done in this study. As a result, the combination of semi-structured interviews and data collection from sources like company documentation can be classified as an in-depth interview.

3.4.1.1 Semi-structured interviews

The interview was steered by interview questions. It took about 45 minutes to complete each interview. With the consent of the interviewees, the interviewer utilized MS

Teams to record and transcription the interviews. The interviewer also took notes throughout the interview and used a mobile phone as a second recording device. For the used interview questions, see Appendix C.

3.4.1.2 Company documentation for secondary data

Data from Statistics South Africa, other sources, and other sources that have already been collected and documented may be used in secondary data analysis, empirical data from other researchers and publicly available data such as company reports, policy and strategy documents (Levine et al., 2008).

3.5 DATA ANALYSIS

Interviews were taped, the transcripts were examined for repeating themes that could provide insight into the study topics and either support or refute the hypotheses put forth. According to Lacey et al. (2016), the researcher used a content analysis methodology to examine the frequency of ideas, patterns in interpretations, and phrases. On the other hand, categories of information received from interviews were created using selective coding and/or theme analysis.

3.6 LIMITATIONS OF THE STUDY

- This study was restricted to the opinions and experiences of the interview subjects and data gathered for yearly ESG and sustainability reports
- It was solely undertaken in the South African setting and its mining industry
- Research interviews were performed in 2023; the industry outlook may change in future.
- Not all mining-related phenomena were studied, the study was restricted to ESG factor’s performance and sustainable business model innovation.

3.7 ETHICAL CONSIDERATIONS

By signing consent forms, participants gave their permission to conduct the interviews. Before starting the participant interviews, the researcher obtained approval from the

Wits ethics committee and upheld the ethical norms outlined in the Wits Business School code of ethics. The researcher has not mentioned which companies the interviewees are from, nor were the company names mentioned when presenting and analysing data from collected from interviews. Company names are only used where publicly available information gathered from company documents (and not interviews) is used.

No incentives were given to the interview participants to participate, no form of deception was be used to get them to agree to being interviewed. Interview participants were requested well in time before the interviews took place and were briefed on the details of the study and the interview process.

3.8 RELIABILITY AND VALIDITY

Reliability is the consistency in research results over time and the accuracy in which the total population under study has been represented (Golafshani, 2003).
For reliability purposes, the interview process was outsourced, and the people interviews did not have other parties answering for them.
For internal validity through data analysis, pattern matching was done, and detailed explanation or concepts and perceptions are given.
To ensure external validity, the research design will be case-based, with the South African mining industry serving as the case study. The whole mining industry in South Africa is included in the extrapolation of the study's conclusions.

3.9 SUMMARY

This chapter contains information about the research methods used for the study. For the case study on the mining industry in South Africa, information was acquired through interviews and secondary data collection. The methodology for the research that was chosen is qualitative, and the researcher will utilise content analysis to look for patterns in the information acquired. Last but not least, the researcher used a pragmatic paradigm for this investigation. Because the researcher does not seek mere understanding of the phenomenon being investigated, but to generate knowledge that can be put into practice by sustainability business model innovation

practitioners and policy makers, the pragmatist paradigm proves to be the relevant one to adopt (Dewey, 2007).

CHAPTER 4. PRESENTATION OF FINDINGS AND DATA

Data gathered through semi-structured interviews with participants in the mining industry, the consulting business, as well as expert commentators, will be provided in this chapter. Data gathered from corporate annual reports that are made publicly available are also presented. The results of each study question are presented, along with a visual depiction of the data gathered.

4.1 RESPONDENT'S BACKGROUND AND PROCESS TO GATHER DATA

In this section, the background profiles of respondents interviewed are presented along with the process followed to gather data.

A combination of face-to-face meetings and Microsoft Teams sessions were used to conduct semi-structured interviews. Seventeen (17) respondents are involved in the mining industry, they are executives in the industry, managers, specialists as well as consultants who work with sustainability and ESG. The last group of respondents comprised of three (3) expert commentators, made up of two retired professionals and one (1) industry researchers. Additionally, the researcher acquired information from the corporate records of the top five mining firms in South Africa, as measured by market capitalisation. A total number of 20 participants was interviewed. See Table 4 below.

All respondents were sent an information sheet with all information concerning the research, they were also sent a consent form where they gave consent to the interview and agreed to their identity being kept anonymous, to being quoted anonymously in this research report and to be audio recorded. The researcher did not need to get permission from the participants' employers; the participant's consent was sufficient. Instead of questions about the business they work for, participants were asked generic questions about the South African mining industry. Copies of the questions that were asked during the semi-structured interviews are included in Appendix C in the appendix section.

Respondent	Background
1	Group Executive for Sustainability
2	Account Lead for Resources (mining and energy) clients
3	Retired Expert
4	Head of Sustainability
5	Head of Sustainability
6	Business Improvement Manager
7	Sustainability Strategy Manager
8	Sustainability Strategy Senior Manager
9	Global Corporate Sustainability
10	Responsible Investment Analyst
11	Environmental Manager
12	Executive head for SHEQ and technical assurance
13	Environmental Manager
14	Sustainability Performance and Reporting Specialist
15	Industry Expert and Researcher on Water and Environment
16	Principal Advisor for Communities and Social Performance
17	Retired Expert, Researcher, Commentator, and Consultant
18	Director of a Mining Sustainability Company
19	Economist and Sustainability Director
20	Safety Health and Environmental Systems Specialist

TABLE 4. INTERVIEW RESPONDENTS' BACKGROUND PROFILES.

4.2. DATA PRESENTATION

The section offers findings and information from research that the researcher did using semi-structured interviews and information gathered from annually published sustainability/ESG reports. The data gathered is applied to these three interviews:

i. Which of the ESG factors, Environmental or Social or Governance, is influential to innovation?
ii. SA Mining companies are already incorporating sustainability goals, concepts and principles into their business models. In their quest to innovate, how do

these ESG factors support or thwart their sustainable business model innovation?

iii. How might adaptive management be used in the process of SBMI?

4.2.1 ESG factors influencing innovation.

The study's main focus is on the relationship between the creation of sustainable business models and ESG performance in South Africa's mining industry. The development of sustainable business models is one area in which the researcher is particularly interested, as well as how these factors either foster or stifle innovation.

In this section data that will be used to gain understanding of which ESG factor (s) is most influential in driving sustainable business model innovation is presented. In essence, information is supplied about the social, environmental, and governance elements as they were mentioned by interviewees. Each factor is divided into a number of components, and bar graphs are used to display the proportion of respondents who specifically addressed each component in their answers.

4.2.1.1 Environmental Factor

Figure 4 below depicts environmental elements which were frequently mentioned by interviewees. Energy efficiency was frequently spoken of followed by water management, waste management and greenhouse gas (GHG) emissions reduction after.

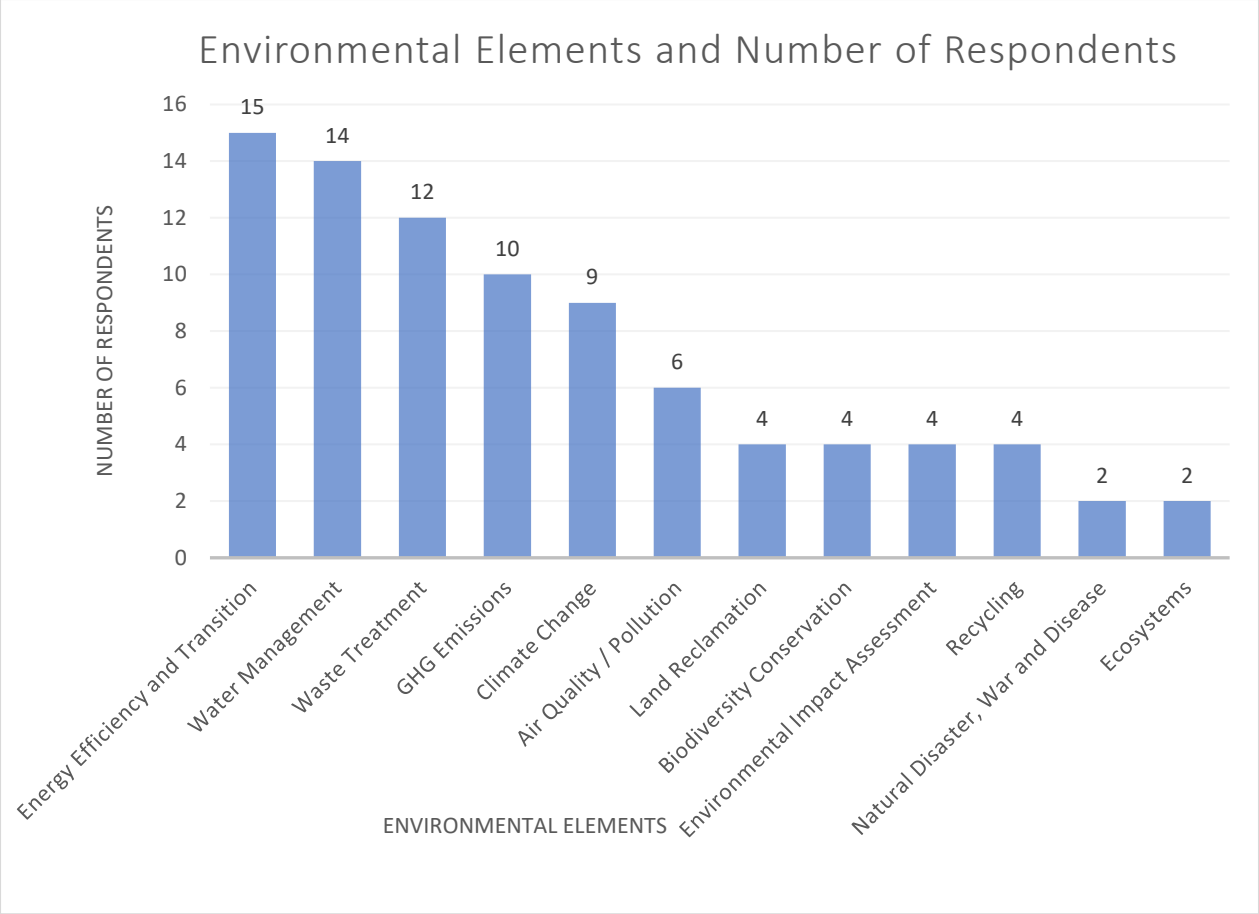


FIGURE 4. ENVIRONMENTAL ELEMENTS AND NUMBER OF RESPONDENTS

Most respondents cited energy efficiency and transition, water management, waste management, greenhouse gas emissions and climate change more frequently when talking about the environmental factor and its different elements.

Energy efficiency and transition

Energy efficiency was one of the most frequently brought up issues by interviewees. South Africa is currently experiencing an energy crisis. South Africa faces energy shortages due to our leading energy supplier (Eskom) facing challenges in stabilising their infrastructure and providing enough energy for both industrial and commercial use (Ting & Byrne, 2020). Respondents talked about the initiatives taken by mining companies to lower their energy consumption, such as the use of technology to monitor their energy use, the installation of motion sensor lights in buildings to turn on only when people are present, and the switch to renewable energy sources like solar to power offices and other parts of their operations that do not require large amounts of energy. amounts of energy. For example, respondent 12 said:

“Now you see companies start to put energy efficient where when you walk out of the office they switch off, it might look expensive when replacing all lights, but in the long run your electricity bill drops. Especially now with this 18% hike being asked for by Eskom for NERSA (National Energy Regulator of South Africa) to approve. You also see them investing in renewables like solar panels and move away from diesel generators as alternative energy source because of the high GHG emissions which is another problem.”

In reviewing company documents from publicly available data on what these companies are saying about their ESG or sustainability initiatives, the researcher found information on renewable energy initiatives by Seriti Resources, a South African coal mining company. Through their green energy subsidiary, Seriti Green, they have embarked on a journey to develop a 3 000 MW renewable energy (wind and solar) facility in the next decade (Seriti Resources, 2023). As part of this initiative, they have started with a construction of a 155 MW wind farm in the Mpumalanga province.

Water and waste management

In talking about managing water and its contamination, most respondents also referenced community impact around this, for example responded 9 said:

"We continue to work on water-related projects to better the lives of the nearby communities where we operate, such as providing water, erecting dams, providing infrastructure, and more. We back various water stewardship programs in South Africa and South America. These include infrastructure initiatives with local governments, water supply projects with our partners, and delivering drinking water to our communities.

These programs may be observed in many mining businesses across the sector, where the treatment of mine water not only eliminates environmental pollutants but also supports local economies and water security. Regarding this, respondent 5 said the following:

"One of the things we have is an irrigation project in one of our mines, where we are taking water from the pit, because when you have open pit mining, you have a lot of water accumulation. So, we take that water, we treat it, and we use that water for the irrigation of agricultural crops by the farmers."

Greenhouse gas emissions

Nine respondents made mention of efforts to reduce greenhouse gas emissions by South African mining companies. By tracking their scope 1 emissions (emissions that occur at the operation site), businesses are working to decarbonize their value chains. scope 2 (emissions resulting from electricity use) and scope 3 emissions (for example, emissions from suppliers to the company off-site) (Hertwich & Wood, 2018).
Respondent 12 said:

"If you're looking at air pollution CO2 emissions, there are companies that are now trying to work towards different energy sources, and I think sometimes when we talk about environmental impact on mining sites, we look at water, we look at contamination on land. But really, air pollution is also a big component. And there are companies that are now implementing cleaner energy sources for their equipment."

Respondent 1 said:

"our biggest strength is how are we going to decrease our energy intensity along with our greenhouse gas emission so these are some of many things we're always looking at and how can we reduce electricity usage so some of the things again that we're looking at is installing our solar panels so that we can use solar lights instead of electricity so that it can use solar you know kind of thinking for things like appliances so you know you have icons running on solar"

Some respondents mentioned asset maintenance as a measure taken by mining companies to improve how their machines operate in term of energy consumption and leaks that may result in increased emissions. Respondent 8 said the following:

"I've seen some guys saying, you know, if you just run machines better, maintain machines better you can reduce your emissions by up to 20%, which is big."

4.2.1.2 Social Factor

As part of the social factor, respondents were asked questions that related to the social expectations over mining companies and how these expectations impacted decision making and operations in mining companies. As part of their responses, they mentioned the elements below as playing a role in expectations for the mining industry. These are ordered by how frequent they were mentioned in descending order. Though these elements were mentioned by interviewees, they did not spend too much time talking about them, hence the small number of comments in this section. See Figure 5 below.

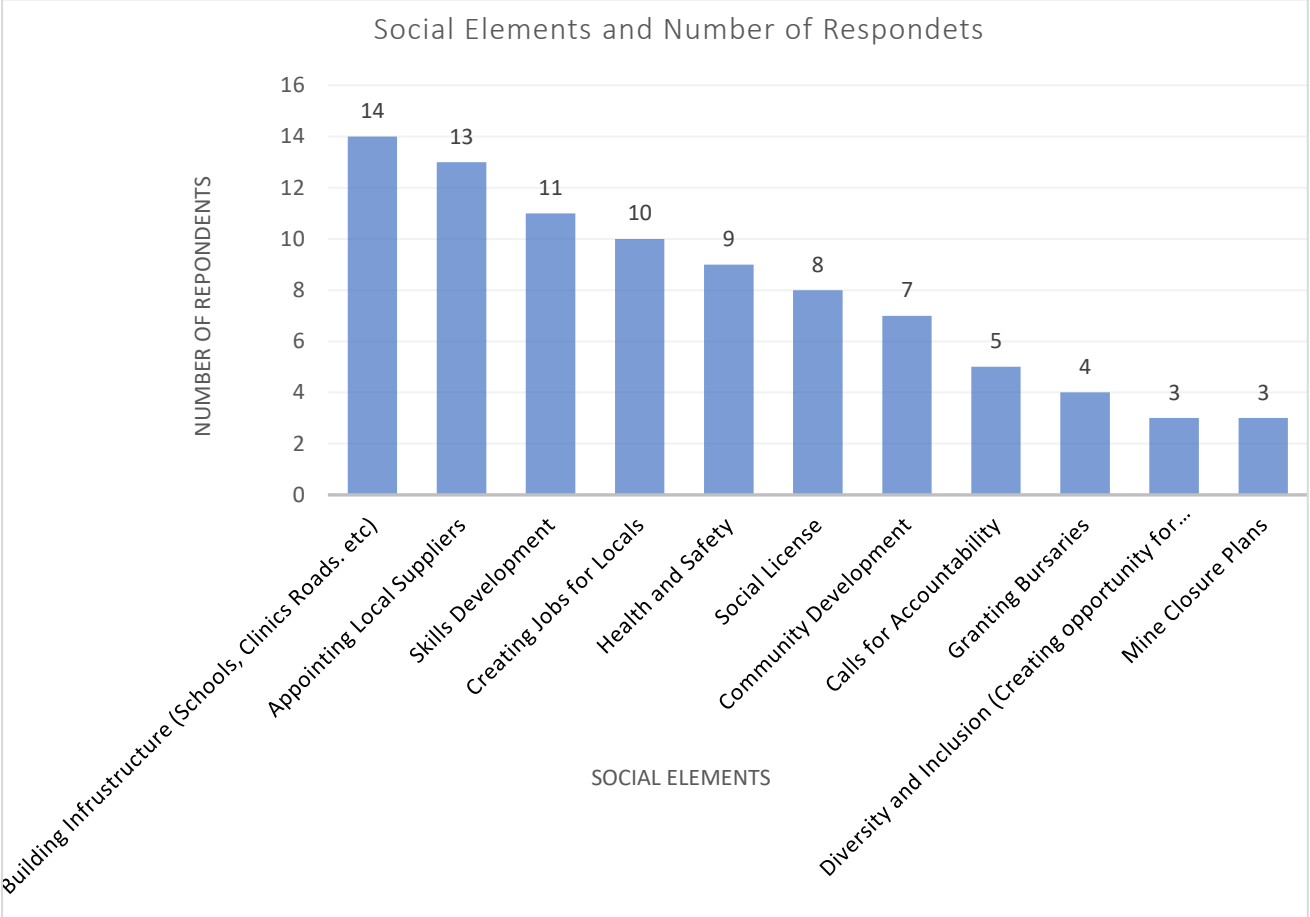


FIGURE 5. SOCIAL ELEMENTS AND NUMBER OF RESPONDENTS.

The interviewees reported that the mining industry is faced with expectation of building infrastructure such as schools and clinics, appointing local suppliers for supplies of equipment and creating jobs for communities in which they operated. They mention quite several initiatives being run by the mines from a social perspective, respondent 1 spoke about the development and appoint of local suppliers:

> *"We need suppliers for example in our various operations, we have programs to develop suppliers and we graduate them to become our suppliers and some of them they diversify their revenue away from us some become big suppliers. We don't encourage dependency on us, they use us to springboard. similarly with communities we partner with them when we do infrastructure projects, we do community well-being programs we do social development programs again with the view that we are going to develop communities that can be self-reliant"*

> *"We set aside money that we have to spend with local communities from the person who sells cookies in the morning to the guy who bring containers for facilities"*

On training and creating job they (respondent 1) said:

> *"We try and focus more on training skills not only for the mining sector because of unemployment, we train and equip young people who are unemployed for the retail sector, but some of them also get placed in some of their local retailers"*

On building infrastructure respondent 5 said the following:

> *"We continue to work on water-related projects to better the lives of the nearby communities where we operate, such as providing water, erecting dams, providing infrastructure, and more. We back a number of water stewardship projects. These include infrastructure initiatives with local governments, water supply projects with our partners, and delivering drinking water to our communities."*

Some in their responses expressed that they saw the expectation placed on mining companies as an unfair burden on the industry because this responsibility should lie with the government, both local and national. Respondent 15 said:

> *"Many companies be expected to bring development. Whilst that's government's responsibility and they do bring development, right, they bring schools and clinics, that's supposed to be done by the government using the money of the mine of pay as royalties. But now, there's a there's another challenge, on top of that, even if the mines build all these things, staffing them is still an issue, it's the government's responsibility, and they still not doing it. They're not staffing the schools with proper teachers, or clinics, with nurses and doctors."*

Other respondents, mainly the expert commentators, expressed dissatisfaction with level of accountability shown by the mining industry for environmental and social ills caused in some mining communities around the country. Respondent 15 (expert commentator) expressed that mining companies should see an opportunity to mine on the land as a privilege, they said:

> *"To turn the land is a privilege that landowners give you whether you're turning the land for agriculture or you're turning the land for mining development. It's a privilege they give you because land is so sacred. But because we come with this approach of it's all about the money. It's all about the light and the glitz and glam. The approach that the mining companies is doing people a favour is wrong."*

A considerable influence on a company's performance and reputation would result from mining businesses being more inclusive and equitable than just being accountable, according to some respondents.
Responded 12 said:

> *"it's more beneficial to have a diverse team around the table because you are able to think holistically some people bring lived experience you know*

especially with people that you have sitting in management and boards, when they talk about social impact they're not talking about things they read about, they mention exactly what they have experienced, that enhances their discussions and helps performance."

4.2.1.3 Governance Factor

Figure 6 below shows elements of the governance factor mentioned by respondents and their frequency in descending order. Governance refers to how a company is managed and governed (Huang, 2019). It includes a range of factors some of which were mentioned by the interviewees, for example, doing business in an ethical manner, policy and regulation, both company and government policy, collaborative governance, strategy and finance. Respondents spent a lot of time speaking about the governance elements.

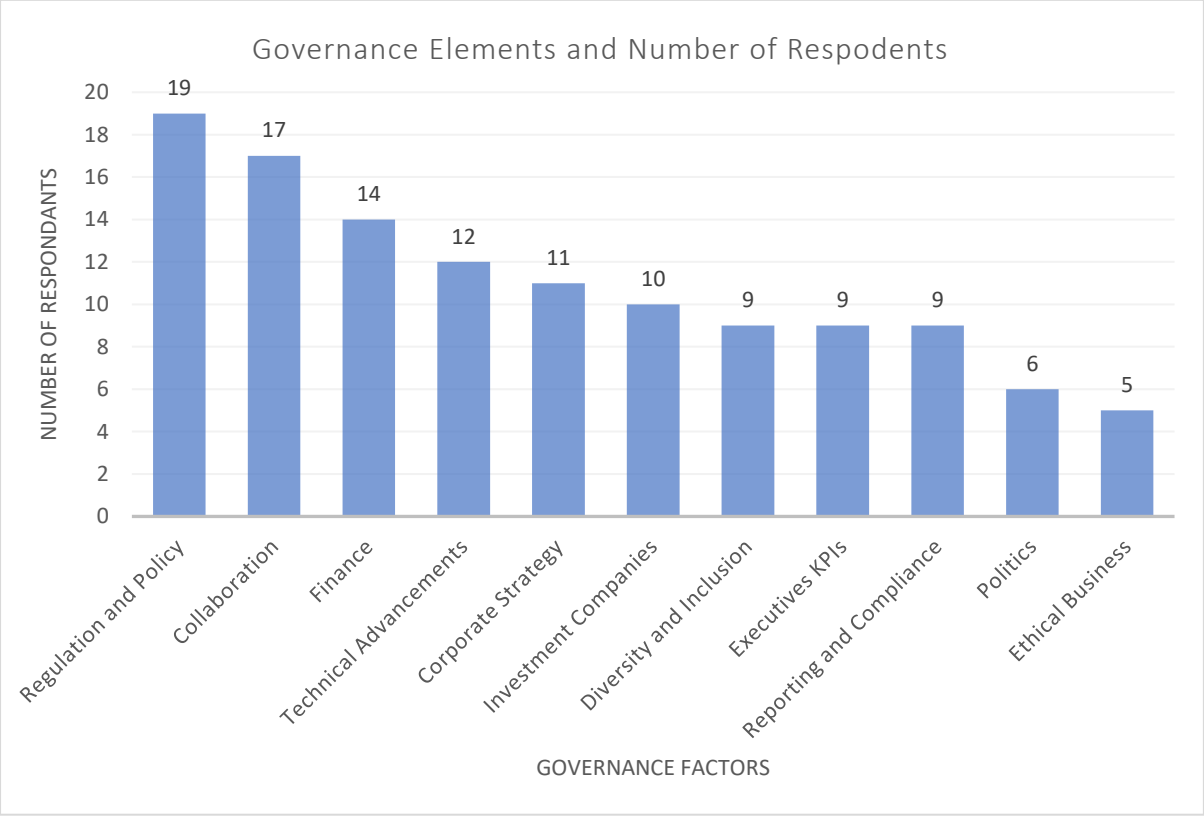


FIGURE 6. GOVERNANCE ELEMENTS AND NUMBER OF RESPONDENTS

Regulation and policy

Respondents largely expressed that governance played a significant role in companies' ESG performance. Most were of the view that the push on governance is mostly from external factors such as the need to comply with various national regulations and international investor policies. One respondent expressed that the social and environmental factors of ESG were strengthened by governance and strong legislation in South Africa. But these were strong and equally important from legislation point of view, when it came to what was happening on the ground, it wasn't clear if governance was as strong.

Respondent 18 said the following:

> *"So, in the mining industry in South Africa, you must have a social labour plan before you ever begin to mine. A plan for environmental management is also required. Thus, in the context of South Africa, both environmental and social elements are crucial. Right. And this is now being considered from a policy or legal standpoint, not necessarily from a practice standpoint. You might have a fantastic environmental plan that you never implement. You might have a fantastic environmental plan that you never implement."*

Respondent 7 said:

> *"We compile and implement a Social Labour Plan (SLP) that is as per the regulators requirements and that takes into consideration the nature & social standing of the operation. The SA mining industry is currently focused on investor requirements (JSE listing requirements) and international investor requirements."*

One expert commentator (respondent 17):

> *"But I believe that it is mostly motivated by a need to comply with the law. Additionally, businesses require consistency. The lessons learned from state capture helped us understand what can happen if these things are not managed properly."*

Key performance indicators

They further expressed that in order to get good traction on ESG, regulation alone was not enough but that ESG needed to be part of the executive Key performance indicators. Respondent 10 said the following:

> *"So, if you make these things key performance indicators for executives then you tend to move faster."*

Respondent 12 then said:

> *"In order drive anything, unfortunately, in South Africa, you have to put in people's KPIs, otherwise, if it's just talk, they won't do it. Now, if it's 30% of my KPI for example, I'll make sure it is done, I know that especially with mining guys, they talk about sustainable mining but need KPIs. So if these initiatives are in the chief executives list, they need to be accompanied by KPIs."*

Collaboration

Collaborative governance is necessary for the success of plans created for stakeholders including employees, clients, suppliers, and communities. Some respondents mentioned the ongoing, honest communication between businesses and stakeholders. This not only helps companies win the confidence and respect of their stakeholders, but it also helps them establish and maintain their social license. Most significantly, it helps them gather insightful information about the social and environmental effects of their activities. These insights have also helped them identify opportunities for innovation and efficiency improvements. These are some of the comments from respondents:

Respondent 9:

> *"Our success depends on establishing and upholding our social and regulatory operating permits. To do this, we must be transparent and honest with our stakeholders. Our goal as we work within our social performance framework is to establish and preserve relationships with our host communities and countries that are based on mutual respect, candour, and trust."*

Respondent 4 said the following:

"Mining operations are mandated to apply for Environmental Authorisations for certain activities. The process of applying for an EA includes a public participation process, which is the process of informing the local communities of the authorisation applied for, the project & how this project will impact on the community socially, environmentally, and financially (job creation)."

"We don't believe in stakeholder management, what's really impactful is stakeholder engagement, yes so if we are going to do a project at the mine whether it's expanding on one of our product lines or whether it's a solar project we go out and engage communities and the business people to bring their proposals and you know obviously talk to how this will impact them and also opportunities that could be the right whether we're building a tailings dam you know we set aside money that we have to spend with local communities."

Respondent 5 said:

"Innovation is going to play a very big part in how we steer things in the mining industry in the ESG space, for example in the digitization aspect of things, I've seen it do wonders for us in our management of our fuel consumption and in reducing greenhouse gas emissions, and not only that but also in the social space how can you be innovative because 38% of unemployment rate is a big percentage how can we think out-of-the-box to ensure that the young people in our communities are making a living as entrepreneurs. You know innovation in terms of governance can be around how are we ensuring that we as mining companies are doing what we said we would do and impacts how we are held accountable."

Inclusion and diversity

According to two respondents, the organisation is more likely to have sound governance and stewardship if the board and the executive team are diverse in terms of race and gender. Respondent 12 said:

"For example, a classic one, if young only have male leadership in the boardroom, strategic making decision is limited. And there are studies now from other schools of business that show that having females as part of the board or executive enhances strategic decision making in boardrooms. Believe it or not, I've seen it when we started to onboard females in certain structures. They ask questions you might think are merely based feeling and are not very useful, but they talk to people, especially the younger generations at work. People want to feel valued which helps with this concept of wellness which we're still grappling with. When they are valued the are easy to return and produce good results."

4.2.2 How are these/this factor(s) supporting or thwarting sustainable business model innovation.

Data that was utilised to understand how ESG elements help or hinder the development of sustainable business models is offered in this part. As was evident in the section on "Factors Most Influential to Sustainable Business Model Innovation," the interviewees' comments were divided into a number of categories for the E, S, and G. For instance, under environmental considerations, we had energy efficiency and transition, GHG emissions, etc. In this section, interviewees' responses are broken down further to reflect their sentiment in each factor, negative statements about a factor are interpreted to be factors thwarting innovation, positive sentiments made are interpreted to be factors supporting innovation. The graphs presented in this section are similar to ones presented in the previous section, the difference is that the responses are divided into two to show how many respondents gave negative sentiments (Thwarting Innovation) and how many respondents gave positive sentiments (Supporting Innovation), and they are not ordered in any order.

4.2.2.1 Environmental Factor

This section presents data on environmental factors supporting and thwarting innovation, number of respondents with positive sentiments are presented in blue coloured bars and those who made negative sentiments are presented in amber coloured bars, see Figure 7 below. Not all factors that appear on the graph are

discussed, only those that stood out in terms of number of respondents or had striking comments made by respondents.

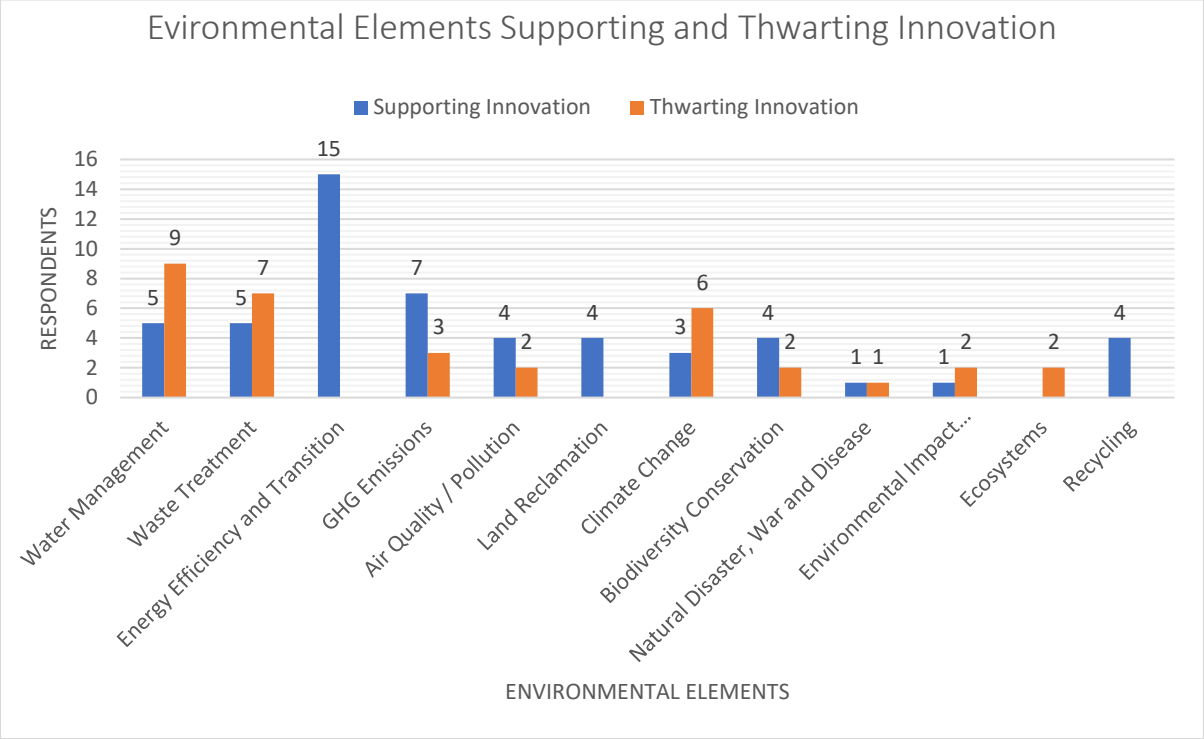


FIGURE 7. ENVIRONMENTAL ELEMENTS SUPPORTING AND THWARTING INNOVATION

Energy efficiency and transition

Despite the energy challenges plaguing South Africa, most respondents had positive things to say about how this in an opportunity for big and energy intensive industries like the mining industry to innovate and change how they operate in order use energy efficiently and transition to renewable sources of energy. Additionally, others saw this as a chance for the business to support sustainable development by lowering greenhouse gas (GHG) emissions and supplying clean energy for consumers. Below are some of the remarks made by interviewees:

Respondent 19 said:

> *"Energy and infrastructure challenges in the country are actually pushing mining companies towards being sustainable when it comes to energy generation of their own power and contribute towards sustainable development."*

Respondent 2 said:

"We see some businesses beginning to innovate around green hydrogen and believe hydrogen has a large and broad systemic role to play in realising a low carbon future and is a driver for the development and deployment of renewables-based power production systems. Over the next ten years, hydrogen has a chance to become a secure, trustworthy, clean, and innovative energy source.

Others saw this an opportunity for major cost reduction, respondent 3 said:

"Companies are gunning to reduce their energy costs by commissioning clean energy projects, diesel is very expensive and unsustainable"

Water Management

Mine operations, both open cast and underground are not just energy intensive, but they are water intensive as well. Unlike with energy, respondents had slightly more negative sentiments than positive sentiments when it came to water management and water contamination and waste treatment. For example, respondent 13 said:

"Most important ones to me are water recycling and waste management. Efficient water management, especially in a water-scarce country like South Africa, can make a huge difference to the operational costs in the situation where water is essential for the mining process (e.g., washing, processing, slurry etc.) With water the price it is these days, and the overall water quality on the decline, good recycling and purification can save a significant amount of money. Unfortunately, we still have accidents such as the Jagersfontein tailings dam accident which talks to bad water and waste management practices"

Respondents also made mention of a number of incidents caused by bursting of water pipes, acid mine drainage and, damaging wetlands and contamination of water bodies used by communities for activities such as watering their plantations and livestock. They did however make positive comments as well, such as the below. Respondent 6 said:

"We continue to observe businesses taking part in water-related projects to enhance the quality of life in the neighbourhoods where we operate, such as providing water, erecting dams, bolstering infrastructure, and more."

Greenhouse gas emissions

One respondent presented an irony or rather dilemma faced by the mining industry, the industry is one of the biggest polluters and emitters of GHG but also the one industry making the most impact on the world going green by providing green minerals such as copper, cobalt and nickel. Respondent 2 said:

"The fact this industry is one of the biggest polluters, yet they are the ones the world looks at for green elements."

4.2.2.2 Social Factor

This section presents data on social factors and respondents' positive sentiments (supporting innovation) and negative sentiments (thwarting innovation), these are shown in blue bars and amber bars respectively. Not all factors that appear on the graph are discussed, only those that stood out in terms of number of respondents or comments made by respondents. The bars in the graph are not sorted in any particular order. See Figure 8 below:

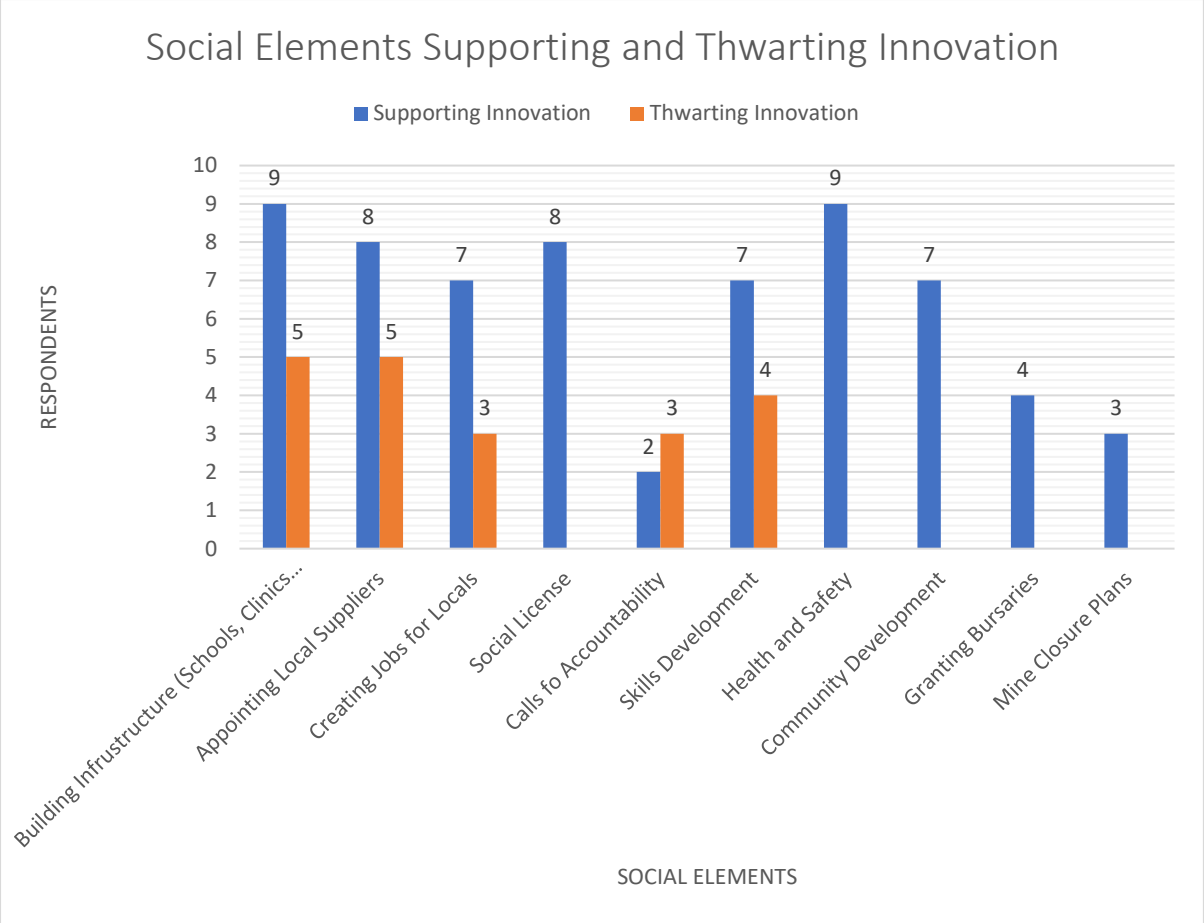


FIGURE 8. SOCIAL ELEMENTS SUPPORTING AND THWARTING INNOVATION

As depicted in Figure 8 above, almost an equal number of respondents had positive sentiments around the involvement of mining companies in building infrastructure for communities they operate in, appointing suppliers from these communities, creating jobs for locals, mining companies working hard to secure social licenses, skills development for employees and the community, health, and safety for both the employees and community and community development at large.

Building Infrastructure

When it comes to building infrastructure for the community, this was generally seen as a positive in terms of developing the community. But there were respondents who saw this as nothing short of a tickbox exercise for ESG scoring, a simple corporate social initiative that has no effect on how a business innovates its business model. Respondent 15 said:

"We've seen schools built, counted and reported in ESG reports, but if you go on the ground, there are no kids in the school and the government does not staff it with teacher, kids still attend old schools with deteriorated structures"

Respondent 19 said the following:

"This regulation and policy have created a compliance mentality to a point where infrastructure is just built but when it comes to ownership of the actual infrastructure and staffing of if where applicable, the community is left in the dark for example."

Appointing Local Suppliers

On the appointment of local suppliers, though most respondents saw this as a positive force for growth, there are ones that were not convinced of this fact and made rather strong comments on how the appointment of local suppliers can be difficult to manage. These are some of the comments made.

Respondent 13:

"There is a difficulty in extending and enforcing accountability to contractors and suppliers"

Respondent 1 said:

"Local suppliers do not have all the skills required to meet all projects."

Positive remarks were made, like the below. Respondent 16 said:

"We need suppliers for example in our various operations we have programmes to develop suppliers and graduate them, some of them diversify their revenue away from us some become big suppliers and don't encourage dependency on us, they use us to springboard."

Skills and community development

Respondents highlighted the need for skills development for both employees and the community for ESG and sustainability initiatives to thrive. They said that the lack of skills was one of the challenges hindering success in this area. Respondent 6 said:

> *"There is a general lack of skills to innovate around sustainability especially at on ground levels"*

Respondent 20 said:

> *"We are seeing inadequate training & awareness of requirements for ESG"*

Another responded highlighted that they recognise this limitation and have since come up with innovative training initiatives to help in this area. Respondent 9 said:

> *"Under our Sustainable Mining Plan, we recognised the need to enhance mining operator training to employ new technologies as part of the move from conventional to mechanized mining. Competent operators have received training utilizing VR since the program's debut to validate the outcomes of the training modules. In addition to preventing accidents, virtual reality training gives operators better understanding of their machinery, enabling them to utilize it to its fullest capacity."*

Respondent 20 said:

> *"Sustainability message must trickle down to operators on the ground who may not necessarily have the level of understanding on sustainability as the person sitting at the head office setting sustainability or and ESG goals."*

Social license and calls for accountability

On mines seeking and keeping their social licence and calls for accountability by the community to the mines, these are some of the comments made:

Respondent 9 said:

"Our social and regulatory licenses to operate are crucial for obtaining and maintaining open and honest engagement with our stakeholders."

Respondent 16 said:

"There's more involvement from a social perspective. And there's more, there's greater demand for accountability, which is not something that was there at the beginning, you know, the mining companies fire, they did what they did, and pollution was kind of a by-product of what they do. And everybody would accept that, because, oh, well, you know, it's a by-product of mining and mining is good for the economy, and so on. But now the demand for accountability and more responsibility, I think that's also really evolving how we're handling the environmental challenges."

Respondent 15 said:

"To turn land is a privilege that landowners give you whether you're turning the land for agriculture or you're turning the land for mining development. It's a privilege they give you because land is so sacred. But because we come with this approach of it's all about the finances. It's all about the light and the glitz and glam. The approach that the mining companies is doing people a favour is wrong"

Health and Safety

All the respondents who spoke about health and safety were in agreement that there has been a number of innovations in this area, and all contribute positively towards ESG performance holistically.

4.2.2.3 Governance Factor

This section presents data on governance factors supporting and thwarting innovation, just like in the previous two sections, number of respondents who made positive sentiments are shown in blue and those who made negative sentiments are shown in amber. In this section, not all factors that appear on the graph are discussed, only

those that stood out in terms of number of respondents or comments made by respondents. See Figure 9 below:

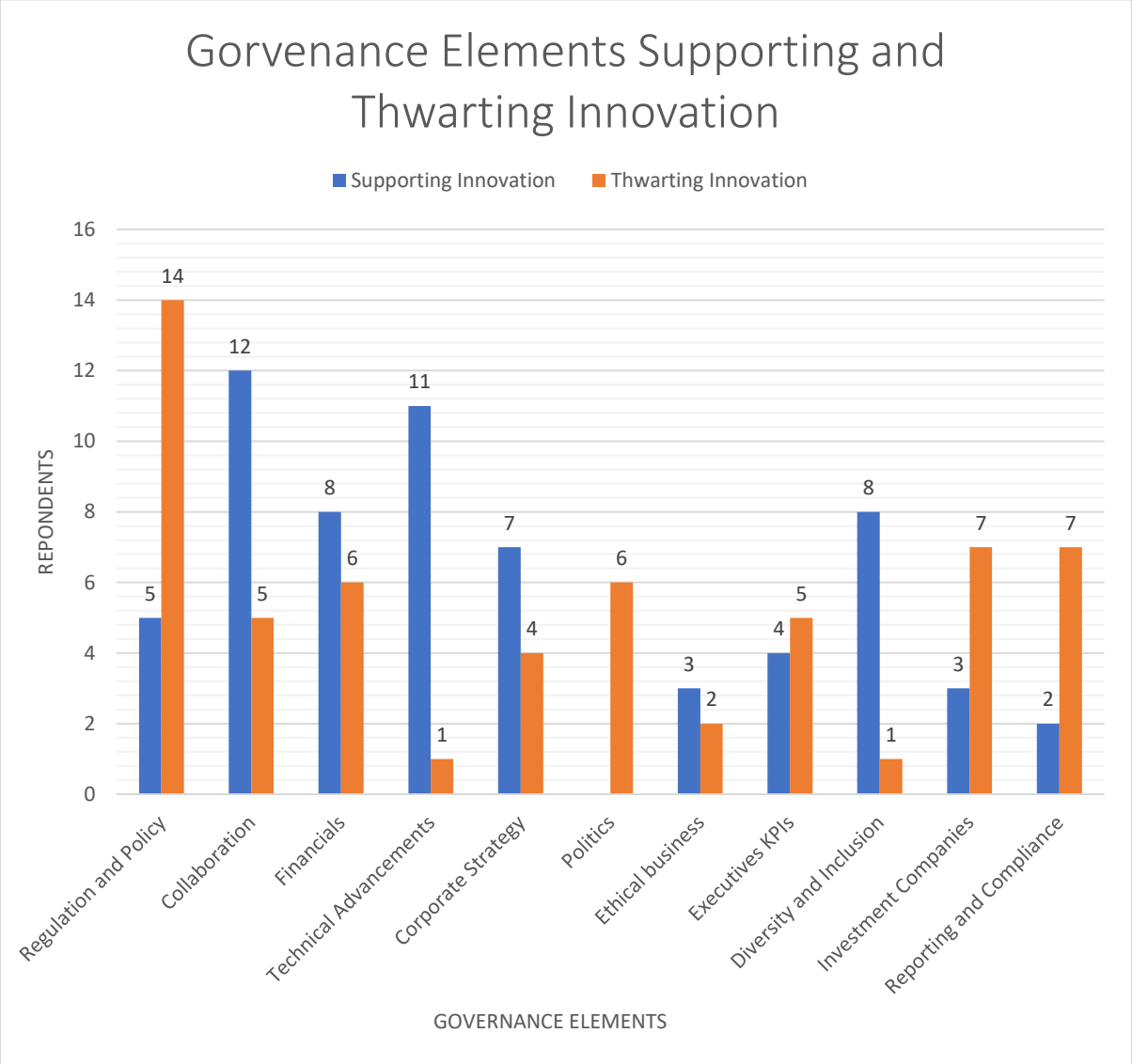


FIGURE 9. GOVERNANCE ELEMENTS SUPPORTING AND THWARTING INNOVATION

Implementation of regulation and policy

The implementation of regulation and policy stand tall as a factor hindering innovation in the industry as reflected by the number of respondents who were not impressed with interventions made or lack thereof to effectively implement a number of policies that have been drafted and put in place in the past. For example, respondent 18 said:

> *"Government bureaucracy and red tape is thwarting innovation; they have a long turnaround time in terms of implementation whilst the mining industry is fast paced, and execution of initiatives needs to be fast."*

Respondent 15 said:

> *"The bureaucracy of having to go and seek deviations in law are time consuming in the sense that you have to go wait on long queues whereas you have a business to run"*

Respondent 17 said:

> *"The lack of effective governance from the government side or the implementation and policing of legislation and regulation is not helping the industry in any way".*

Numerous respondents said that the fact that at least three government departments, rather than just one, control the industry led to shortcomings in the application of policy to promote growth in the South African mining sector. For example, respondent 10 said:

> *"The industry is regulated by about three departments and to have to make all the three work together towards achieving a common goal is sometimes a challenge. You must apply for permission, for using more water with one department, then generating your own electricity on site with yet another department and so on"*

Respondent 17 had the below to say:

> *"Mining is a long-term business. It takes years to identify, quantify, develop, and operate a mine, with all the compliance steps along the way, so there is a certain "momentum" to operations, that takes time to change. Like a sea-going oil tanker, it is very difficult and time-consuming to change direction, and it is the same in mining. Plans are made and development undertaken with a certain goal in mind, and that may be anywhere from 2 to 10 years in the future. So short-term changes in policy, implementation, ministerial governance etc. are extremely difficult to respond to on the spur of the moment, and it is this*

lack of understanding on a national government level that has been behind much of the negative interaction between government and industry. All mining companies are looking for is a stable, workable set of policies and rules that can be accommodated into current mining and development plans, are reasonably achievable and will be overseen by competent Dept officials, none of which is currently the case."

Not all respondents had negative sentiments about policy and regulation, some commended efforts being made around the policies enforcing the inclusion of previously disadvantaged groups such as females and people of colour into executive levels of the industry, for example, respondent 12 the following to say:

"Regulations such as ones around diversity and inclusion help drive positive ESG performance, for example: it's more beneficial to have a diverse team around the table because you are able to think holistically, some people bring lived experience you know especially with people that you have sitting in management and boards they when they talk about social impact they're not talking about things they read about, they mention exactly the experience for them and that sometimes enhances discussions."

Collaboration

On the other hand, cooperation is thought to be one of the most powerful drivers supporting sustained growth and innovation in various sectors of the mining industry. This involves the mining industry collaborating with different stakeholders such as communities, suppliers, investors and even government to deliver projects. Respondent 7 said that :

"Collaboration or lack thereof can either help boost or burst a company's brand".

Respondent 1 spoke of how he heard of a company say they don't manage stakeholders but engage with them in different initiatives that need to be undertaken, this is what they said:

"They don't believe in stakeholder management, what's really impactful is stakeholder engagement, yes so if they do a project at the mine whether it's expanding on one of their product lines or whether it's a solar project, they go out and engage communities and the business people to bring their proposals and you know obviously how this will impact them and also opportunities can come from there, so whether they are building a tailings dam, they set aside money that they have to spend with local communities."

Respondent 16 mentioned the importance of collaboration and proper engagement with the community and how it is beneficial for business continuation at the mine:

"Of course, better community relations would mean less strikes, sabotage etc., which means less disruption to operations and so the mine can continue producing what they mine and meeting targets."

Respondent 2 mentioned the unique offtake agreements that are emerging between the mining companies and manufacturing companies where these companies secure their supply of raw input materials or even secure electricity supply for their energy intensive operations. They said:

"There are unique offtake agreements emerging in the industry where companies like South32 are engaging Eskom to secure 50% of power output from Koeberg's power station in order to power their smelter. You have collaboration between Anglo America and Anglo Gold partnering to build extractive technologies powered by hydrogen."

Not all respondents saw collaboration in a positive light though, some expressed that there was still not enough collaboration between mining companies, communities and government as well as not enough collaboration between mining companies themselves (peer to peer collaboration). Respondent 19 said:

"There's poor collaboration between the mines, regulators and the community. There's poor collaboration between peer groups like mines operating in the same region, it is much easier to ring fence work. For example,

when a company talks about what it want to achieve in terms of creating a thriving community without talking about collaboration with its peer group organisation in the same area, you have to question the intended impact."

They further expressed that levels of dissatisfaction amongst communities in mining areas is still very high despite the huge amounts of money being spend by mining companies on communities.

"Levels of dissatisfactions amongst mining communities is still very high, despite the large amounts of money being spend by mining companies on them, you have to then question the nature of collaboration and engagement that happens with the communities."

Respondent 20 expressed that this dissatisfaction was caused by the fact that mining communities are past the stage of want simple handout from the mines through corporate social initiatives, they want equal partnerships and opportunities to be owners of projects being delivered by the mines.

Technical Advancements and Finances

Technical advancements are mostly seen to support any form of innovation in the mining industry, respondent 13 said enthusiastically said:

"I've never seen technical advancement stifle growth or innovation"

Some respondents associated technical advancements with finances. Respondent 5 said:

"Digitisation has helped in reducing costs. For example, the start stop technology in mining fleets. This helps reduce costs in terms of fuel and emissions. We also use a lot of paper, we find ourselves using hundreds of thousands of papers, per year, now tablets are being used. This also helps reduce costs."

Respondent 1 said:

"It is proving to be a challenge to incorporate innovative solutions to ensure people's safety, enhance sustainability performance, and deliver industry-leading margins and returns all at the same time."

When it comes to finances, some respondents saw the cost or investing in new initiatives as stumbling block for the mining industry to contribute meaningfully towards sustainable development or having a good ESG performance. Respondent 2 said:

"The cost of new investments in the industry is a stumbling block, the world needs more than 60 new copper mines to meet the forecasted demand as per the report by one of the leading mining company's report. They stated that this about a trillion dollars of investment. The short-term outlook is not too great in terms of the amount of money needed. Initiative overload is another challenge and there is therefore competing priorities for cost allocation."

Diversity and inclusion

Most respondents who mentioned inclusion and diversity saw it as a factor supporting innovation and even positive social impact for employees and the community. Respondent 12 said:

"It's more beneficial to have a diverse team around the table because the company is able to think holistically, some people bring lived experience, especially with people sitting in management and board positions. When they talk about social impact, they're not talking about things they read about, they mention lived experiences and that sometimes enhances discussions and brings positive impact."

Respondent 1 related inclusion and diversity to cost savings by saying:

"Including and diversity is helping to reduce company costs, for example, a leadership team with males only is limited in terms of their thinking or even strategic decision making. And there are studies now from other schools of business that show that females think differently, even in business. I've seen it when we started to onboard females in certain structures, they ask questions

no male will ask and you might think they're as based on emotion only but there's thought behind it in the sense that they even easily relate to the younger generation of employees. People want to feel valued, especially the younger generation. This bring and embraces the concept of wellness in a workplace and makes having conversations easy.

Respondent 10 said:

In the long run, it minimizes the rate of which people resign, which minimizes the costs. So, you have tenure, and the good news is that when you start to realise that by having these conversations, it reduces incidents, and safety costs and improves revenue."

Reporting and Compliance & Investment Companies

Most respondents who mentioned reporting and compliance saw this as the reason most companies embark on initiatives to improve their ESG performance. Some mentioned that this is reflected by input-based reporting seen narrated by the mines in the annual ESG/sustainability reports. For example, respondent 19 said:

"Reporting on ESG factors has mostly been input based and haven't been based on the impact of the ESG projects for example insuring the independence and sustainability of local suppliers. There seems to be a general lack of understanding on measuring and reporting based on impact."

Respondent 18 said:

"To show that these companies do this for compliance, they report quite comprehensively on the environment than they do on the Social and Governance factor. This is because of the many regulations on the environment and global focus on things the greenhouse gas emissions. Also, the E is much more easily quantifiable than the S and the G. A lot of mining companies quite frankly struggle with governance, not just in Africa but globally as well"

Respondent 11 expressed how ESG performance and sustainability are given focus at head offices and even make inputs into national legislation but down at operational level this does not trickle down well, things are still quite “unsustainable”.

> *“Some of the mines have been vocal in the industry trying to shape legislation around sustainability. As the higher level there is a good message is impressive but down where the work is done, the industry is still lacking.”*

On investment companies, some respondents who mentioned this thought these companies were not being helpful either in terms of driving impact based ESG, instead they are to an extent responsible for the compliance-based reporting by mining companies. One expert commentator (respondent 3) said:

> *"Investment firms like Sygnia and BlackRock have investment policies that speak to ESG; the question is whether they use it in their AGM voting process to vote based on sustainability or whether they look at share price and dividends. They will still buy the index even if they lose the vote or even if the company in question is not adhering to best practices."*

4.2.3 Summary of Interview Responses

This section summarises responses from interview participants presented in quotation marks in Section 4.2.1 and 4.2.2 and data presented in Section 4.2.3

4.2.3.1 ESG factors influencing innovation.

Environmental Factor: The section broke down environmental factors into components such as energy efficiency, water management, waste management, and greenhouse gas emissions. Key points include:

- **Energy Efficiency and Transition:** Respondents highlighted initiatives to reduce energy consumption, such as technology use, motion sensor lights, and transitioning to renewable energy sources.
- **Water and Waste Management:** Companies demonstrated efforts to improve water quality and implement water-related projects for community well-being.

- **Greenhouse Gas Emissions:** Mining firms are actively working to reduce emissions, track different scopes, and explore cleaner energy sources.

Social Factor: The section addresses social expectations on mining companies, covering infrastructure development, local supplier appointments, job creation, and community impact. Key points include:

- **Infrastructure Development:** Companies engage in projects like building schools and clinics, but some respondents question the effectiveness and authenticity of these initiatives.
- **Local Supplier Appointments:** While seen as positive for growth, challenges in extending and enforcing accountability to contractors and suppliers are acknowledged.
- **Skills and Community Development:** Respondents emphasize the need for skills development for sustainability, recognizing a lack of skills as a hindrance.
- **Social License and Accountability:** The mining industry faces increasing demands for accountability and responsible practices from the community, impacting the approach to environmental challenges.

Governance Factor: The section explored governance elements such as regulation and policy, key performance indicators, collaboration, and inclusion/diversity. Key points include:

- **Regulation and Policy:** External factors, including compliance with national regulations and international investor policies, significantly influence governance.
- **Key Performance Indicators:** Embedding ESG in executive key performance indicators is seen as essential for driving positive change.
- **Collaboration:** Ongoing, honest communication with stakeholders is emphasized for success, helping companies gain trust and maintain their social license.
- **Inclusion and Diversity:** Diversity in leadership is seen as enhancing strategic decision-making and improving overall governance.

4.2.3.2 How ESG factors support or thwart sustainable business model innovation.

This section analysed how ESG elements contribute to or hinder sustainable business model innovation. It breaks down responses into positive and negative sentiments for each factor.

Environmental Factor: Insights into how energy efficiency and transition, water management, and greenhouse gas emissions impact innovation are discussed.

- **Energy Efficiency and Transition:** Despite energy challenges, respondents see opportunities for innovation in energy-efficient practices and transitioning to renewable sources.
- **Water Management:** While seen as a challenge, innovative projects for water-related issues are acknowledged, but incidents like tailings dam accidents pose concerns.
- **Greenhouse Gas Emissions:** The mining industry faces a dilemma as a major polluter but also a key contributor to green elements like copper, cobalt, and nickel.

Social Factor: This section covered aspects like infrastructure development, local supplier appointments, and skills/community development.

- **Infrastructure Development:** Positive initiatives are noted, but scepticism exists about the impact and authenticity of such projects.
- **Local Supplier Appointments:** While generally positive, challenges in managing local suppliers are acknowledged.
- **Skills and Community Development:** Respondents highlight the need for skills development and recognize challenges in training and awareness.
- **Social License and Accountability:** Increasing demands for accountability are seen as an evolution in handling environmental challenges.

Governance Factor: This section covered Implementation of Regulation and Policy, Collaboration, Technical Advancements and Finances, Diversity and Inclusion, Reporting and Compliance & Investment Companies.

- **Implementation of Regulation and Policy:** Negative sentiments were expressed about government bureaucracy hindering innovation, citing slow implementation and challenges in seeking deviations. However, some respondents commended diversity and inclusion regulations for positively impacting ESG performance.
- **Collaboration:** Collaboration was viewed as a potent driver for growth and innovation, with positive outcomes like improved community relations. However, dissatisfaction was expressed due to poor collaboration between mines, regulators, and communities, along with high levels of community dissatisfaction.

- **Technical Advancements and Finances:** Technical advancements were seen as supportive of innovation and cost reduction, particularly in digitization. Financial challenges, notably the cost of new investments, were highlighted as impediments to meaningful contributions to sustainable development.
- **Diversity and Inclusion:** Inclusion and diversity were deemed supportive of innovation and cost-effective, contributing to strategic decision-making and reducing safety costs. Diverse perspectives were seen as valuable for positive social impact.
- **Reporting and Compliance & Investment Companies:** Reporting and compliance were acknowledged as driving ESG initiatives, but concerns were raised about the lack of emphasis on impact-based reporting. Investment companies were criticized for potentially prioritizing financial metrics over sustainability, contributing to compliance-based reporting.

Conclusion: The presented sections offer a comprehensive overview of the background, data gathering process, and detailed findings from semi-structured interviews. The research delves into the complex interplay of ESG factors in the South African mining industry, providing insights into the industry's sustainability practices and their impact on innovation.

4.2.4 How might adaptive management be used in the process of SBMI.

For the third research question, “How might adaptive management be used in the process of SBMI?”, the researcher gathered data from annual sustainability reports of top five (by market capitalisation) mining companies in South Africa. See Figure 10 below showing the top five companies by market capitalisation shown in billion rands.

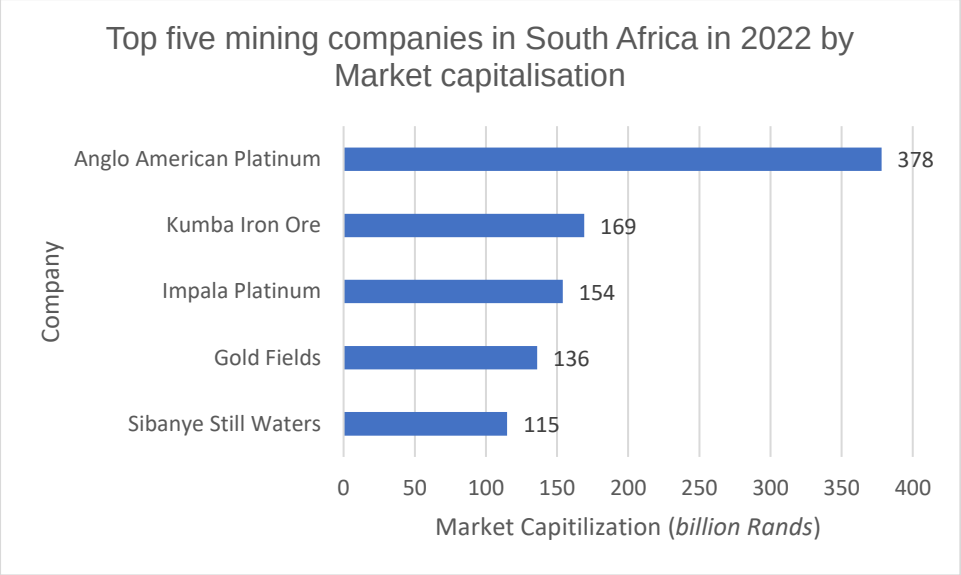


FIGURE 10. TOP FIVE MINING COMPANIES IN SOUTH AFRICA IN 2022 BY MARKET CAPITALISATION (GALAL, 2023).

The researcher looked for proof that these businesses are using data to inform decision-making, testing and refining new approaches, and involving stakeholders in the process of innovating their business models. According to Kingsford et al. (2017) adaptive management involves ongoing monitoring, evaluation, and adjustment of strategies and practices based on feedback and new information. Figure 11 shows this:

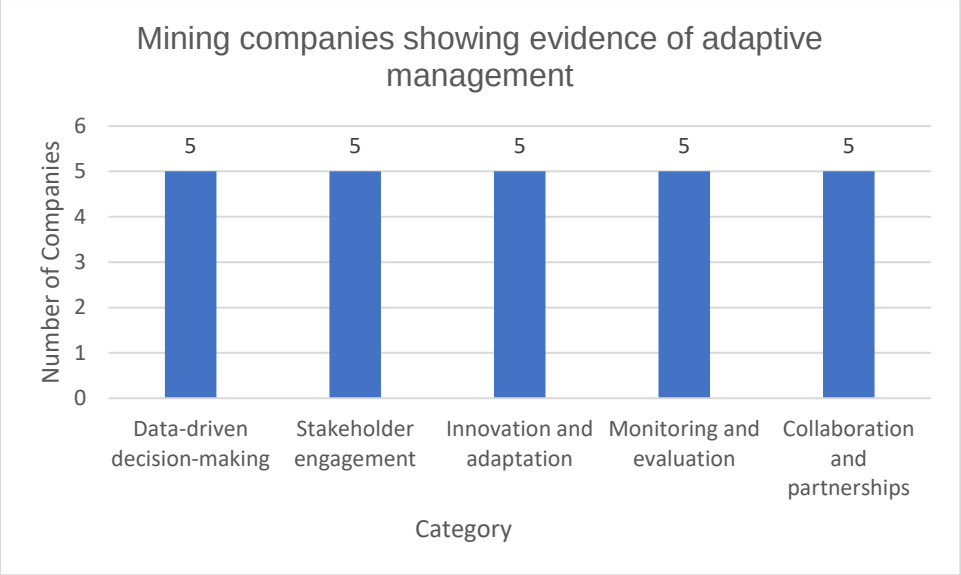


FIGURE 11. MINING COMPANIES SHOWING EVIDENCE OF ADAPTIVE MANAGEMENT

Data-driven decision-making:

- All five companies chosen report that they use data to make decisions informing their sustainability strategies and innovation around business models (Anglo American Platinum, 2023; Anglo American Platinum, 2022; Gold Fields, 2021; Implats, 2020; Kumba Iron Ore, 2019; Sibanye Still Waters, 2022). For example, Anglo American Platinum makes use of a "Sustainability Framework" for sustainability initiatives prioritisation, then Kumba Iron Ore uses a materiality assessment to identify most important and relevant issues around sustainability. For each of these, ongoing data collection and analysis is necessary to monitor progress and pinpoint areas in need of improvement.

Stakeholder engagement:

- They have reported engaging with stakeholders as part of their sustainability strategies and business model innovations (Anglo American Platinum, 2023; Anglo American Platinum, 2022; Gold Fields, 2021; Implats, 2020; Kumba Iron Ore, 2019; Sibanye Still Waters, 2022). Impala Platinum for example has what's called Sustainable Development Forum use to engage with local communities, and they also established regular meeting with other stakeholders. These companies have reported to have still continued to engage with communities and other stakeholders virtual during COVID-19.

Innovation and adaptation:

- These companies also report that they have implemented sustainability initiatives to help innovate and adapt their business models in respond to sustainability challenges. For example, Gold Fields and Seriti through their green energy subsidiary have implemented a renewable energy strategy to reduce its carbon footprint and add solar and wind energy to their energy mix respectively. On top of this Sibanye has gone to create a water conservation and demand strategy in order to curb water wastage.

Monitoring and evaluation:

- They have reported monitoring and evaluating their sustainability strategies and business model innovations. Anglo American Platinum reported that they conduct regular sustainability assessments along with implementing a sustainability reporting dashboard, the latter is also done by Kumba Iron Ore.

Collaboration and partnerships:

- Lastly, they have reported collaborating with other stakeholders and partners For example, Impala Platinum continuously partners with the South African government and other stakeholders such as the community to come up with water demand strategies and demand management just like Gold Fields. Gold fields has also partnered with the University of the Witwatersrand to develop a climate risk management tool.

4.3 CONCLUSION DATA PRESENTATION

Under research the first research, when the respondents were asked a direct question on which of the three ESG factors was most influential to innovation in the South African mining industry, most of them said the environmental factor was given the most importance due to legislation around it, global focus on the environment, but when looking at the rest of the data presented. For the second research question, elements under the governance factor were the most mentioned and stronger views were on these elements as well.

For the third research question, when reviewing company documents for indications of adaptive management, data-driven decision making, stakeholder engagement, innovation and adaptation, monitoring and evaluation as well as collaboration and partnerships were looked were looked at and all five mining companies' documents pointed towards the presence of these elements.

CHAPTER 5: RESEARCH FINDINGS ANALYSIS AND DISCUSSION

5.1 INTRODUCTION

This chapter includes an analysis and discussion of the empirical study data from chapter 4 along with the learnings and understanding from the second chapter's literature review in which numerous papers were used. The analysis focuses on ESG (Environmental, Social, and Corporate Governance) elements that are presented in interview data; this data will be contrasted with chapter two literature to assist answer the research questions and prove or disprove the three established propositions.

The research questions are examined in the next section, along with arguments made in opposition to each one, a brief summary of what existing literature has to say regarding the research questions, gaps found, and conclusions drawn from the data in the fourth chapter.

5.2 BACKGROUND

Semi-structured interviews were used in this study to gather primary data combined with a review of the annual ESG/sustainability reports from the top five mining firms in South Africa according to market capitalisation, as explained in the research methodology chapter, chapter three. This study focuses on the connection between ESG performance and innovative sustainable business models in the mining sector of South Africa.

In particular, the researcher wants to know which ESG elements have the most impact on fostering creativity and how they help or impede the development of sustainable business models. Last but not least, the researcher seeks to comprehend how adaptive management might be applied in the process of developing innovative sustainable business models. This will greatly influence the recommendations that emerge from this research.

5.3 DISUCUSSION PERTAINING TO RESEARCH QUESTIONS AND HYPOTHESIS

The researcher divided E.S.G into factors or themes that both emerged during interview and themes from the conceptual framework in order to gain understanding on the nature of relationship between sustainable business model innovation and ESG performance in the South African mining industry, specifically which factors of ESG are most influential in driving sustainable business model innovation and how they either support or hinder innovation. Under each research question and proposition, the most outstanding themes under E.S.G will be discussed.

5.3.1 Which of the ESG factors (Environmental or Social or Governance) is influential to innovation.

The researcher's proposition for the first research question was as follows: "As seen in the research problem, some authors have noticed a substantial association between environmental elements and SBMI, while some concluded that social factors have a bigger influence. Due to the widespread prevalence of Corporate Social Responsibility (CSR) initiatives by the industry, the researcher hypothesizes that social variables may have a bigger impact on SBMI in the South African mining industry (Hamann 2004)". In this section, the author discusses, factors found under E, factors found under S and under G through interviews and does an analysis based on data gathered from responses on which factor is most influential to innovation which will either prove or disprove the proposition made.

5.3.1.1 Environmental factor

Under the environmental factor, mining impact on the environment through elements such as waste, the contamination of water and greenhouse gas emissions are going to be discussed. Among these effects include the exploitation and depletion of non-renewable resources, the extinction of biodiversity, the destruction of forested areas, and dangers to the health and safety of workers and the local population (Azapagic,

2004). Mining has a significant role to play in sustainable development by resolving social and environmental issues, according to Krause and Drusche (2021).
In order to meet current demands—whether they be social, economic, or environmental—sustainability must be pursued without endangering the ability of future generations to meet their own needs (Verma, 2019). In the context of this section, mining corporations' involvement in environmental impact research and mitigation is crucial to guaranteeing sustainability. As part of a sustainable firm, the pursuit of innovative sustainable business models and having an impact on the environment, such as the conservation, preservation, and management of natural resources, including air, water, land, and biodiversity, are important (Keijzers, 2001).

According to Hart (1995), a business should first concentrate on preventing waste and pollution. Then, they should work to improve supply chain collaboration and implement product stewardship (or resource stewardship in the context of mining) schemes and integrated chain management. Finally, they should adopt a fully integrated strategic environmental management approach that is implemented at all organisational levels.

Gladwin et al. (1995) were the loudest about this and noted that during the 1970s and 1980s, international organisations were required to operate in accordance with severe environmental criteria contained in operating licences and licenses. Businesses first perceived this as a restriction and a burden rather than an opportunity. Up until the Brundtland Report was written in the late 1980s and many other environmental reports, enforcement of environmental laws was a significant problem. These reports emphasized the significance of achieving a balance between environmental conservation and economic growth.

Acts like the Minerals and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA) are used to regulate the peaceful coexistence of economic development and environmental protection in businesses like mining in South Africa (Mubanga & Kwarteng, 2020). A review of mining and minerals policy was started in 1995, and participants included officials from the government, business, small-scale mining industry, trade unions, communities, and environmental organisations. The MPRDA was ultimately passed as a result of this legislative assessment (United Nations, 2017). Environmental enforcement under the MPRDA has significantly improved the

mining industry's adherence to environmental best practices and assured that it is progressing in the direction of environmental sustainability (United Nations, 2017).

Section 4.2.1.1 in the fourth chapter presented data on environmental elements most influential to in the mining industry as per the interviewees responses. Their responses showed that energy efficiency and transition, water management, waste treatment, green-house gas emissions and climate change were most influential elements of the environmental factor.

Energy and its transition being one of the big topics in the country and the globe at the moment, it makes sense for this to be top of mind and most influential according to the interview responses. According to research by the CSIR (2020), South Africa has been suffering rising electricity costs since 2008, which has made it difficult for the operations of the mining industry to adapt. Dr Peter Klein. Klein from the CSIR (2020) also highlighted that with rising grid electricity prices, costs of renewables such solar photovoltaics (PV) will continue to decline, which presents good opportunities for energy transition. This supports research by the national Integrated Resource Plan released in 2019 which has indicated that the cost of electricity will be on the rise continuously up to 2050 when the aging Eskom coal fleet has been replaced by new generation capacity (SA Department of Energy, 2019). Self-generation has increasingly become an option as reliability of Eskom has decreased (Votteler & Brent, 2016). In the data presented, we see mining companies such as Seriti embarking on projects to generate their own green energy in the face of a struggling national power utility.

The results of interviews indicate that the management of water in the mining sector is the second-most significant aspect of the environmental component. An outstanding example of why water management is still a huge challenge today is the way in which the mining sector has historically handled water, particularly by gold mining operations in South Africa. Early gold mining in the nation was prioritized over potential negative long-term repercussions, with little regard for the environment or water (Adler et al., 2007). The greatest gold reserves in the world were located in the Gauteng province's far West Rand, but they were located at enormous depths, making extraction technically challenging in part because they were covered by dolomitic aquifers (Adler

et al., 2007). The industry therefore had to use extraordinary pumping systems to draw water from the shafts which resulted in consequences such as groundwater being exposed to pyrite and other minerals which compromised the quality of water through acidification and exposure to heavy metals. This compromised water quality greatly and meant mining needed to pay special attention to water management. Over 70% of the water utilised in South Africa comes from springs, rivers, lakes, streams, and ponds, both in rural and urban settings (DWAF, 2004).

The mining sector in South Africa uses less water than other industries, according to a 2017 study by Askham and Van der Poll. Figure 13 shows that while mining only uses 3% of the available water, it can have a detrimental effect on water quality, especially for home use.

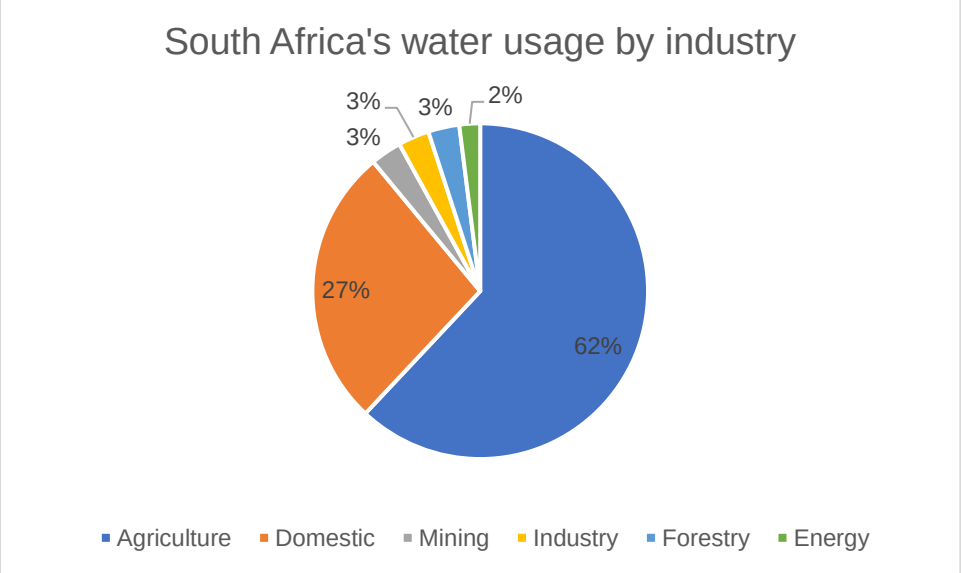


FIGURE 12. SOUTH AFRICA'S WATER USAGE BY INDUSTRY (ASKHAM & VAN DER POLL, 2017)

Due to this, a significant amount of money must be spent on water filtration and recycling before it can be used for human consumption. The fact that South Africa is a country with severe water constraints makes these repercussions worse. Askham and Van der Poll (2017) predicted that by 2030, there would be a 17% gap between water supply and demand in the nation.

Waste treatment, which is frequently connected to water in the mining industry, was the next most talked-about environmental topic. Up to 65 billion tons of waste are produced annually by the mining sector, which presents significant challenges in terms

of environmental management and storage concerns (Kalisz et al., 2022). The absence of a comprehensive policy outlining or detailing how mine waste and water are to be treated is the core of various waste management issues in the mining industry, according to Adler et al. (2007). About two (2) primary and eleven (11) secondary pieces of law concern waste management; as for departmental management, it is overseen by three primary and six secondary departments.

The responders emphasized the following factors: greenhouse gas emissions and climate change. South Africa's huge coal reserves are mined there, and the country primarily uses coal for energy production. Since apartheid was dissolved in the 1990s, South Africa's economy—which is the second largest in Africa and is dominated by Nigeria—has tripled. Due to this expansion, the nation's GHG emissions increased; in 2015, they reached 460 million tonnes of carbon dioxide. According to the CSIR (2020), the country's emissions of greenhouse gases that cause climate change were created by the mining industry to the tune of 6%.

In light of the factors cited by respondents—energy and the transition to alternative energy sources, water management, waste management, GHG emissions, and climate change—the mining sector has a substantial impact on the environment. However, the business sector has a big role to play in the development of sustainable business models, and it is crucial to take into account the environmental aspects that are important to the sector for long-term sustainability.

5.3.1.2 Social factor

The social factor of ESG refers to initiatives around stakeholders such as the mining community and employees and the value created for them (Appelstrand, 2002). To secure a ‘social license’ mining companies engage and consult with local communities, indigenous groups and other stakeholders before undertaking projects that will affect them at any capacity. They also look to protect human rights which is inclusive of labour rights, health and safety and the fair treatment of employees (Verrier et al., 2021). Social initiatives are mostly recognised as social responsibility towards the community through initiatives such the development of infrastructure and

conducting community projects that promise community's well-being improvement and their social inclusion.

This section addresses the variables that respondents believed will have the most effects on the mining industry in South Africa. Due to the growing demand for greener technology on a worldwide scale, pressure is placed on the mining industry to increase the supply of minerals required for this transformation while overcoming fairly challenging ESG challenges (Verrier et al., 2021). The sector today has to balance increasing production through resource extraction with growing scrutiny from shareholders, investors, civil societies, and stockholders.

Section 4.2.1.2 in the fourth chapter presented data on social elements most influential in the mining industry as per the interviewees responses. Their responses reflected that infrastructure development, the appointment of local suppliers, skills and community development, health and safety and attaining a social license were influential elements of the social factor.

As part of their social corporate responsibilities mining companies share their wealth with communities they operate in, and they do this through building infrastructure such as schools, community centres and clinics as well as minimising the impact of mining in the community. Carvalho (2017) states that therefore the future of mining rests on good mining practices that help to not only environmental conservation but also taking time to develop communities mining companies operate in and contributing to good quality of life there.

The respondents hinted at the idea that water projects have been some of the most influential infrastructure initiatives. As a result of mining operations, new water infrastructure is built or current water infrastructure is expanded, resulting in various water projects for the community. Additionally, they have assisted with water distribution in the neighbourhood as part of their CSR projects. They also take part in the training required to manage and maintain the infrastructure (Admiraal et al., 2017).

The selection of local suppliers by mining firms or the development of local suppliers were the second and third most frequently reported social factor components. The

Broad-Based, Black Economic Empowerment (B-BBEE) policy was established by the South African government for businesses to go with in order to address previous economic injustices against black enterprises (Sibiya & Barnard, 2020). To do this, businesses like mining firms deploy ESD programs. ESD is used to establish and maintain local businesses in mining regions, and it has become quite important to the South African mining sector (Ntombezintle, 2022). Small to medium-sized businesses (SMEs) owned by black people are the goal of these efforts. Additionally, it serves as a means of encouraging interaction between local populations and mining businesses.

The next two elements which were highlighted by respondents were skills development and job creation, not only are these two linked but they are linked to the previous element as well, ESD. Nevertheless, the development of current employees can also be discussed in relation to skill development. Skills development programs assist businesses construct safe and effective operations, which benefits not just the community being skilled or employees (Adolph et al., 2014). These training programs include a several activities ranging from apprenticeships and internships to partnerships with universities and technical institutions that offer formal education. Skills development and job creation again link to ESD in the sense that they are particularly important for previously disadvantaged members of the mining community.

The next element to be mentioned was health and safety, this is one of the most important social elements or even social metrics in the mining industry world-wide and the safety challenges that are continuously face by the industry. Every legitimate mining company measure health and safety and has it amongst their priority items. In South Africa, the mining industry places emphasis on health and safety in order to try and prevent mining accidents, occupational health hazards and injuries (Tshoose, 2014). Mining businesses are obligated by law to abide by health and safety rules in order to protect the health and safety of those working in and around mines (Muthelo et al., 2022).

Last but not least for this area, obtaining a social license may very well be the driving force for mining firms' involvement in any social endeavour. The significance of obtaining a social license was noted by a few interviewees in their comments. The community or culture in which a mining business operates really grants it a "social

license" by embracing, believing in, and supporting it (Parsons et al., 2014). It can also be viewed to be beyond legal compliance and gives legitimate reflection of the company's activities. It is earned through socially and environmentally responsible and sustainable practices and built through meaningful and respectful collaboration with local stakeholders (Harvey & Bice, 2014).

5.3.1.3 Governance factor

The governance factor in ESG refers practices and structures a company has put in place to ensure transparency, accountability, responsible and ethical decision making (Heenetigala et al., 2015). According to Lee (2021), effective governance starts in the boardroom first because this helps in the setting of company strategy, goals, and policies, the board needs to be diverse and have the necessary skills and knowledge to oversee all company ESG matters.

In this section, governance factors with the most influence in the mining industry according to the respondents are discussed along with what literatures has to say about them. When asked which factor between the environment, social and governance is more influential to innovation, respondents said the environmental factor was because this was easily measured and there were thorough local and global environmental policies, but also because most environmental elements are measurable and easy to report on.

But when looking at the rest of the data given through responses, it points towards governance being the most influential factor. This may be because of the definition of what governance refers to in this context, the environmental and social factors are built up on practices and structure such as policies and regulations, whether internal or external, which are formulated through governance. One of the governance difficulties the mining sector in South Africa suffers is the unpredictability of the laws governing the industry.

Section 4.2.1.3 in the fourth chapter presented data on governance elements most influential to in the mining industry as per the interviewees responses. According to

their comments, the governance component in the mining business is most influenced by teamwork, finances, technological improvements, corporate strategy, and investment firms.

With the exception of one interviewee, everyone expressed an opinion on policy and regulation, which stands out as the governance factor's most powerful component. Policy and regulation in the mining sector include items like licensing and permitting for activities like the use of the environment and resources like water, as well as legislative actions like the MRPDA (Van Eeden et al., 2009). The majority of the respondents' discussions of policy and regulation focused on the laws and rules that the mining industry is required to abide by in this area. Different regulatory concerns affect the mining sector in developing countries; for the business climate to be stable and draw investment, this sector need clear and stable regulation (Vicoda, 2017).

The MRPDA in South Africa, which governs the exploration and extraction of mineral resources as well as petroleum resources, has come under fire, particularly because of licensing B-BBEE requirements' ambiguity and delays, as well as the short period of time it gives miners to use their licenses before they lose them (April, 2012).

The South African government does recognise the limitations placed by these factors on the industry and is continuously amending and reforming policy to prove clarity and streamline processes (Humby, 2015).

The next element of the governance factor highlighted by the interview respondents was collaboration. In order to address problems or innovate, mining corporations work with a variety of stakeholders, including the local communities they operate in, local and federal governments, non-governmental organisations (NGOs), investors, and regulatory agencies (Peloza & Falkenberg, 2009). This level of collaboration allows the different stakeholders to pool their different perspectives, expertise, and resources together (Fong, 2003). The section on social factor made mention of a social license, according to Jenkins and Yakovleva (2006) continuous and meaningful collaboration with society allows mining companies to secure a mining license with the community/society it operates in. Society does not want things done for them anymore, they want meaning collaboration in the form of partnerships and ownership in projects,

they also want business opportunities. To bring meaningful change, mining community operating in a common area are better off collaborating with each other to bring up change as opposed to delivering siloed projects (Hamann, 2004).

Mining firms work collaboratively with a variety of stakeholders, including the local communities they operate in, local and federal governments, non-governmental organizations (NGOs), investors, and regulatory agencies to address problems or invent new solutions (Peloza & Falkenberg, 2009). The industry donated resources to be utilised at the time and assisted the South African government in implementing successful COVID-19 tactics.

The third most spoken about element that influenced innovation was finances. Finance play a crucial role in funding sustainable mining initiatives (Lazaro et al., 2023). In as much as mining has been one the most environmentally disturbing human activities and linked to negative societal impacts and inequalities, the world's transition to sustainability is largely dependent on the mining industry (Carvalho, 2017). Financing helps the mining industry with funding for environmentally friendly innovations, improving resources efficiency, reducing GHG emissions, increasing responsible mineral sourcing as well as the enhancement of social and community development (Sindhwani et al., 2022). This links to the sixth most mentioned element which is investment institutions such as Blackrock and banks, these institutions help with offering finance tailored for the unique risks faced by the mining sector.

Advancements in technology were the fourth most element to be mentioned by respondents as influencing innovation under the governance factor. Advancement in technology refers to the development and adoption innovative technology-based solutions that improve areas of mining operations. It addresses a wide range of subjects, including safety, environmental management, and logistics. For example, in safety, a few respondents made mention of remotely operated machinery and in logistics they referred to stop-start technologies implemented in trucks to reduce fuel consumption and emissions. Silvestre and Neto (2014) assert that technology progress aims to lessen negative environmental effects, enhance operational efficiency, and save costs. As it pertains to safety, Ralston et al. (2015) in their paper on "Longwall automation", state that advancements in technology have the ability to

enhance safety for workers through the automation of hazardous tasks, providing real-time monitoring of conditions and allowing for machinery to be remotely operated. Clean technology can assist in minimizing greenhouse gas emissions and lessening the impact on regional ecosystems. Examples include energy-efficient cars and equipment and renewable energy sources (Ellabban et al., 2014).

The next element mentioned by respondents was corporate strategy which also links to another element under the governance factor, the executive's key performance indicators (KPIs). According to Bora et al. (2017), a corporate strategy is a company's long-term plan and direction for achieving its stated goals and objectives. Part of the strategy is allocation of resources, ways to compete in a marketplace and value creation for all stakeholders involved (Whittington et al., 2020). Creating value in this context involves for stakeholders including the environment and society. The majority of respondents made reference to the idea that any changes to how mining companies conduct business in relation to sustainability and ESG must be well ingrained in the executive's KPI. This will result in business strategy and business model shift towards ESG and sustainability as we see in some mining company's reports. Executive KPIs are crucial in influencing corporate change toward sustainability and strong ESG performance, according to Arvidsson and Dumay (2021). Examples of these metrics are, environmental stewardship metrics, health and safety metrics, community engagement metrics as well as governance and supply chain metrics.

The same number of respondents that mentioned executive's KPIs also mentioned diversity and inclusion and reporting and compliance. In prioritising diversity and inclusion, mining companies can create an inclusive workforce that's well in tune with the needs of communities they work in, more than that, inclusion and diversity create an equitable workplace and attracts and retains talent (Young & Thyil, 2009). On reporting and compliance, several respondents made mention that there has been over reporting on the ESG and sustainability and not enough action on the ground by the mining industry. Some respondents were not pleased that some companies are reporting on inputs of ESG and sustainability but not necessarily the income yielded by these inputs. Good reporting on ESG performance in the mining industry can sometimes miss addressing the complaints brought forward by communities they operate in (Bester & Groenewald, 2021). Deegan et al. (2002) evaluated BHP's

corporate social and environmental disclosures from 1983 to 1997 as a test of legitimacy theory. tested the legitimacy of what was reported by a mining company in question in the stated years and state that while companies communicate sustainability efforts through their reports, community perceptions and lived experiences may differ to what's being reported.

This may primarily to the following gaps but also because of what was expressed by some of the interview respondents that some companies report on inputs and not necessarily outcomes from these inputs. These are some of the gaps; limited local participation or engagement, communication gaps, mismatched expectations that may be caused by cultural and social factors (Deegan et al., 2002).

To conclude of this section, this part will answer the first research question and prove or disprove the first proportion which were: "Which of the ESG factors (Environmental or Social or Governance) is influential to innovation to sustainable business models?" and "In the South African mining industry, Due to the widespread prevalence of Corporate Social Responsibility (CSR) initiatives by the sector, the researcher contends that the social component may have a bigger impact on the development of sustainable business models in the South African mining industry (Hamann 2004).

The nature and direction of the relationship between ESG and sustainable business models has been researched to some extent in industries like finance, but the studies are skewed towards Europe and generalized to other regions like Africa, according to the literature used to formulate the problem statement for the study. In a study by Spoz et al. (2021), the authors assert that the study assessed the outcomes of a global setting (Asia, America, Africa, and Europe), however they only make reference of Europe and Asia with a focus on Europe. The study found that there is a reasonably high association between social variables and sustainable business models (SBMs) in Europe, out of the three categories of environment, social, and governance (Spoz et al., 2021). A study by Bak et al. (2022) further supports these conclusions.

During the interviews for this current research, when the interviewees were asked which factor between the environment, social and governance is more influential to innovation or even business models, respondents said the environmental factor was

more influential because this was easily measured and there were thorough local and global environmental policies, but also because most environmental elements are measurable and easy to report on.

But when analysing the full data given through responses from all 20 participants, it points towards governance being the most influential factor. They had stronger views on elements of the governance factor and a lot of what they had to say in their responses pointed towards the governance factor as being more influential.

This may be because of the definition of what governance refers to in this context, the environmental and social factors are built up on practices and structure such as policies and regulations, whether internal or external, which are formulated through governance. Uncertainty in legislation controlling the mining business is one of the governance issues the mining industry in South Africa faces (Ledwaba & Mutemeri, 2018). Therefore, the most influential factor of ESG to sustainable business model innovation according to data collected during interviews is the governance factor. The first research proportion therefore disproved or is untrue.

5.3.2 How are these factors supporting or thwarting sustainable business model innovation?

In this section, data presented for the second research question is discussed in the context of literature. The first research question asked which of the three factors of ESG was most influencing to innovation and this was answered using the elements of each factor that came the interviews conducted. The second research question is “How are these factors supporting or thwarting sustainable business model innovation?” these are the ESG factors, and this will also be answered using the elements of each factor which came out of the interviews. For this research question, the number of respondents who mentioned each element under each factor of ESG is broken down to show the number of respondents who had negative sentiments about element which is interpreted as thwarting innovation and positive sentiments about the element which is interpreted as supporting innovation.

5.3.2.1 Environmental factor

During the interviews with interview participants, their responses indicated that these environmental elements were most influential in the mining industry; energy efficiency and transition, water management, waste treatment, green-house gas emissions and climate change were most influential elements of the environmental factor. Under this section, the number of respondents who mentioned each element of the environmental factor is broken down to show the number of respondents who had negative sentiments about element which is interpreted as thwarting innovation and positive sentiments about the element which is interpreted as supporting innovation.

The environmental factor of ESG can hinder innovation in a number of ways, for example regulations aimed at environmental practices and compliance requirement in South Africa are meant for the protection of the environment and the promotion of sustainability but are quite stringent and can be found to be complex (Maponga & Musa, 2021). Meeting the regulatory requirements may often need significant investments for operational and infrastructure changes. This can be financially burdensome and consume a lot of time in the process. The pursuit of compliance can take resources away from innovation initiatives (Malecki , 2009). Mining companies that fail to show that they are able to adequately manage environmental practices and sustainability efforts will find it difficult to access capital from investors to work on other innovation activities (Christmann, 2017).

The environmental component of the ESG framework, for instance, stimulates mining businesses to spend in R&D for innovation (Blinova et al., 2022). The environmental component of the ESG framework can also help the ESG in a variety of ways. This include innovation in elements discussed under this section which are energy efficiency and transition, water management, waste treatment, greenhouse gas emissions and climate change.

Despite the energy challenges plaguing South Africa, the respondents who mentioned energy efficiency and transition had only positive sentiments towards element. Most respondents had positive things to say about how this in an opportunity for big and energy intensive industries like the mining industry to innovate and change how they operate in order use energy efficiently and transition to renewable sources of energy.

Some further saw this as an opportunity for the industry to make contributions towards sustainable development through the reduction of GHG emissions while providing clean energy for themselves.

Energy transition and efficiency are crucial for fostering innovation in the mining sector in South Africa. Through energy-efficiency initiatives and transition to cleaner energy, the mining industry can innovate, improve operational performance, and enhance sustainability (Chavalala & Nhamo, 2014). Measures taken up in an effort to achieve energy efficiency such as asset maintenance, implementation of newer and efficient technology and the adoption of energy management systems, lead to cost savings as well as improved overall efficiency (Lee & Cheng, 2016). Transition to cleaner energy such as renewable energy sources will reduce the industry's reliance on energy generated from fossil fuels and reduce GHG emissions, therefore aligning to global sustainability targets (Khan et al., 2022). Energy efficiency and transition will also reduce demand on the South African energy (Eskom) utility's grid which has been under constant pressure over the past several years which has resulted in rolling blackouts in the country (Folly, 2021).

Not only is the mining industry an energy intensive industry, but it is also water intensive. This is reflected the interviewees responses, the next element which was mentioned the most was water management. Unlike energy efficiency and transition, under water management, they had both positive and negative sentiments about the element. As stated by Northey et al. (2016), effective water management practices are important when it comes to sustainable mining operations and the reduction of the industry's impact on various water sources. The implementation of innovative water management strategies such as recycling, using water efficiently and treating wastewater responsibly, the industry can mitigate waters scarcity risks in a country that is already water scarce like South Africa and improve their environmental sustainability performance (Fraser & Kunz, 2018). Just like energy efficiency practices and transition, finding innovative ways to manage water can lead to cost savings, operational efficiency, compliance, and improvement in environmental sustainability performance. On the other hand, there are also water related challenges, such as quality issues through contamination, limited availability, and increased competition for water resources and these can pose a challenge to innovation (Hamilton, 2018).

After water management, the next element mentioned by respondents was waste treatment.

Managing waste effectively helps minimise the environmental impact of mining operation and promotes sustainable practices (Ranjbari et al., 2021). Implementing innovative waste treatment practices such as the use of mine waste for other applications such building roads, recycling and responsible disposal methods, the industry can mitigate the negative effects of waste generation (Lottermoser, 2011). This can also lead to waste reduction, reduced pollution as well as environmental and economic benefits. On the negative side, bad waste management practices have in the past been a challenge leading to negative environmental and health consequences. An example of this is poor management of mine tailings, tailings are waste materials left over after valuable minerals have been extract through various mining practices (Kossoff et al., 2014). The uncontrolled release of tailings into near water bodies contaminate the water and make it unfit for use and even destroying aquatic life and biodiversity that relies on this water to survive. More than this, if tailings dams are not managed properly, they lead to catastrophic failures which has in the past lead to loss of lives and damage to the surrounding area (Lyu et al., 2019).

GHG emissions were the second factor identified by respondents. On this topic, the overwhelming feeling was that the mining industry has become more innovative as a result of efforts to reduce GHG emissions. Due to the energy intensity of its operations and reliance on fossil fuels like coal and diesel, the sector is one of the greatest emitters of GHG (Igogo et al., 2021). The industry's sustainability and climate commitments depend on reducing these emissions and moving toward a low-carbon future. The industry may promote innovation and lessen its carbon footprint by implementing cutting-edge solutions like carbon capture and storage systems (Chanda & Bose, 2020). However, the transition towards being low-carbon emitters does come with challenges which can potentially be barriers to innovation. These can include the high capital expenditure of implementing new low emitting technologies, carbon capture technologies, the uncertainty of reliability of renewal energy resource and the complexity of emissions reduction targets (Gürsan & de Gooyert, 2021).

During the interviews, GHG emissions were mostly mentioned alongside climate change but perspectives on climate change were somewhat different from GHG in those more negative sentiments arose from it being mentioned. Challenges posed by climate change in the industry include climate change impacts such as water scarcity, extreme weather events delaying operations and shifting goal posts when it comes to regulation (Lioubimtseva & Henebry, 2009). These may require a significant amount of funds for investment, collaboration, and advancement in technology.

In conclusion, the energy issues the South African mining industry has as a result of failing public utilities, the need to minimize greenhouse gas emissions, and the switch to renewable energy sources are all factors that encourage innovation in the sector. On the other hand, mismanagement of water and waste as well as heavy demands that come with climate change present barrier to innovate in the mining industry.

5.3.2.2 Social factor

During the interviews with interview participants, their responses indicated that these social elements were most influential in the industry; infrastructure development, the appointment of local suppliers, skills and community development, health and safety and attaining a social license. Under this section, the number of respondents who mentioned each element of the environmental factor is broken down to show the number of respondents who had negative sentiments about element which is interpreted as thwarting innovation and positive sentiments about the element which is interpreted as supporting innovation.

The social factor in the mining industry plays an important to both supporting and potentially hindering innovation and areas like sustainable business models. The social environment in which the sector functions is quite complicated; major factors that must always be taken into account include stakeholder expectations, community relations, and social license (Parsons et al., 2014). To actively support their own innovation efforts in how they operate, mining companies need to actively engage local communities, respect human rights, and be inclusive in their practices in order to promote social well-being. The integration of social considerations into operations enhances company reputation, builds trust with stakeholders, and creates shared

value for communities they operate in (Alsayegh et al., 2020). In doing so, they support the implementation of innovations such as the sustainable business model innovation that aligns social success with economic progress.

However, negative social impacts such as displacement of communities and labour disputes can lead to social unrest, legal disputes and reputational damage which can thwart innovation efforts (Vanclay & Hanna, 2019). Despite the millions of rands spent on social initiatives by mining companies, communities situated around mining operations are still plagued with inequality and every now then social unrest arise (Freed, 2017).

Under the social factor, the first element mostly mentioned during the interviews was infrastructure development or building of infrastructure such schools, roads, and clinics by mining companies for surrounding communities. When the mining industry invests in community infrastructure such as schools, clinics, and roads, it brings positive impact on local development and social well-being. Through these investments on essential infrastructure, the industry is actually developing human capital and growing local talent which may be needed in the industry or a different industry (Faggian et al., 2017). Further to this, collaboration between the mining companies and communities in infrastructure projects can grow social cohesion, foster partnerships, and drive innovation through sharing knowledge and expertise (Hamann, 2004). However, there are potential challenges posed by mining companies using resources towards infrastructure developments efforts. There is a concern that a focus on community infrastructure has potential to divert resources and attention away from innovations needed by the mining industry itself (Lockie et al., 2009).

The selection of vendors came next on the list. In order to correct historical economic injustices against black businesses, the South African government established a Broad-Based, Black Economic Empowerment (B-BBEE) policy for corporations to follow (Sibiya & Barnard, 2020). Companies like mining companies use ESD programs to this end. ESD is utilized as a means of establishing and maintaining small companies in mining communities and has grown to be significant in the South African mining sector (Ntombezintle, 2022). These initiatives are target at black owned small

to medium enterprises (SMEs). This is also using a vehicle to foster collaboration between mining companies and the communities.

There are however challenges raised by some ESD programmes such as the fact that local suppliers or contractors don't always poses all the necessary skills needed to complete a project and the difficulty in enforcing accountability (Rogerson, 2008). Lastly, despite the efforts made by the South African government to achieve growth foster growth through programmes such as ESD, inequalities persist (Ntombezintle, 2022).

Appointing local suppliers is linked to the next elements mentioned by interview respondents which is the creation of job for the local community members. Job creation is a crucial part of sustainable development, it promotes economic growth within the communities, and also promotes social welfare (Shackelton et al., 2008). Job creation in these communities does not only stimulate the economy, but it fosters entrepreneurship through ESD programmes and innovation as local gain skills and experience. According Matebesi and Marias (2018) local community member increasingly leaning towards wanting ownership in the mines, they want to be partners and own share, they are no longer satisfied with merely getting jobs and participate in ESD programmes. A challenge seen with this element of job creation is that jobs are dependent on mines being in operation and being profitable and this is subject to fluctuations in commodity prices as well as conditions seen in the market (Rehner et al., 2014). Community locals need skills that are applicable to other industries as well as communities that are sustainably developed. This links to two other elements of the social factor which are skills development and community development.

The next element which was mostly mentioned and had quite strong views was 'health and safety'. All of the views from the responses where positive ones and the element was thought to support innovation and change the way business was done by mining companies and so supported sustainable business model innovation. Rightfully so, as Kumah (2006) noted, as worker well-being as well as the general sustainability and productivity of mining operations are directly impacted by health and safety. Realising how important the wellbeing of workers is, mining companies in South African have and are still prioritising health and safety practices which has led to significant

advancements and innovative approaches to mining (Guild et al., 2001). By investing in safer equipment, the implementation of stringent safety protocols and providing safety training, mining companies are increasingly able to provide safe working environments for their employees. The health and safety focus not only takes care of the workers' wellbeing but it in turn supports sustainable business model innovation by reducing costs associated with safety incidents and therefore improving productivity of the operation (Ismali et al., 2021).

The mining industry's efforts to not only pursue but also retain a social license to operate were the final important factor that respondents raised. A social license is not a legal document, but rather the community or society where a mining business operates accepting, trusting, and supporting it (Parsons et al., 2014). It can also be viewed to be beyond legal compliance and gives legitimate reflection of the company's activities. It is earned through socially and environmentally responsible and sustainable practices and built through meaningful and respectful collaboration with local stakeholders (Harvey & Bice, 2014). By integrating social considerations into how business is conducted or mining companies' business models, the industry is able to great shared value and minimise social impacts (Mbilima, 2021). Additionally, mines are able to employ local knowledge and experience for more sustainable and context-specific business practices by involving local populations in the decision-making process and the co-creation of solutions (Randhawa et al., 2018).

In conclusion, elements mentioned in the social factor were generally spoken off in a positive light, they are seen to support innovation. Health and safety, the attainment and maintenance of a social license to operate and community developments did not have negative sentiments. By integrating social considerations into how business is conducted or mining companies' business models, the industry is able to great shared value and minimise social impacts (Mbilima, 2021). The health and safety focus not only takes care of the workers' wellbeing but it in turn supports sustainable business model innovation by reducing costs associated with safety incidents and therefore improving productivity of the operation (Ismali et al., 2021).

5.3.2.3 Governance factor

During the interviews with interview participants, their responses indicated that these governance elements were most influential in the mining industry; regulation and policy (this is government regulation and policies for the mining industry in this context), collaboration, technical advancements, financials, corporate strategy, inclusion and diversity, investment companies such as Blackrock and banking institutions, reporting and compliance and politics. Under this section, the number of respondents who mentioned each element of the governance factor is broken down to show the number of respondents who had negative sentiments about element which is interpreted as thwarting innovation and positive sentiments about the element which is interpreted as supporting innovation.

Al Faruque (2015) states that strong governance practices are important for the establishment of accountable and transparent systems in any company including mining companies. The practice of good governance produces long-term value creation, and attracts sustainable investment, which can be a drive of technological innovation, processes, and operational practices that improve environmental performance, social performance or impact, and sustainability of the overall business (Alsayegh et al., 2020). The adoption of good governance framework, and responsible leadership, mining companies can create an environment where sustainable business model innovation thrive.

However, any type of sustainable innovation might be hampered by poor governance practices, the existence of structures or conditions that hinder the application of good governance, or both. Lacking governance structures, insufficient transparency whether by a company or supporting structures such as government can create risks and challenges that hinder innovation (Ahrens & Rudolph, 2006).
Regulation and policy stood out as the most mentioned element in the governance factor, it was also the most mentioned in all of the factors (environmental, social, and governance). Many responders to this research question who referenced regulation and policy did so in the context of how government regulation and policy affected the mining industry and did so with a negative attitude. According to the Fraser Institute's annual survey rankings of the policy-attractiveness of countries' resources sectors, South Africa was ranked 75th out of the 84 jurisdictions examined in 2023 (MCSA, 2023), echoing these sentiments.

This regulatory and policy uncertainty has been in play for a number of years now, Leon (2015), cited that a decline or contraction of the mining industry's growth is attributed to uncertainty that lies in regulation and policy, he stated that a combination of changing regulatory regimes with some of the MRPDA's vague and ambiguous provisions have in fact led to delay in issuing permits as well as well licenses. He also cited flaws in BEE that it has promoted narrow rather than broad-based black ownership of the mining industry. The mining industry in South African is also regulated by multiple government departments which has led to complexities and challenges (Mpanza et al., 2021). This can lead to overlapping responsibilities, and delays in decision making processes. These South African agencies include, among others, the Department of Water and Sanitation, the Department of Environmental Affairs, and the Department of Mineral Resources and Energy (DMRE) (Mpanza et al., 2021).

However, regulation and policy in place are not all that bad or only thwarting innovation, there's a positive side to this as well especially in areas of ESG performance and sustainability. These regulations and policies give frameworks that are responsible for promoting responsible mining, environmental protection, and social impact, this helps with long-term sustainability of the industry (Bilham, 2020).

The next most mentioned element was collaboration, just like regulation and policy, there were respondents cited levels of dissatisfaction with the limited levels of collaborations that they have seen or experienced between the mining sector and other sectors. The respondents mostly had positive sentiment but the ones who had negative sentiments had stronger views. They mention the underlying innovation potential that remains untapped due to lacking collaboration. The first area of disconnect or lack of meaningful collaboration is at national government level where not enough collaboration with the mining industry has resulted in policy and regulation that is not favourable to the industry. This is demonstrated by the Fraser Institute's yearly survey rankings of the policy-attractiveness of the resources sector for each country, which were published in 2023 and placed South Africa 75th overall out of the 84 jurisdictions evaluated (MCSA, 2023). When mining firms create Social Labour Plans for the initiatives that will be put in place for mine closures, Marais (2013)

criticized the lack of early community input in the decision-making process. This is also reflected by the high levels of dissatisfaction amongst mining communities despite the large amounts of funds being spend on corporate social initiatives by mining companies, it speaks to a lack or limited consultation/collaboration with the communities that the money is being spent on (Hamann, 2004).

There are however positive cases of collaboration that involve the mining industry, an example is the positive collaboration between government and the mining industry to come up with efficient response and vaccine strategies during the COVID-19 pandemic (Atif et al., 2020). The government was able to leverage the mining industry's experience in conducting daily medical test on their employees and experienced medical staff. Yakolvleva et al. (2017) have argued that the focus of sustainable development policies for mining sectors or companies in developing nations should be collaboration, such as mining companies partnering with governments, investment, as well as cross-sector collaboration to bring about good health, education, and infrastructure. The South African government has come to understand the value of working with the mining sector and the need to provide it with the finest tools for innovation. For the purpose of research and development as well as innovations that will shape the future of mining in the nation and develop a vision for mining 2030, the state has established a public-private partnership between the Department of Science and Innovation (DSI), the Minerals Council of South Africa (MCSA), and the South African mining industry (Macfarlane, 2018).

The next element mentioned by respondents to have influence in the mining industry is technical advancements. Positive sentiments were made about this element, and it is seen as a positive driver of innovation. As it pertains to sustainability, technical advancements that allow mining companies to monitor their operations and give reliable forecasts of operational performance and safety have been quite key (Litvinenko, 2020). Employing a combination of technically advanced and efficient machinery as well as good asset maintenance practices not only help mining companies' production and operation up time, but they are also good for the environment as they emit less GHG and have as little leaks as possible (Holmberg et al., 2017). Apart from production and environmental gains, technological advancement has helped the mining industry become safer than has been in the past with the

introduction of remotely operated machinery which have reduced to need for miners to be in hazardous environments (Ralston et al., 2015).

Respondents mentioned financials as the next element. Respondents who spoke of finances in the mining sectors in respect to innovation in a positive light are slightly more than those who spoke of it in a negative light. These views were largely based on mining companies that have a good financial standing and their ability to invest in sustainability and innovation. Finances in the form of investment have a significant influence on both innovation and sustainable development. With the world becoming more sustainable, new investments need to be made into the mining and production of strategic minerals such as copper, according to Elshkaki et al. (2016), the world's copper demand will increase by between 275 and 350 percent by the year 2050 and this will need significant financial investment. When it comes to finances, for sustainability reasons, mining company cannot only think about operations and investments into new mining ventures, the also need to be thinking about mine closure requirements (Peck & Sinding, 2009). This entails leaving viable an ecosystem that supports human activity, a healthy environment as well as an alternative sustainable human activity. For this to be in place, there needs to be financial assurance that ensures innovative, clean, and lasting closure of mine (Peck & Sinding, 2009).

Inclusion and diversity, which respondents saw as a factor supporting innovation and sustainability, was the second factor mentioned by respondents. Kincaid and Smith (2021) claim that the mining industry is reliant on inclusion and diversity to handle problems like public pressure and the constant desire for cutting-edge technological answers to mining problems. A study by Houston (2021), which asserts that diversity in senior management teams can add value through innovation and an improvement in performance in the mining industry, supports the positive opinions revealed in the interview responses.

Respondents then mentioned the influence of investment companies on the mining industry innovation for sustainability. Their sentiments when it came to the element were mostly negative. An investment company called BlackRock conducted a sustainable investment survey in 2020 and found that 86% of the surveyed responders in Europe, the Middle East, and Africa indicated that sustainable is or will become

central to the investment strategies (Steele-Schober, 2021). They stated ESG being a positive influence on a company's market value being the reason for this. Institutions like banks are responsible for borrowing money to mining companies, they are increasingly including the borrower's ESG performance in the assessment of risk and finance pricing (Lambertz, 2022). Lambertz (2022) also states three potential motivations lenders and investors integrate ESG into their lending and investment requirements, these are; preservation of self-reputation, decisions that good ESG performance is associated with good financial performance, and transparency. But ESG performance comes at a cost to mining companies, the requirements from investors and lenders before funds are released may in themselves require that mining companies invest in environmental protection, social responsibility, governance practices (Zhai, et al., 2022).

The final key element mentioned by respondents was reporting and compliance, there were more negative than positive sentiments on this element as well. The requirements of reporting and compliance play a significant role in shaping the behaviours and practices of mining companies as it pertains to ESG (Bilham, 2020). The criticism that came from interview respondents were on the fact that some ESG reporting was based on inputs and not outcomes of the initiated ESG programmes.
In summary, regulation and policy along with politics, investment companies, and reporting and compliance were seen by interview respondents as thwarting innovation in the mining industry while collaboration, finances, technical advancements, cooperate strategy as well as diversity and inclusion were seen as element supporting innovation.

To conclude this section, the below answers the second research question, and prove or disprove the accompanying proposition. In the first research question it was found that governance was the most influential factor of ESG in the mining industry according to the data gathered from research interviews. In this section, the researcher asked how this factor thwarts or supports SBMI. As seen in the analysis and discussion of the research data above, inefficiencies cause by uncertainty in regulation and policy cause delays such as licensing and permit delays for innovations needed in the mining industry. Secondly, expectations on mining companies by investments companies put a financial burden in the face or competing priorities for mining companies. Thirdly,

pressures on frequent reporting for compliance reasons see mining companies report on inputs rather than on outcomes based on impact made through their ESG initiatives.

Then it was found that elements such as collaboration, finances, technical advancements, and diversity and inclusion support sustainable innovation. Mining sectors or firms in poor countries should put a strong emphasis on sustainable development through partnerships with the government, investment, and cross-sector collaboration to improve infrastructure, health, and education. As it pertains to sustainability, technical advancements have allowed mining companies to monitor their operations and give reliable forecasts of operational performance, help predict and avoid safety incident and closely monitor the leak of potentially harmful substances to the environment (Litvinenko, 2020). Investments into these technical advancements and the investment into the mining and production of strategic minerals such as copper is heavily reliant on funds from investment companies and banking institutions. The mining industry can benefit from diversity among senior management teams by improving ESG performance and innovating (Houston, 2021).

5.3.3 How might adaptive management be used in the process of SBMI

According to Kingsford et al. (2017) adaptive management involves ongoing monitoring, evaluation, and adjustment of strategies and practices based on feedback and new information. It is a method for managing natural resources while also learning about them, according to Williams (2011). William (2011) discusses the history of adaptive management in his paper. Beverton and Holt (1957) provided one of the earliest explanations of the theory in the context of natural resources, such as fisheries, but they used the term "adaptive decision making" rather than "adaptive management." Years later, Holling (1978) gave the concept of adaptive resource management a name and established a conceptual foundation. However, Walters (1986) did not present an exhaustive technical analysis of adaptive decision-making until 1986. According to Failing et al. (2004), numerous people have occasionally made false claims that they utilize an adaptive management technique to manage natural resources.

Adaptive management according to Holling (1978) involves experimentation in the implementation of policies and when it comes to resource management, it is a methodological innovation, he states that is a process of learning by doing. This suggests that managing resources and putting policies into practice involve an iterative process with updated goals and fresh tactics (Lee, 1999). The key components, according to Keith et al. (2011), are management goals, an understanding of the strategies that can be used to achieve these goals, uncertain environmental responses to management actions, continuous monitoring to attempt to measure outcomes, and finally, learning from experience of prior actions to enable better iteration of actions.

The third study question, "How might adaptive management be used in the process of sustainable business model innovation," will be addressed in this section. The researcher decided to look for evidence that the mining companies in South Africa engaged in data-driven decision making, monitoring and evaluation, innovation and adaptation, stakeholder engagement, as well as collaboration and partnership because adaptive management involves a process of learning, iteratively implementing novel ways of managing resources to get the revised ends. Data for this evidence was gathered from annual ESG and sustainability reports (from 2019 to some in 2023) of the top 5 mining organisations in South Africa by market capitalisation in 2022.

For data-driven decision-making, on-going monitoring of data is used for the evaluation of interventions made by management, normally these interventions (Kuiper et al., 2023). The data presented in chapter 4 shows that the chosen companies utilise data in their decision making with an example of one having a sustainability framework for input of data to help with sustainability initiative prioritisation. They report the use of continuous data collection and analysis for tracking their progress as well as improving improvement areas.

Then for evaluation and monitoring, in the context of adaptive management it involves monitoring and evaluation of implementation actions with the intention to learn and reiterate (Kuiper et al., 2023). Data presented shows the chosen companies engage in monitoring and evaluation, for example some of these companies conduct regular

sustainability assessments along with implementing a sustainability reporting dashboard.

For the third element innovation and adaptation, this is about the emphasis on the capacity to adapt as well as modify factors such as management strategies and SBMs (Williams & Brown, 2013). Data on the selected companies shows that they have implemented sustainability initiatives to help innovate and adapt their business models in respond to sustainability challenges. Some have adapted to the national energy crisis and implemented renewable energy strategies to add solar and wind energy to their energy mix respectively.

For the fourth element which is stakeholder engagement, Williams and Brown (2018) state that stakeholder engagement provides a mechanism for receiving ongoing feedback, have dialogue and opportunities for learning. Regular engagement with stakeholders allows them to receive regular input on the performance and effectiveness of management action such as modification of sustainable business models in this context, monitor outcomes, and identify areas of improvement. Companies selected reported engaging with stakeholders as part of their sustainability strategies, one of them for example has what's called Sustainable Development Forum use to engage with local communities, and they also established regular meeting with other stakeholders. These companies have reported to have continued to engage with communities and other stakeholders virtual during COVID-19 pandemic.

Finally for collaboration and partnerships, Webb et al. (2017) states that success in adaptive management depends on forming and maintaining strong partnerships as well as not undermining the importance of individual teams. They also state that such partnerships allow for coordinated monitoring of programs and the creation of innovate ways to doing evaluation. Data from selected companied shows that they are collaborating with other stakeholders and partners for example, they continuously partner with the South African government and other stakeholders such as communities to come up with water demand management strategies and institutions such as the university of the Witwatersrand to develop a climate risk management tool.

Comparing Interview responses with data from annual reports

Despite data from the five chosen companies' annual reports showing evidence of data-driven decision making, monitoring and evaluation, innovation and adaptation, stakeholder engagement as well as collaboration and partnership, data collected from interview respondents point to an existence of gaps in ESG performance and a need for adaptive management in process of SBMI.

The first research question looked into which of the three ESG (Environmental, Social, and Governance) factors the South African mining sector paid the most attention to. According to response data, governance received the greatest attention. In practice, adaptive management needs an equal pursuit of conserving the Environment, empowering Society, and excelling in business development and Governance (Holling, 1995). See Figure 6 below:

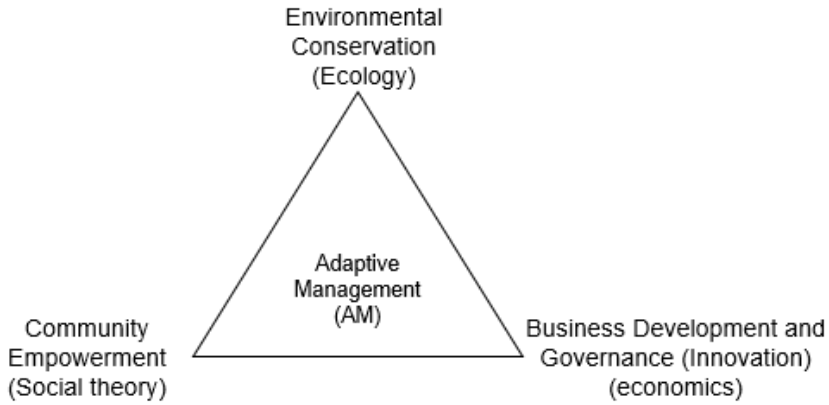


FIGURE 13. ADAPTED FROM ADAPTIVE MANAGEMENT FRAMEWORK BY HOLLING (1995).

Leopold (1968) introduces the concept of interconnectedness of all elements in an ecosystem in his writing titled "Thinking like a mountain". He uses a metaphor of a mountain, a wolf, a deer, a hunter, and a farmer to explain that in an ecosystem, all elements are equally important, one cannot survive without the other and the elimination of one is to the detriment of the entire ecosystem. The mining industry in South Africa must take into account the entire ecosystem, the interconnectedness of the environment, society, and business in the form of governance, in order to pursue sustainable development by focusing on ESG performance and engaging in sustainable business model innovation.

When innovating in all components of SBMI, whether it is SVPI, SVC&DI or SVCI all factors of ESG need to be equally considered.

How can adaptive management be used in the process of SBMI

By including all ESG factors and ensuring that their performance is pursued with equal emphasis, adaptive management can play a significant role in the process of developing innovative sustainable business models.

In the literature, there are two types of adaptive management: active adaptive management and passive adaptive management. Active adaptive management entails experimenting with management actions, whereas passive adaptive management merely entails putting actions into practice, watching for results, and then revising actions iteratively in response to these results (Keith et al., 2011). Passive adaptive management would not be suitable for the mining industry, it involves minimal intervention and relies on natural processes to drive changes (Atkins et al., 2020). Active adaptive management on the other hand involves the proactive monitoring, experimentation and iterative implementation of actions based on new knowledge.

The strategies described below can be utilised to innovate in the domain of sustainable business model development:

- Learning and feedback loops: This involves promoting a culture of continuous learning and feedback. It can be done through encouraging employees to give insights and idea on SBMI and ESG performance. Actively get inputs from stakeholders, this includes customers, communities, and industry experts (Archibald et al., 2018).
- Experimentation and innovation: This involve embracing experimentation and innovation as an integral part of SBMI (Massa & Tucci, 2014). It can be done through testing new approaches, processes and technologies that have the potential to enhance SBMI and address ESG challenges. Monitoring and evaluating outcomes of the experiment to see if they were effective and if they can be done at a bigger scale would go a long way.
- Adaptation and Iteration: This is adapting and iterating the sustainable business model using insights gained through experimentation, learning as well as monitoring and evaluation (William & Brown, 2014). This can be followed by the implementation of changes that aligns with driving positive outcomes in terms of environmental impact, social well-being and good governance practices.

5.4 CONCLUSION

Which ESG element (environmental, social, or governance) is significant to innovation in sustainable business models? was the initial study question and proposal. and "In the South African mining industry, the researcher proposes that the social factor may have a stronger influence on sustainable business model innovation in the South African mining industry due to the large existence of Corporate Social Responsibility (CSR) initiatives by the industry (Hamann 2004)" are two examples of statements that describe the South African mining industry. The nature and direction of the relationship between ESG and sustainable business models have been studied in literature to some extent in sectors like finance. According to the study, there is a reasonably high association between social variables and sustainable business models (SBMs) in Europe, out of the three categories of environment, social, and governance (Spoz et al., 2021).

But when analysing the full data given through responses from all 20 participants for this research study, it points towards governance being the most influential factor. They had stronger views on elements of the governance factor and a lot of what they had to say in their responses pointed towards the governance factor as being more influential. Therefore, the most influential factor of ESG to sustainable business model innovation according to data collected during interviews is the governance factor. The first research proportion therefore disproved or is untrue.

For the second research question, the researcher asked how this factor thwarts or supports sustainable business model innovation. As seen in the analysis and discussion of the research data above, inefficiencies cause by uncertainty in regulation and policy cause delays such as licensing and permit delays for innovations needed in the mining industry. The second research question focused on how this aspect hinders or promotes the development of sustainable company models. As can be observed from the analysis and discussion of the research data above, inefficiencies brought on by regulatory and policy uncertainties result in delays, including those for

obtaining licenses and permits for innovations required in the mining sector. Then it was found that elements such as collaboration, finances, technical advancements, corporate strategy, and diversity and inclusion support sustainable innovation.

How this element hinders or promotes the generation of sustainable business models was the subject of the second study question. As can be observed from the analysis and discussion of the study data presented above, regulatory and policy uncertainty results in inefficiencies that lead to delays in the licensing and issuance of permits for innovations that the mining industry needs.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In Chapter 6, research findings are summarized, along with a conclusion based on empirical information obtained through interview data. Additionally, conclusions are reached in light of the reviewed material. This study looked at how ESG performance (by analysing the various components) and innovative sustainable business models in the mining sector in South Africa relate to one another. Mining has a reputation for having significant negative social repercussions because of its extractive nature and the fact that most of its natural resources and reserves are found in developing nations (Krause & Drusche, 2021). This is supported by the literature reviewed in the review section of the report.

Mining communities in South Africa are still grappling with socio-economic challenges and environment impacts caused by mining activities such as the collapse of mine tailings dams are still legacies of the mining industry (Liefferink, 2019). The industry, like other industries and sectors, measures and reports its impact on the environment and society using environmental, social, and corporate governance (ESG) performance. This study set out to discover how ESG performance affects the development of the mine's sustainable business model.

In order to enable management professionals create with purpose in sustainable business models and make a beneficial influence on the environment and society while thriving economically, it attempted to produce scientifically based insights. Since studies have been undertaken in the global north regions like Europe but not in the global south, the study aims to add to the body of knowledge on the impact of ESG on developing innovative sustainable business models in countries in the global south.

Interviews were used to gather data, which was then recorded, transcribed, and analysed for reoccurring themes that provided answers to the research questions and supported or refuted the stated propositions. According to Lacey et al. (2016), the researcher used a content analysis methodology to examine the frequency of ideas, patterns in interpretations, and phrases. On the other hand, categories of information

received from interviews were created using selective coding and/or theme analysis. Three research questions where posed and data collected through interviews and from company documents, these are the questions:

i. Which of the ESG factors, Environmental or Social or Governance, is influential to innovation?
ii. SA Mining companies are already incorporating sustainability goals, concepts and principles into their business models. In their quest to innovate, how do these ESG factors support or thwart their sustainable business model innovation?
iii. How may the innovation of sustainable business models make use of adaptive management?

The third question was helpful in generating recommendations for the industry based on adaptive management theory. The study concludes with recommendations based on the research findings, limitations of study, and suggestions for further research.

The below were propositions made for the three research questions above respectively:

i. i. As shown by the research problem, while some writers reported a substantial correlation between environmental factors and SBMI, others discovered social elements to have a stronger influence. Due to the widespread prevalence of Corporate Social Responsibility (CSR) initiatives by the industry, the researcher hypothesizes that social variables may have a bigger impact on SBMI in the South African mining industry (Hamann 2004).
ii. ESG in most mining companies is reduced to CSR initiatives shaped by charitable donations with not much effort directed toward changing business' core practices and have limited meaningful collaboration with external stakeholders (Hamann, 2004)
iii. Adaptive management can be used to explore and experiment with new ways of managing resources, conserving the environment, and developing society while achieving economic growth.

6.2 MAJOR FINDINGS

6.2.1 Literature Findings

The literature review has shown that the literature currently in circulation does not adequately establish a link between ESG performance and innovative sustainable business models used in the mining sectors of developing nations like African nations (this research study is only limited to the South African context). In a study conducted by Ritala et al., (2018) on United States companies listed in the S&P 500, they found that a large numbers of firms in this index adopted environmental-oriented categories of sustainable business models (SMB) more than they did ones that are oriented towards society on the ESG categories. In a study with a primarily European focus, the authors discovered that there was a moderately strong correlation between social factors and sustainable business models (SBMs) in Europe. They sought to identify the most notable patterns in drivers of companies' business models adapting to sustainability business models and link them with their relationship to ESG categories (Spoz et al., 2021). In another study by Bak et al. (2022), where they wanted to find out if there was any difference on the impact of ESG on BMs in countries belonging to different continents, the study found that more publications on ESG factors are produced in European countries than in Asia and concluded that ESG had more impact on business models of companies belonging to European countries.

The South African mining industry was used as a case study in this research, and it was discovered that despite adaptive management not being specifically mentioned in their annual ESG and sustainability reports, the industry has adopted a significant number of ESG practices and has consistently used business elements that are indicative of it. In innovating their value proposition, they've strongly considered the environment, society, and an ethical way of doing business. Sustainable innovation in value delivery and delivery has taken a form of partnerships with locals in major projects and sustainable value capture innovation has taken a form of adding new revenue models to their portfolios such as building renewable energy subsidiaries such as Seriti Green by a South African coal mining company called Seriti.

6.2.2 Findings from data collected from interviews

Under the environmental factor, it was discovered that these elements are the most influential and therefore heavily considered when mining companies undertake innovation:

- energy efficiency and transition
- water management
- waste treatment
- green-house gas emissions and
- climate change.

As energy costs continue to increase and become more difficult to absorb by mining operations (CSIR, 2020), with the national electricity supplier increasingly becoming unreliable (Votteler & Brent, 2016) and a pressing need to reduce GHG emissions, mining companies are slowly transitioning to self-electricity generation through the adoption of renewable energy. When it comes to GHG emissions, the industry generates up to 65 billion tons a year (Kalisz et al., 2022), this needs to be dealt with innovatively, but the mining industry struggles with this because of the tedious nature of compliance involved in this element. Waste management in the mining industry is addressed through two (2) primary pieces of legislation and eleven (11) secondary pieces, when it comes to departmental management, it is governed by three primary and six secondary departments (Adler et al., 2007). Respondents expressed positive sentiments on energy efficiency and transition signalling that this element was supporting innovation while water management, waste treatment and climate change had negative sentiments signalling the fact they these elements may be thwarting innovation.

Under the social factor, it was discovered that these elements are the most influential and therefore heavily considered when mining companies undertake innovation:

- infrastructure development
- the appointment of local suppliers
- skills and community development
- health and safety and

- attaining a social license.

The respondents hinted at the idea that water projects have been the most effective infrastructure initiatives. Mining activities lead to the creation of new water infrastructure or the extension of already existing water infrastructure, which in turn results in some water projects for the community. Additionally, they participate in developing the necessary skills for managing and maintaining the infrastructure (Admiraal et al., 2017).

The appointment of local suppliers is achieved through programmes such as enterprise supplier development (ESD) which has become quite important in the mining industry and used as a vehicle for establishing and sustaining local businesses in mining communities (Ntombezintle, 2022). These initiatives are target at black owned small to medium enterprises (SMEs). This is also using a vehicle to foster collaboration between companies and the communities.

Every legitimate mining company measure health and safety and has it amongst their priority items. In order to attempt and prevent mining accidents, occupational health risks, and injuries, the mining industry in South Africa lays a strong emphasis on health and safety (Tshoose, 2014). In order to protect the health and safety of persons working in and around mines, mining companies are required by law to adhere to regulations regarding health and safety (Muthelo et al., 2022). Health and safety must be the primary consideration in every sustainable value proposition innovation produced by the mining industry.

The final essential component is social license, which is the community's or society's acceptance, confidence, and support of a mining firm (Parsons et al., 2014). According to interview respondents, this may very well be the reason mining firms engage social efforts under ESG.

Under the social factor all the key elements mentioned were mostly mentioned in a positive light meaning that they were seen as elements supporting innovation. Some respondents did though have negative sentiments about building of infrastructure such as schools and clinics, the appointment of local suppliers and initiatives to develop skills.

Under the governance factor, it was discovered that these elements are the most influential and therefore heavily considered when mining companies undertake innovation:

- regulation and policy (this is government regulation and policies for the mining industry in this context)
- collaboration
- technical advancements
- financials
- inclusion and diversity
- investment companies such as Blackrock and banking institutions as well as
- reporting and compliance.

Regulation and policy stood out as the most mentioned element in the governance factor, it was also the most mentioned in all of the factors (environmental, social, and governance). It in fact stood out as the one element that impedes innovation in the mining industry more than the other mentioned element. This is because the mining industry needs permits and licenses for initiatives they take due to environmental and social impacts they potentially have, the vague and ambiguous provisions in the regulation causes delays issuing permits as well as well licenses (Leon, 2015). This is demonstrated by the Fraser Institute's annual poll, which in 2023 ranked South Africa 75th out of the 84 jurisdictions surveyed in terms of how attractive the resources industry is from a policy perspective (MCSA, 2023).

Similar to regulation and policy, some respondents expressed degrees of unhappiness with the scant levels of partnerships between the mining industry and other sectors that they had seen or experienced. The respondents mostly had positive sentiments but the ones who had negative sentiments had stronger views. The lack of meaningful collaboration at national government level, where there is not enough collaboration with the mining industry, has resulted in policy and regulation that is not favourable to the industry. This is supported by the aforementioned survey from the Fraser Institute, which ranks the policy attractiveness of countries' resources sectors and placed South Africa 75th overall out of 84 jurisdictions surveyed.

Technical advancements on the other hand are favourable to sustainable innovation. For example, employing a combination of technically advanced and efficient machinery as well as good asset maintenance practices not only help mining companies' production and operation up time, but they are also good for the environment as they emit less GHG and have as little leaks as possible (Holmberg, et al., 2017). Just like in most industries, technical advancement leads innovation in the industry as well.

On the finances element, large sums of money are needed to make investments into new sustainable mining operations or mining of minerals that are considered important for the world to decarbonise and go green. With the world becoming more sustainable, new investments need to be made into the mining and production of strategic minerals such as copper, according to Elshkaki et al. (2016), the world's copper demand will increase by between 275 and 350 percent by the year 2050 and this will need significant financial investment.

The 'investment companies' element is linked to the finance element. An investment company called BlackRock conducted a sustainable investment survey in 2020 and found that 86% of the surveyed responders in Europe, the Middle East, and Africa indicated that sustainable is or will become central to the investment strategies (Steele-Schober, 2021). Lambertz (2022) also states three potential motivations lenders and investors integrate ESG into their lending and investment requirements, these are; preservation of self-reputation, decisions that good ESG performance is associated with good financial performance, and transparency. But ESG performance comes at a cost to mining companies, the requirements from investors and lenders before funds are released may in themselves require that mining companies invest in environmental protection, social responsibility, governance practices (Zhai et al., 2022).

A study by Houston (2021) indicated that diversity among senior management teams can add value through innovation and an improvement in performance in the mining industry, which supported the respondents' comments on inclusion and diversity. According to Kincaid and Smith (2021), the mining sector is relying on inclusion and

diversity to manage issues including public pressure and the ongoing desire for cutting-edge technology solutions to mining concerns.

Then finally, on the last element reporting and compliance is the first driver for sustainability innovation in most cases even though most important for society and environment, it is driven by governance. The requirements of reporting and compliance play a crucial role in shaping the behaviours and practices of mining companies as it pertains to ESG (Bilham, 2020). Input based reporting was heavily criticised by respondents as this can be misleading due to a lack of visibility on the outcomes.

6.2.3 Findings from data collected from annual ESG and sustainability reports

Because adaptive management involves a process of learning, iteratively implementing novel ways of managing resources to get the revised ends, the researcher chose to look for evidence that the mining companies in South Africa engaged in data-driven decision making, monitoring and evaluation, innovation and adaptation, stakeholder engagement as well as collaboration and partnership. Findings from the documents reviewed showed that the chosen companies utilise data in their decision making with an example of one having a sustainability framework for input of data to help with sustainability initiative prioritisation. On monitoring and evaluation, they engage in monitoring and evaluation, for example some of these companies conduct regular sustainability assessments along with implementing a sustainability reporting dashboard.

Some have adapted to the national energy crisis and implemented renewable energy strategies to add solar and wind energy to their energy mix respectively. Regular engagement with stakeholders allows them to receive regular input on the performance and effectiveness of management action such as modification of sustainable business models in this context, monitor outcomes, and identify areas of improvement under stakeholder engagement. Then under collaboration and partnerships, they continuously collaborate with government and knowledge institutions such as the university of the Witwatersrand for innovative initiatives.

The main finding is that, despite evidence of data-driven decision making, monitoring and evaluation, innovation and adaptation, stakeholder engagement, as well as collaboration and partnership, in the annual reports of the five selected companies, data gathered from interview respondents point to the existence of gaps in ESG performance and the necessity of adaptive management in the process of innovating sustainable business models.

6.3 KEY CONCLUSIONS

This section summarises the answers for each research question and proposition and concludes the research report.

6.3.1 Which of the ESG factors, Environmental or Social or Governance, is influential to innovation?

The social component showed a reasonably strong association for having a beneficial impact on sustainable business models (SBMs), according to a study conducted in Europe by Spoz et al. (2021). It backed up previous research that was cited in the literature review. However, this study indicated that the governance component had the greatest impact on decisions about innovation and the development of sustainable business models in the South African mining sector. Therefore, it was established that the hypothesis put out for this study was false.

6.3.2 How do these ESG factors support or thwart their sustainable business model innovation?

Inefficiencies caused by uncertainty in regulation and policy cause delays such as licensing and permit delays for innovations needed in the mining industry under the governance factor are strongly thwarting innovation and preventing mining companies from realising sustainable business model innovation. Secondly, expectations on mining companies by investments companies put a financial burden in the face or competing priorities for mining companies. Thirdly, pressures on frequent reporting for compliance reasons see mining companies report on inputs rather than on outcomes based on impact made through their ESG initiatives.

Then it was found that elements such as collaboration, finances, technical advancements, and diversity and inclusion support sustainable innovation. Mining sectors or firms in poor countries should put a strong emphasis on sustainable development through partnerships with the government, investment, and cross-sector collaboration to improve infrastructure, health, and education. As it pertains to sustainability, technical advancements have allowed mining companies to monitor their operations and give reliable forecasts of operational performance, help predict and avoid safety incident and closely monitor the leak of potentially harmful substances to the environment (Litvinenko, 2020). Investments into these technical advancements and the investment into the mining and production of strategic minerals such as copper is heavily reliant on funds from investment companies and banking institutions. The mining industry can benefit from diversity among senior management teams by improving ESG performance and innovating (Houston, 2021).

With these findings, the second proposition was proven to be untrue as well.

6.3.3 How might adaptive management be used in the process of sustainable business model innovation?

Active adaptive management and passive adaptive management were the two types of adaptive management covered in Chapter 5. On the other hand, active adaptive management entails proactive monitoring, experimentation, and iteratively putting new knowledge into practice. It may be applied in the methods described below to innovate in the domain of sustainable business model development:

- *Learning and feedback loops.* This involves promoting a culture of continuous learning and feedback. It can be done through encouraging employees to give insights and idea on SBMI and ESG performance. Actively get inputs from stakeholders, this includes customers, communities, and industry experts (Archibald et al., 2018).
- *Experimentation and innovation.* This involve embracing experimentation and innovation as an integral part of SBMI (Massa & Tucci, 2014). It can be done through testing new approaches, processes and technologies that have the

potential to enhance SBMI and address ESG challenges. Monitoring and evaluating outcomes of the experiment to see if they were effective and if they can be done at a bigger scale would go a long way.

- *Adaptation and Iteration.* This is adapting and iterating the sustainable business model using insights gained through experimentation, learning as well as monitoring and evaluation (William & Brown, 2014). This can be followed by the implementation of changes that aligns with driving positive outcomes in terms of environmental impact, social well-being and good governance practices.

6.4 RECOMMENDATIONS

Based on the results of the conducted research study, recommendations have been made to the mining industry in South Africa in this section. Recommendations come from gaps identified as the respondents interview in the mining industry's pursuit of ESG performance and SBMI. Then the last three recommendations come from the recommendations made under the adaptive management section.

- *Learning and feedback loops.* This involves promoting a culture of continuous learning and feedback. It can be done through encouraging employees to give insights and idea on SBMI and ESG performance. Actively get inputs from stakeholders, this includes customers, communities, and industry experts (Archibald et al., 2018).
- *Experimentation and innovation.* This involve embracing experimentation and innovation as an integral part of SBMI (Massa & Tucci, 2014). It can be done through testing new approaches, processes and technologies that have the potential to enhance SBMI and address ESG challenges. Monitoring and evaluating outcomes of the experiment to see if they were effective and if they can be done at a bigger scale would go a long way.
- *Adaptation and Iteration.* This is adapting and iterating the sustainable business model using insights gained through experimentation, learning as well as monitoring and evaluation (William & Brown, 2014). This can be followed by the implementation of changes that aligns with driving positive outcomes in terms of environmental impact, social well-being and good governance practices.

- *Pursue performance of Environmental, Social, and Governance factors* with equal importance as economic gain when embarking on a journey for sustainable business model innovation.
- *Employ and give training on systems thinking* to everyone responsible for sustainable innovation. Promoting systems thinking and capacity building among these resources will allow for holistic thinking in sustainability implementations.

6.5 LIMITATIONS OF THE STUDY

- This study was restricted to the opinions and experiences of the interview subjects and data gathered for yearly ESG and sustainability reports
- It was solely undertaken in the South African setting and its mining industry
- Research interviews were performed in 2023; the industry outlook may change in future.
- Not all mining-related phenomena were studied, the study was restricted to ESG factor's performance and sustainable business model innovation.

6.6 SUGGESTIONS FOR FUTURE RESEARCH

The below have been identified as possible future research to be pursued.

Studies on ESG and sustainable business model innovation have largely been concentrated in Europe and only extrapolation have been made for regions like Africa.

- This study found that the governance factor's which is regulation and policy were the main obstacles to innovation in the South African mining sector. It is necessary to do research on how to assess the efficiency of current laws, policies, and governance structures in promoting ESG and the development of sustainable business models in the mining sector in South Africa.
- A future study on the impact of ESG on the development of sustainable business models used by mining companies operating in Africa can be done.

- It would be beneficial to do a research on the possibilities of cutting-edge innovations in the mining industry, such as artificial intelligence (AI) and sustainable business model innovation.

7. REFERENCES

Adler, R. A., Claassen, M., Godfrey, L., & Turton, A. R. (2007). Water, mining, and waste: an historical and economic perspective on conflict management in South Africa. *The Economics of Peace and Security Journal*, *2*(2), 749-852.

Admiraal, R., Sequeira, A., McHenry, M. P., & Doepel, D. (2017). Maximizing the impact of mining investment in water infrastructure for local communities. *The Extractive Industries and Society*, *4*(2), 240-250.

Adolph, S., Tisch, M., & Metternich, J. (2014). Challenges and approaches to competency development for future production. *Journal of International Scientific Publications*, *12*(1), 1001-1010.

Aghion, P., Veugelers, P., & Hemous, D. (2009). No green growth without innovation. *Bruegel Policy Brief* 2009/07. http://aei.pitt.edu/12218/

Ahrens, J., & Rudolph, P. M. (2006). The Importance of Governance in Risk Reduction and Disaster Management. *Journal of Contingencies and Crisis Management*, *14*: 207-220. https://doi.org/10.1111/j.1468-5973.2006.00497.x

Al Faruque, A. (2015). Transparency in Extractive Revenues in Developing Countries and Economies in Transition: a Review of Emerging Best Practices. *Journal of Energy & Natural Resources Law*, *24(*1), 66-103. 10.1080/02646811.2006.11433426

Alsayegh, M. F., Rahman, R. A., & Homayoun, S. (2020). Corporate Economic, Environmental, and Social Sustainability Performance Transformation through ESG Disclosure. *Sustainability*, *12*(9), 3910. **https://doi.org/10.3390/su12093910**

Anglo American. (2021, 03 07). *Sustainability Report 2021.* Retrieved from Anglo American plc: https://www.angloamerican.com/~/media/Files/A/Anglo-American-Group/PLC/investors/annual-reporting/2022/aa-sustainability-report-full-2021.pdf

Anglo American. (2022, May 6). *Press releases – 2022*. Retrieved from Anglo American: https://www.angloamerican.com/media/press-releases/2022/06-05-2022

Anglo American. (2022, 03 03). *Sustainability Report 2022.* Retrieved from Anglo American plc: https://www.angloamerican.com/~/media/Files/A/Anglo-

American-Group-v5/PLC/investors/annual-reporting/2022/Sustainability-Report-2022.pdf

Anglo American Platinum. (2022, March 31). *ESG Report 2021.* Retrieved from Anglo American Platinum: https://www.angloamericanplatinum.com/~/media/Files/A/Anglo-American-Group-v5/Platinum/report-archive/2021/esg-report-2021.pdf

Anglo American Platinum. (2023, March 31). *Integrated Report.* Retrieved from Anglo American Platinum: https://www.angloamericanplatinum.com/~/media/Files/A/Anglo-American-Group-v5/Platinum/report-archive/2022/integrated-annual-report-2022.pdf

Ansari, S., Munir, K., & Gregg, T. (2012). Impact at the 'Bottom of the Pyramid': The Role of Social Capital in Capability Development and Community Empowerment. *Journal of Management Studies*, *49*: 813-842. https://doi.org/10.1111/j.1467-6486.2012.01042.x

Appelstrand, M. (2002). Participation and societal values: the challenge for lawmakers and policy practitioners. *Forest Policy and Economics*, *4*(4), 281-290. https://doi.org/10.1016/S1389-9341(02)00070-9

April, Y. (2012). An analysis of the Mineral and Petroleum Resources Development Act 28 of 2002, and the nationalisation of minerals debate in South Africa. *Sabinet African Journals*, *42*(1),1-42.

Archibald, T., Sharrock, G., Buckley, J., & Young, S. (2018). Every Practitioner a "Knowledge Worker": Promoting Evaluative Thinking to Enhance Learning and Adaptive Management in International Development. *New Directions for Evaluation*, *158:* 73-91. **https://doi.org/10.1002/ev.20323**

Arvidsson, S., & Dumay, J. (2021). Corporate ESG reporting quantity, quality and performance: Where to now for environmental policy and practice? *Business Strategy and the Environment*, *31*(3), 1091-1110. **https://doi.org/10.1002/bse.2937**

Askham, T. M., & Van der Poll, H. M. (2017). Water Sustainability of Selected Mining Companies in South Africa. *Sustainability*, *9*(6), 957; **https://doi.org/10.3390/su9060957**

Atif, I., Cawood, F. T., & Mahboob, M. A. (2020). The Role of Digital Technologies that Could Be Applied for Prescreening in the Mining Industry During the

COVID-19 Pandemic. *Springer Link*, *5,* 663–674. https://doi.org/10.1007/s41403-020-00164-0

Atkins, B. D., Jewell, C. P., Runge, M. C., Ferrari, M. J., Shea, K., Probert, W. J., & Tildesley, M. J. (2020). Anticipating future learning affects current control decisions: A comparison between passive and active adaptive management in an epidemiological setting. *Journal of Theoretical Biology*, *506* (110380), 30-62. https://doi.org/10.1016/j.jtbi.2020.110380

Azapagic, A. (2004). Developing a framework for sustainable development indicators for the mining and minerals industry. *Journal of Cleaner Production*, *12*(6), 639-662. https://doi.org/10.1016/S0959-6526(03)00075-1

B. Baldassarre, Calabretta, G., Bocken, N., & Jaskiewicz, T. (2017). Bridging sustainable business model innovation and user-driven innovation: A process for sustainable value proposition design. *Journal of Cleaner Production*, *147,* 175-186. 10.1016/J.JCLEPRO.2017.01.081

Bak, I., Cheba, K., Ziolo, M., & Spoz A. (2022). Environmental, social and governance factors in comanies' business models and the motives to incorporate them in the core business. *Journal of Business Economics and Management*, *23*(4), 837-855. https://doi.org/10.3846/jbem.2022.16207

Bester, V., & Groenewald, L. (2021). Corporate social responsibility and artisanal mining: Towards a fresh South African perspective. *Resources Policy*, *72*(C), 102-124. 10.1016/j.resourpol.2021.102124

Beverton, R., & Holt, S. J. (1958). *On the Dynamics of Exploited Fish Populations.* Wales: Springer Science Business and Media.

Bilham, T. N. (2020). Responsible mining and responsible sourcing of minerals: opportunities and challenges for cooperation across value chains. *Geological Society Publication*, *508*(1), 161-186. 10.1144/SP508-2020-130

Blinova , E., Ponomarenko, T., & Knysh, V. (2022). Analyzing the Concept of Corporate Sustainability in the Context of Sustainable Business Development in the Mining Sector with Elements of Circular Economy. *Sustainability Journal*, *14*(13), 63-81. **https://doi.org/10.3390/su14138163**

Boons, F., & Ludeke-Freund, F. (2013). Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *Journal of Cleaner Production*, *45*, 9-19. https://doi.org/10.1016/j.jclepro.2012.07.007

Bora, B., Borah, S., & Chungyalpa, W. (2017). Crafting Strategic Objectives: Examining the Role of Business Vision and Mission Statements. *Journal of Entrepreneurship & Organization Management* , *6,* 1-6. https://doi.org/10.4172/2169-026x.1000205

Brown, P., Bocken, N., & Balkenende, R. (2018). Why Do Companies Pursue Collaborative Circular Oriented Innovation? *Sustainability Journal*, *11*(3), 600-635. **https://doi.org/10.3390/su11030635**

Cairns, M. A., & Lackey, R. T. (1992). Biodiversity and Management of Natural Resources: The Issues. *Fisheries*, *17*(3), 6-10. 10.1577/1548-8446(1992)017<0006:BAMONR>2.0.CO;2

Carvalho, F. P. (2017). Mining industry and sustainable development: time for change. *Food and Energy Security*, *6*(2), 61-77. **https://doi.org/10.1002/fes3.109**

Chakwizira, J. (2022). Stretching resilience and adaptive transport systems capacity in South Africa: Imperfect or perfect attempts at closing COVID -19 policy and planning emergent gaps. *Transport Policy*, *125*, 127-150.

Chanda, C. K., & Bose, D. (2020). Challenges of Employing Renewable Energy for Reducing Greenhouse Gases (GHGs) and Carbon Footprint. *Encyclopedia of Renewable and Sustainable Materials*, 346-365.

Chavalala, B., & Nhamo, G. (2014). Clean and energy efficient technology as green economy transition mechanism in South African gold mining: case of Kusasalethu. *Environmental Economics*, *5*(1), 74-83. http://hdl.handle.net/10500/14033

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, *43*(2), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Christmann, P. (2017). Effects of “Best Practices” of Environmental Management on Cost Advantage: The Role of Complementary Assets. *Academy of Management Journal*, *15*(4), 15-56. **https://doi.org/10.3390/su15043597**

Clinton, L., & Whisnant, R. (2019). *Business model innovations for sustainability. In: Lenssen, G.G., Smith, N.C. (Eds.), Managing Sustainable Business: an Executive Education Case and Textbook.* Dordrecht: Springer Netherlands.

Cooper, D., & Schindler, P. (2011). *Business research methods, 11th Edition.* New York: The McGraw-Hill Companies, Inc.

CSIR. (2020, September 30). Retrieved from Council for Scientific and Industrial Research: https://www.csir.co.za/towards-energy-efficient-mining-sector

De Silva, C., & Ediriweera, A. (2015). An Investigation of Environmental, Social and Governance Measures of Listed Mining Sector Companies in Australia. *Journal of Law and Governance*, *10*(4), 1-18. **https://doi.org/10.15209/jbsge.v10i4.866**

Deegan, C., Rankin, M., & Tobin, J. (2002). An examination of the corporate social & environmental disclosures of BHP from 1983-1997: A test of legitimacy theory. *Accounting Auditing & Accountability Journal*, *15*(3), 312-343. http://dx.doi.org/10.1108/09513570210435861

Dembek, K., & Ludeke-Freund, F. (2017). Sustainable business model research and practice: emerging field or passing fancy? *Journal for Cleaner Production*, *168* (3), 1668-1678. https://doi.org/10.1016/j.jclepro.2017.08.093

Dewey, J. (2007). The development of American pragmatism. *Scientiae Studia* , *5*(2), 227-243.

DMRE. (2009, April 9). *Department of Minerals and Energy.* Retrieved from Strategic-framework-minerals-april-2009: https://www.gov.za/sites/default/files/gcis_document/201409/sd-strategic-framework-minerals-april-2009.pdf

DPWI. (2022, March 11). *National Infrastructure Plan 2050.* Retrieved from DEPARTMENT OF PUBLIC WORKS AND INFRASTRUCTURE: https://www.gov.za/sites/default/files/gcis_document/202203/46033gon1874.pdf

Dunbar, W. S., Fraser, J., Reynolds, A., & Kunz, N. C. (2020). Mining needs new business models. *The Extractive Industries and Society*, *7*(2) 263-266. 10.1016/j.exis.2019.07.007

DWAF. (2004). *Olifants Water Management Area: Internal Strategic Perpective. Report P WMA.* Pretoria: Department of Water Affairs and Forestry.

Eccles, R. G., Lee, L.-E., & Stroehle, J. C. (2019). The Social Origins of ESG: An Analysis of Innovest and KLD. *SAGE Journals*, *3*(4), 659–688. https://doi.org/10.1177/1086026619888994

Elkington, J. (1997). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business.* New Society Publishers.

Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (2014). Renewable energy resources: Current status, future prospects and their enabling technology. *Renewable and Sustainable Energy Reviews*, *39*, 748-764. https://doi.org/10.1016/j.rser.2014.07.113

Elshkaki, A., Graedel, T. E., Ciacci, L., & Reck, B. K. (2016). Copper demand, supply, and associated energy use to 2050. *Global Environmental Change*, *39*(6), 305-315. 10.1016/j.gloenvcha.2016.06.006

Faggian, A., Partridge, M., & Malecki, E. J. (2017). Creating an Environment for Economic Growth: Creativity, Entrepreneurship or Human Capital? *International Journal of Urban and Regional Research*, 41(6), 997-1009. **https://doi.org/10.1111/1468-2427.12555**

Failing, E., Horn, G., & Higgens, P. (2004). Using expert judgment and stakeholder values to evaluate adaptive management options. *Ecology and Society*, *9*(1), 3-24.

Feiel, S., Moser, P., Hitch, M., Tost, M., & Endl, A. (2021). Europe's mining innovation trends and their contribution to the sustainable development goals: Blind spots and strong points. *Resources Policy*, *74*: 101440, 101-140. 10.1016/j.resourpol.2019.101440

Folly, K. A. (2021). *Local Electricity Markets.* Cape Town: Academy Press.

Fong, P. S. (2003). Knowledge creation in multidisciplinary project teams: an empirical study of the processes and their dynamic interrelationships. *International Journal of Project Management*, *21*(7) 479-486. 10.1016/S0263-7863(03)00047-4

Fraser, E. D., Dougill, A. J., Mabee, W. E., & Reed, M. (2006). Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management*, *78*(2) 114-127. 10.1016/j.jenvman.2005.04.009

Fraser, J., & Kunz, N. C. (2018). Water Stewardship: Attributes of Collaborative Partnerships between Mining Companies and Communities. *Sustainability Journal*, *10*(8), 33-50. **https://doi.org/10.3390/w10081081**

Freed, C. M. (2017). Trade union participation in social and labour plan and corporate social responsibility planning and execution to placate community

relations in the South African mining sector. *UPSpace Institutional Repository*, 1-122. http://hdl.handle.net/2263/64845

Galal, S. (2023, January 09). *Market capitalization of the leading mining companies in South Africa in 2022*. Retrieved from Statista: https://www.statista.com/statistics/1014904/south-africa-leading-mining-companies/

Geissdoerfer Martin, Vladimirova, D., & Evans, S. (2018). Sustainable business model innovation: A review. *Journal of Cleaner Production*, *198*, 401-416. https://doi.org/10.1016/j.jclepro.2018.06.240

George, G., & Bock, A. J. (2011). The Business Model in Practice and Its Implications for Entrepreneurship Research. *Entrepreneurship Theory and Practice*, *35*(1), 83–111. 10.2139/ssrn.1490251

Geradtsc, T. H., & Bockena, N. M. (2020). Barriers and drivers to sustainable business model innovation: Organization design and dynamic capabilities. *Long Range Planning*, *53*(4), 53-101. 10.1016/j.lrp.2019.101950

Gladwin, T. N., Kennelly, J. J., & Krause, T.-S. (1995). Shifting Paradigms for Sustainable Development: Implications for Management Theory and Research. *Academy of Management Review*, *20*, 874-907.

Golafshani, N. (2003). The Research Process. *Understanding Reliability and Validity in Qualitative Research*, *8*(4), 597-607. https://doi.org/10.46743/2160-3715/2003.1870

Gold Fields. (2021, April 01). *2020 Gold Fieds Climate Change Report.* Retrieved from Gold Fields Sustainability Reporting: https://www.goldfields.com/pdf/sustainbility/sustainability-reporting/carbon-submissions/cdp-submission/climate-change-report-2020.pdf

Grimley, M., Shastry, V., Kânoğlu-Özkan, D. G., Blevins, E., Beck, A. L., Chan, G., & Rai, V. (2022). The grassroots are always greener: Community-based organizations as innovators of shared solar energy in the United States. *Energy Research & Social Science*, *90*, 1-23. 10.1016/j.erss.2022.102628

Guild, R., Ehrlich, R. I., Johnston, J. R., & Ross, M. H. (2001, March 31). *OCCUPATIONAL HEALTH PRACTICE IN THE SOUTH AFRICAN MINING INDUSTRY.* Retrieved from Mine Health and Safety Council: https://www.mhsc.org.za/sites/default/files/public/publications/OH%20Handbook.pdf

Gürsan, C., & de Gooyert, V. (2021). The systemic impact of a transition fuel: Does natural gas help or hinder the energy transition? *Renewable and Sustainable Energy Reviews*, *138*, 110-125. 10.1016/j.rser.2020.110552

Hamann, R. (2003). Mining companies' role in sustainable development: The 'why' and 'how' of corporatesocial responsibility from a business perspective. *Development Southern Africa*, *20* (2),1470-3637. 10.1080/03768350302957

Hamann, R. (2004). Corporate social responsibility, partnerships, and institutionalchange: The case of mining companies in South Africa. *Natural Resources Forum*, *28*(4), 278-290. 10.1111/j.1477-8947.2004.00101.x

Hamilton, R. (2018). From Water Management to Water Stewardship—A Policy Maker's Opinion on the Progress of the Mining Sector. *MDPI Sustainability Journal*, *11*(3), 438-458. **https://doi.org/10.3390/w11030438**

Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative research methods: when to use them and how to judge them. *Human Reproduction*, *31*(3), 498-501. https://doi.org/10.1093/humrep/dev334

Harley, D. A., Stebnicki, M., & Rollins, C. W. (2000). Applying Empowerment Evaluation as a Tool for Self-Improvement and Community Development with CULTURALLY Diverse Populations. *Journal of the Community Development Society*, *31*(2), 348-364. 10.1080/15575330009489711

Hart, S. (1995). A natural-resource-based view of the firm. *Academy of management*, *20*(4), 54-65. https://doi.org/10.5465/amr.1995.9512280033

Hart, S., & Milstein, M. (1999). Global Sustainability and the Creative Destruction of Industries. *MIT Sloan Management Review*, *41*(1), 23-33.

Hart, S., & Prahalad, C. (2002). The Fortune at the Bottom of the Pyramid." Strategy+Business. *Stragegy and Business*, (26), 2-14.

Harvey, B., & Bice, S. (2014). Social impact assessment, social development programmes and social licence to operate: tensions and contradictions in intent and practice in the extractive sector. *Impact Assessment and Project Appraisal*, *32*(4), 327-335. 10.1080/14615517.2014.950123

Harvey, R. (2019). Mining for a Circular Economy in the Age of the Fourth Industrial Revolution: The Case of South Africa. *South African Institute for International Affairs*.

Heenetigala, K., Lokuwaduge, C. D., Armstrong, A., & Ediriweera, A. (2015). An Investigation of Environmental, Social and Governance Measures of Listed

Mining Sector Companies in Australia. *Journal of Law and Governance*, *10*(4), 1-18. **https://doi.org/10.15209/jbsge.v10i4.866**

Hertwich, E. G., & Wood, R. (2018). The growing importance of scope 3 greenhouse gas emissions from industry. *Environment research letters*, *13*(10), 18-44. 10.1088/1748-9326/aae19a

Holling, C. S. (1978). Adaptive Environmental Assessment and Management. *Arizona State University*.

Holmberg, K., Kivikytö-Reponen, P., Härkisaari, P., Valtonen, K., & Erdemir, A. (2017). Global energy consumption due to friction and wear in the mining industry. *Tribology International*, *115*(6), 116-139. 10.1016/j.triboint.2017.05.010

Houston, S. (2021). How cognitive diversity in senior management teams can add value through innovation and improved performance in the mining industry. *Cranfield University.* http://dspace.lib.cranfield.ac.uk/handle/1826/17902

Huang, D. Z. (2019). Environmental, social and governance (ESG) activity and firm performance: a review and consolidation. *Accounting and Finance*, *61*(1), 335-360.

Humby, T.-L. (2015). One environmental system': aligning the laws on the environmental management of mining in South Africa. *Journal of Energy and Natural Resources Law*, *33*(2), 110-130.

Igogo, T., Awuah-Offei, K., Newman, A., Lowder, T., & Engel-Cox , J. (2021). Integrating renewable energy into mining operations: Opportunities, challenges, and enabling approaches. *Applied Energy*, *300*, 300-320. 10.1016/j.apenergy.2021.117375

Implats. (2020, March 31). *ESG reporting.* Retrieved from Implats: https://www.implats.co.za/pdf/annual-reports/annual-integrated-report/2019/sustainable-development-report-2019.pdf

Ismail, S. N., Ramli, A., & Aziz, H. A. (2021). Influencing factors on safety culture in mining industry: A systematic literature review approach. *Resources Policy*, *74*(1), 102-150. 10.1016/j.resourpol.2021.102250

Jenkins, H., & Yakovleva, N. (2006). Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure. *Journal of Cleaner Production*, *14*(3), 271-284. https://doi.org/10.1016/j.jclepro.2004.10.004

Jhariya, M. K., Banerjee, A., & Meena, R. S. (2022). Chapter 1 - Importance of natural resources conservation: Moving toward the sustainable world. *Natural Resources Conservation and Advances for Sustainability*, 3-27. 10.1016/B978-0-12-822976-7.00027-2

Joyce, S., & Thompson, I. (2000). Earning a social licence to operate: social acceptability and resource development in Latin America. *CIM Bulletin*, *93*(1037), 49-52.

Kalisz, S., Kibort, K., Mioduska, J., Lieder, M., & Małachowska, A. (2022). Waste management in the mining industry of metals ores, coal, oil and natural gas - A review. *Journal of Environmental Management*, *304*, 114-239. 10.1016/j.jenvman.2021.114239

Karolia-Hussain, F., & Fourie, E. (2021). The relevance and impact of South African labour law in the mining sector: a Fourth Industrial Revolution perspective. *SciELO South Africa*, *42*(3) 1682-5853.

Kates, R. W., & Parris, T. M. (2003). Characterising and measuring sustainable development. *AR Reviews in advance*, 2813(1), 1-13. 10.1146/annurev.energy.28.050302.105551

Keijzers, G. (2001). The transition to the sustainable enterprise. *The Journal of Cleaner Production*, *10*(4), 349–359. 10.1016/S0959-6526(01)00051-8

Keith, D. A., Martin, T. G., McDonald-Madden, E., & Walters, C. (2011). Uncertainty and adaptive management for biodiversity. *Biological Conservation*, *144*(4), 1175-1178. 10.1016/j.biocon.2010.11.022

Kemp, D. (2009). Mining and community development: problems and possibilities of local-level practice. *Community Development Journal*, *45*(2), 198-218. 10.1093/cdj/bsp006

Khan, I., Zakari, A., Zhang, J., Dagar, V., & Singh, S. (2022). A study of trilemma energy balance, clean energy transitions, and economic expansion in the midst of environmental sustainability: New insights from three trilemma leadership. *Energy Journal*, *248*(318), 123-140. 10.1016/j.energy.2022.123619

Kincaid, C., & Smith, N. M. (2021). Diversity and inclusion in mining: An analysis of indicators used in sustainability reporting. *The Extractive Industries and Society*, *8*(4),10-29.

Kingsford, R. T., Roux, D. J., McLoughlin, C. A., Conallin, J., & Norris, V. (2017). Strategic Adaptive Management (SAM) of Intermittent Rivers and Ephemeral Streams. *Ecology and Management*, 535-562. 10.1016/B978-0-12-803835-2.00021-8

Kossoff, D., Dubbin, W. E., Alfredsson, M., Edwards, S. J., Macklin, M. G., & Hudson-Edwards, K. A. (2014). Mine tailings dams: Characteristics, failure, environmental impacts, and remediation. *Applied Geochemistry*, *51*(SM6), 229-245. 10.1016/j.apgeochem.2014.09.010

Krause, S., & Drusche, O. (2021). Potentials of business model innovation and values-based management approaches in the mining sector. *E3S Web of Conferences*, *266*(2). 10.1051/e3sconf/202126606004

Kubiszewski, I., Costanza, R., Franco, C., Lawn, P., Talberth, J., Jackson, T., & Aylmer, C. (2013). Beyond GDP: Measuring and achieving global genuine progress. *Ecological Economics*, *93*(C) 57-68.

Kuiper, T., Ngwenya, N., Kavhu, B., Mandisodza-Chikerema, R., & Milner-Gulland, E. J. (2023). Making adaptive management more user friendly to encourage manager buy-in. *People and Nature*, *5*(2), 684-698. **https://doi.org/10.1002/pan3.10440**

Kumah, A. (2006). Sustainability and gold mining in the developing world. *Journal of Cleaner Production*, *14*(3-4), 315-323. 10.1016/j.jclepro.2004.08.007

Kumba Iron Ore. (2019, March 31). *Sustainabillity Report 2018.* Retrieved from Kumba Iron Ore: https://www.angloamericankumba.com/~/media/Files/A/Anglo-American-Group-v5/Kumba/investors/annual-reporting/sustainability-report-2018.pdf

Lambertz, N. (2022). *ESG (Environmental, Social, Governance) performance and its impact – which role will financial institutions play in order to build a more sustainable access to financial loans and other forms of credit in the future?* Lisbon: Catolica Lisbon.

Lazaro, L. L., Grangeia, C. S., Santos, L., & Giatti, L. L. (2023). What is green finance, after all? – Exploring definitions and their implications under the Brazilian biofuel policy (RenovaBio). *Journal of Climate Finance.* 10.1016/j.jclimf.2023.100009

Ledwaba, P. F., & Mutemeri, N. (2018). Institutional gaps and challenges in artisanal and small-scale mining in South Africa. *Resources Policy*, *56*, 141-148. 10.1016/j.resourpol.2017.11.010

Lee, A. H. (2022). Climate, ESG, and the board of directors: 'You cannot direct the wind, but you can adjust your sails'. *Journal of Energy & Natural Resources Law*, 275-285.

Lee, D., & Cheng, C.-C. (2016). Energy savings by energy management systems: A review. *Renewable and Sustainable Energy Reviews*, *56*, 760-777. https://doi.org/10.1016/j.rser.2015.11.067

Lee, K. N. (1999). Appraising Adaptive Management. *Ecology and Society*. *3*(2). http://www.consecol.org/vol3/iss2/art3/

Lekan, M., Jonas, A., & Deutz, P. (2021). Circularity as Alterity? Untangling Circuits of Value in the Social Enterprise–Led Local Development of the Circular Economy. *Economic Geography*. 97(3), 257-283. https://doi.org/10.1080/00130095.2021.1931109

Leon, P. (2015). Whither the South African Mining Industry? *Journal of Energy & Natural Resources Law*, *30*(1), 5-27. 10.1080/02646811.2012.11435281

Leopold, A. (1968). *Thinking Like a Mountain, A Sound County Almanac: And Sketches Here and There.* Oxford: Oxford University Press.

Levine, D. M., Stephan, D. F., Krehbiel, T. C., & Berenson, M. L. (2008). *STATISTICS FOR MANAGERS USING Microsoft Excel. Fifth Edition.* United States of America: Pearson Prentice Hall.

Liefferink, M. (2019). Selected extracts from South Africa's environmental legislation: challenges with the management of gold tailings within the Witwatersrand gold fields and case studies. *Federation for a Sustainable Environment, South Africa*, 53-67. https://doi.org/10.36487/ACG_rep/1910_0.04_Liefferink

Limpitlaw, D. (2004). Key Challenges Facing The Mining And Minerals Sector In South Africa. *Research Gate.*

Lioubimtseva, E., & Henebry, G. M. (2009). Climate and environmental change in arid Central Asia: Impacts, vulnerability, and adaptations. *Journal of Arid Environments*, *73*(11), 963-977. https://doi.org/10.1016/j.jaridenv.2009.04.022

Litvinenko, V. S. (2020). Digital Economy as a Factor in the Technological Development of the Mineral Sector. *Springer Link*, *29*(1). 1521–1541. 10.1007/s11053-019-09568-4

Liu, L., & Chen, Y. (2022). Improving eco-efficiency in coal mining area for sustainability development: An emergy and super-efficiency SBM-DEA with. *Journal of Cleaner Production*, *339*, 130. DOI: 10.1016/j.jclepro.2022.130701

Lockie, S., Franettovich, M., Petkova-Timmer, V., Rolfe, J., & Ivanova, G. (2009). Coal mining and the resource community cycle: A longitudinal assessment of the social impacts of the Coppabella coal mine. *Environmental Impact Assessment Review*, *29*(5), 330-339. 10.1016/j.eiar.2009.01.008

Lottermoser, B. G. (2011). Recycling, Reuse and Rehabilitation of Mine Wastes. *Elements*, *7*(6), 405–410. 10.2113/gselements.7.6.405

Lyu, Z., Chai, J., Xu, Z., Qin, Y., & Cao, J. (2019). A Comprehensive Review on Reasons for Tailings Dam Failures Based on Case History. *Advances in Civil Engineering*, *2019*, 50-68. https://doi.org/10.1155/2019/4159306

Macfarlane, A. S. (2018). *Presidential Address: Towards the future: African Mining Vision, Mining Phakisa and the SAIMM.* Johannesburg: Journal of the Southern African Institute of Mining and Metallurgy.

Macmillan, H. (2017). Plus ça change? Mining in South Africa in the last 30years – an overview. *Review of African Political Economy*, *44*(152), 272-291. 10.1080/03056244.2017.1313728

Malecki , E. J. (2009). Global Knowledge and Creativity: New Challenges for Firms and Regions. *Regional Studies*, 44(8), 1033-1052. https://doi.org/10.1080/00343400903108676

Maponga, O. P., & Musa, C. (2021). Domestication of the role of the mining sector in Southern Africa through local content requirements. *The Extractive Industries and Society*, *8*(1), 95-210. 10.1016/j.exis.2020.06.001

Marais, L. (2013). Resources policy and mine closure in South Africa: The case of the Free State Goldfields. *Resources Policy*, *38*(3), 363-372. 10.1016/j.resourpol.2013.04.004

Massa, L., & Tucci, C. (2014). Chapter 21: Business Model Innovation. In M. Dodgson, D. M. Gann, & N. Phillips, *The Oxford Handbook of Innovation Management* (pp. 421- 456). Oxford: Oxford University Press.

Matebesi, S., & Marais, L. (2018). Social licensing and mining in South Africa: Reflections from community protests at a mining site. *Resources Policy*, *59*, 371-378. 10.1016/j.resourpol.2018.08.009

Maubane, P., Prinsloo, A., & Van Rooyen, N. (2014). Sustainability reporting patterns of companies listed on the Johannesburg securities exchange. *Public Relations Review*, *40*(2), 153-160. 10.1016/j.pubrev.2014.02.014

Mbilima, F. (2021). Extractive industries and local sustainable development in Zambia: The case of corporate social responsibility of selected metal mines. *Resources Policy*, *74*(2), 101-124. 10.1016/j.resourpol.2019.101441

MCSA. (2022, August 20). *Fact Sheet, Safety in Mining.* Retrieved from Minerals Council South Africa: https://www.mineralscouncil.org.za/downloads/send/3-fact-sheets/1915-safety-in-mining-2022

MCSA. (2022, May 09). *FACTS AND FIGURES.* Retrieved from Mineral Council South Africa: https://www.mineralscouncil.org.za/industry-news/publications/facts-and-figures

MCSA. (2023). *South Africa's inclusion in fraser institute's ten least attractive mining jurisdictions is an alarming wake up call that we are moving in the wrong direction.* Johannesburg: Minerals Council South Africa.

Mpanza, M., Adam, E., & Moolla, R. (2021). A critical review of the impact of South Africa's mine closure policy and the winding-up process of mining companies. *The journal for transdisciplinary research in Southern Africa*, *17*(1), 10-41. **https://doi.org/10.4102/td.v17i1.985**

Mubanga, R. O., & Kwarteng, K. (2020). A comparative evaluation of the environmental impact assessment legislation of South Africa and Zambia. *Environmental Impact Assessment Review*, *83*(3), 106-401. 10.1016/j.eiar.2020.106401

Muthelo , L., Mothiba, T. M., Malema , N. R., Mbombi, M. O., & Mphekgwana, P. M. (2022). Exploring Occupational Health and Safety Standards Compliance in the South African Mining Industry, Limpopo Province, Using Principal Component Analysis. *Int. J. Environ. Res. Public Health*, 19(6), 2-41. 10.3390/ijerph191610241

Nason, R. W. (2008). Structuring the Global Marketplace: The Impact of the United Nations Global Compact. *SAGE Journals*, *28*(4), 51-64. 10.1177/0276146708325388

Nidumolu, R., Prahalad, C., & Rangaswami, M. (2009). Why Sustainability is Now the Key Driver of Innovation. *Harvard Business Review*, *41*(2), 57-64. 10.1109/EMR.2013.6601104

Northey, S. A., Mudd, G. M., Saarivuori, E., Wessman-Jääskeläinen, H., & Haque, N. (2016). Water footprinting and mining: Where are the limitations and opportunities? *Journal of Cleaner Production*, *135*, 1098-1116. https://doi.org/10.1016/j.jclepro.2016.07.024

Ntombela, M. S., Bohlmann, H. R., & Kalaba, M. W. (2019). Greening the South Africa's Economy Could Benefit the Food Sector: Evidence from a Carbon Tax Policy Assessment. *Environmental and Resource Economics* , 891-910. http://hdl.handle.net/2263/70144

Ntombezintle, R. (2022). *Enablers and barriers to the implementation of inclusive enterprise and supplier development in South Africa.* Cape Town: UCT. http://hdl.handle.net/11427/37326

O'Faircheallaigh. (2013). Community development agreements in the mining industry: a growing global phenomenon. *Community Dev*, 44(2), 222–238. 10.1080/15575330.2012.705872

Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation.* Hoboken: Wiley and Sons.

Parsons, R., Lacey, J., & Moffat, K. (2014). Maintaining legitimacy of a contested practice: How the minerals industry understands its 'social licence to operate. *Resources Policy*, *41,* 83-90. 10.1016/j.resourpol.2014.04.002

Peck, P., & Sinding, K. (2009). Financial assurance and mine closure: Stakeholder expectations and effects on operating decisions. *Resources Policy*, *34*(4), 227-233. 10.1016/j.resourpol.2009.03.001

Pegels, A. (2010). Renewable energy in South Africa: Potentials, barriers and options for support. *Energy Policy*, 38(9), 4945-4954. 10.1016/j.enpol.2010.03.077

Peloza, J., & Falkenberg, L. (2009). The Role of Collaboration in Achieving Corporate Social Responsibility Objectives. *Sage Journals*, *51*(3) 1-21. 10.2307/41166495

Pijoos, L., & Seleka, N. (2022, August 6). *Zama zamas, kingpins, police and the govt: Why the West Rand is burning*. Retrieved from News24: https://www.news24.com/news24/southafrica/news/zama-zamas-kingpins-police-and-the-govt-why-the-west-rand-is-burning-20220806

Poovan, N., Du Toit, M. K., & Engelbrecht, A. S. (2018). The effect of the social values of ubuntu on team effectiveness. *South African Journal of Business Management*, *37*(3), a604. **https://doi.org/10.4102/sajbm.v37i3.604**

Porter, M. E., & Kramer, M. R. (2018). How to Reinvent Capitalism—And Unleash a Wave of Innovation and Growth. *Managing Sustainable Business*, *89*(1)323–346.

Puumalainen, K., Albareda, L., Bocken, N., Huotari, P., & Ritala, P. (2017). Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study. *Journal of cleaner production*, *170*, 216-226. 10.1016/j.jclepro.2017.09.159

Qureshi, F., Yusuf, M., Kamyab, H., Vo, D.-V. N., Chelliapan, S., Joo, S.-W., & Vasseghian, Y. (2022). Latest eco-friendly avenues on hydrogen production towards a circular bioeconomy: Currents challenges, innovative insights, and future perspectives. *Renewable and Sustainable Energy Reviews*, *5*(1), 112-132. 10.9770/IRD.2023.5.1(7)

Ralston, J. C., Reid, D. C., Dunn, M. T., & Hainsworth, D. W. (2015). International Journal of Mining Science and Technology. *International Journal of Mining Science and Technology*, 865-876.

Ralston, J. C., Reid, D. C., Dunn, M. T., & Hainsworth, D. W. (2015). Longwall automation: Delivering enabling technology to achieve safer and more productive underground mining. *International Journal of Mining Science and Technology*, *25*(6) 865-876. 10.1016/j.ijmst.2015.09.001

Randhawa, K., Wilden, R., & Gudergan, S. (2018). Open Service Innovation: The Role of Intermediary Capabilities. *Journal of Product Innovation Management*, *35*(5), 808-838. 10.1111/jpim.12460

Ranjbari, M., Saidani, M., Esfandabadi, Z. S., Peng, W., Lam, S., Aghbashlo, M., . . . Tabatabaei, M. (2021). Two decades of research on waste management in the circular economy: Insights from bibliometric, text mining, and content analyses. *Journal of Cleaner Production*, *314,* 120-133.

Rehner, J., Baeza, S. A., & Barton, J. R. (2014). Chile's resource-based export boom and its outcomes: Regional specialization, export stability and economic growth. *56 Geoforum*, 35-45. 10.1016/j.geoforum.2014.06.007

Rogerson, C. M. (2008). Tracking SMME Development in South Africa: Issues of Finance, Training and the Regulatory Environment. *Urban Forum*, 19(1), 61-81. 10.1007/s12132-008-9025-x

Roome, N., & Louche, C. (2015). Journeying Toward Business Models for Sustainability: A Conceptual Model Found Inside the Black Box of Organisational Transformation. *Sage Journals*, *29*(1) 427-442. https://doi.org/10.1177/1086026615595084

SA Department of Energy. (2019, March 1). *Integrated Resource Plan (IRP20190.* Retrieved from DEPARTMENT OF ENERGY: https://www.gov.za/sites/default/files/gcis_document/201910/42778gon1359.pdf

SA Gov. (2015, October 15). *National Environmental Management Act of 2008.* Retrieved from South African Government: https://www.gov.za/sites/default/files/gcis_document/201902/42203gen56.pdf

SAG. (2015). Tough choices facing the South African mining industry. *Journal of the Southern African Institute of Mining and Metallurgy*, *115*(6), 2225-6253. Retrieved from South African Government.

SAHO. (2015, March 20). *Grade 8 - Term 2: The Mineral Revolution in South Africa*. Retrieved from South African History Online: sahistory.org.za/article/grade-8-term-2-mineral-revolution-south-africa

SAHRC. (2016, November 01). *National Hearing on the Underlying Socio-economic Challenges of Mining-affected Communities in South Africa.* Retrieved from South Africam Human Rights Commission: https://www.sahrc.org.za/home/21/files/SAHRC%20Mining%20communities%20report%20FINAL.pdf

Schaltegger, S., & Wagner, M. (2011). Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions. *Business Strategy and Environment*, *20*(4), 222-237. 10.1002/bse.682

Schaltegger, S., Hansen, E., & Lüdeke-Freund, F. (2016). Business models for sustainability: origins, present research, and future avenues. *Organisation and Environment*, *29*(1), 3-10. 10.1177/1086026615599806

Schwab, K. (2018, May 01). *The global competitive report.* Retrieved from World Economic Forum: http://www3.weforum.org/docs/GCR2017-

2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf.

Seelos, C., & Mair, J. (2005). Social Entrepreneurship - The Contribution of Individual Entrepreneurs to Sustainable Development. *IESE Business School Working Paper*, 510-553. 10.2139/ssrn.701181

Seriti Resources. (2023, February 03). *Announcements*. Retrieved from Seriti: https://seritiza.com/news-media/announcements/2023/seriti-to-construct-155-mw-wind-farm-in-mpumalanga/

Shackleton, S., Campbell, B., Lotz-Sisitka, H., & Shackleton, C. (2008). Links between the Local Trade in Natural Products, Livelihoods and Poverty Alleviation in a Semi-arid Region of South Africa. *World Development*, 36(3), 505-526. 10.1016/j.worlddev.2007.03.003

Shakeel, J., Mardani, A., Chofreh, A. G., Goni, F. A., & Kleme, J. (2020). Anatomy of sustainable business model innovation. *Journal of Cleaner Production*, 121-201. 10.1016/j.jclepro.2020.121201

Shongwe, N. B. (2018, November 30). *The impact of coal mining on the environment and community quality of life: a case study investigation of the impacts and conflicts associated with coal mining in the Mpumalanga Province, South Africa.* Retrieved from OpenUCT: https://open.uct.ac.za/handle/11427/28127

Sibanye Stillwaters. (2022, March 31). *Sustainability Reporting.* Retrieved from Sibanye Stillwaters: https://www.sibanyestillwater.com/sustainability/

Sibiya, D. Z., & Barnard, B. (2020). Institutionalizing entrepreneurship: The case of B-BBEE Based Enterprise and Supplier Development In South Africa. *IUP Journal of Business Strategy*, 1-65. Retrieved from Research Gate: https://www.researchgate.net/profile/Brian-Barnard/publication/337943474_Institutionalizing_entrepreneurship_The_case_of_B-BBEE_Based_Enterprise_and_Supplier_Development_In_South_Africa/links/5df6890e4585159aa4807da3/Institutionalizing-entrepreneurship-Th

Silvestre, B. S., & Neto, R. e. (2014). Are cleaner production innovations the solution for small mining operations in poor regions? The case of Padua in Brazil. *Journal of Cleaner Production*, *84*(1) 809-817.

Sindhwani, R., Singh, P. L., Behl, A., Afridi, M. S., Sammanit, D., & Tiwari, A. K. (2022). Modeling the critical success factors of implementing net zero

emission (NZE) and promoting resilience and social value creation. *Technological Forecasting and Social Change*, *181*(2), 181-200. 10.1016/j.techfore.2022.121759

Singh, R. L., & Singh, P. K. (2016). Global Environmental Problems. *Principles and Applications of Environmental Biotechnology for a Sustainable Future*, (pp.13-41)

Singhania, M., & Saini, N. (2023). Institutional framework of ESG disclosures: comparative analysis of developed and developing countries. *Journal of Sustainable Finance & Investment*, 13(1), 1-44. 10.1080/20430795.2021.1964810

Sorensen, P. (2012). Sustainable development in mining companies in South Africa. *International Journal for Environmental Studies*, *69*(1)21-40. 10.1080/00207233.2011.652821

South African History Organisation. (2015, March 20). *South African History Organisation.* Retrieved June 15, 2018, from https://www.sahistory.org.za/article/lesson-industrial-revolution-britain-and-southern-africa-1860

Spieth, P., & Schneider, S. (2013). Business Model Innovation: towards an integrated future research agenda. *International Journal of Innovation Management*, *17*(1), 34. 10.1142/S136391961340001X

Spoz, A., Ziolo, M., & Kluza, K. (2021). Innovation and environmental, social, and governance factors influencing sustainable business models - Meta - analysis. *Journal of Cleaner Production*, *303*(5), 1-14. 10.1016/j.jclepro.2021.127015

Stahel, W. (2016). The Circular Economy. *Nature*, *531*(7595) 435-438.

Stats SA. (2021, September 14). *Four facts about the mining industry (2019)*. Retrieved from Stats SA: https://www.statssa.gov.za/?p=14682

Stats SA. (2022, June 28). *Census 2022*. Retrieved from Statistics South Africa: https://www.statssa.gov.za/?p=15601#:~:text=The%20population%20of%20South%20Africa,the%20end%20of%20June%202022.

Steele-Schober, T. (2021). *The Importance of ESG for Mineral Reporting.* Johannesburg: Journal of the Southern African Institute of Mining and Metallurgy, *121*(6)

Stubbs, W., & Cocklin, C. (2008). Conceptualizing a "sustainability business model, 2. Organization & Environment. *Sage Journal*, *21*(2), 103-127. 10.1177/1086026608318042

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Plan*, *43*(2) 172-194.

Ting, M. B., & Byrne, R. (2020). Eskom and the rise of renewables: Regime-resistance, crisis and the strategy of incumbency in South Africa's electricity system. *Energy Research & Social Science*, *60*, 101333. 10.1016/j.erss.2019.101333

Tshoose, C. (2014). Placing the right to occupational health and safety within a human rights framework : trends and challenges for South Africa. *Sabinet African Journals*, *47*(2), 276-296.

UN. (2003, February 3). *UN Documentation: Development*. Retrieved from United Nations Library: https://research.un.org/en/docs/dev/2000-2015

UN. (2019, February 2). *South African Voluntary National Review.* Retrieved from United Nations: https://sustainabledevelopment.un.org/content/documents/23402RSA_Voluntary_National_Review_Report___The_Final_24_July_2019.pdf

United Nations. (2017, April 9). *Mining.* Retrieved from United Nations: https://sustainabledevelopment.un.org/dsd_aofw_ni/ni_pdfs/NationalReports/south_africa/Mining.pdf

van der Linde, C., & Porter, M. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. *Journal of Economic Perspectives*, *9*(4), 97-118. 10.1257/jep.9.4.97

Van Eeden, E. S., Liefferink, M., & Durand, J. F. (2009). Legal issues concerning mine closure and social responsibility on the West Rand. *Sabinet African Journal*, *5*(1), 1-18.

van Zyl, M. (2020). Reflecting on Corporate Governance in South Africa: Lessons Learned and the Way Forward. *UP Journals*, *24*, 1-24.

Vanclay, F., & Hanna, P. (2019). Conceptualizing Company Response to Community Protest: Principles to Achieve a Social License to Operate. *MDPI*, *8*(9). 80-101. 10.3390/land8060101

Verma, A. (2019). Sustainable Development and Environmental Ethics. *International Journal on Environmental Sciences*, *10*(1). 1-5.

Verrier, B., Smith, C., Yahyaei, M., Ziemski, M., Forbes, G., Witt, K., & Azadi, M. (2021). Beyond the social license to operate: Whole system approaches for a socially responsible mining industry. *Sustainable Minerals Institute,* (pp.19-33).

Vicoda, V. (2017). Determinants of Foreign Direct Investment in the Mining Industry. *Mining in Asia Pacific*, 19-33.

Votteler, R. G., & Brent, A. C. (2016). A literature review on the potential of renewable electricity sources for mining operations in South Africa. *Journal of Energy in Southern Africa*, *27*(2), 2413-3051. https://doi.org/10.17159/2413-3051/2016/v27i2a1337

Walters, C. J. (1986). *Adaptive Management of Renewable Resources.* New Jersey: Blackburn Press.

Webb, J. A., Watts, R. J., Allan, C., & Warner, A. T. (2017). Chapter 25 - Principles for Monitoring, Evaluation, and Adaptive Management of Environmental Water Regimes. *Water for the Environment*, (pp.599-623)

White, K. (2019). The Elusive Green Consumer. *Sauder School for Business*, 125-136.

Whittington, R., Regner, P., Angwin, D., Johnson, G., & Scholes, K. (2020). *Exploring Strategy, Text & Cases, 12th edition.* United Kingdom: Pearson.

Williams, B. K. (2011). Adaptive management of natural resources—framework and issues. *Journal of Environmental Management*, *92(*5*)*, 1346-1353. https://doi.org/10.1016/j.jenvman.2010.10.041

Williams, B. K., & Brown , E. D. (2013). Adaptive Management: From More Talk to Real Action. *Springer Link*, *53(2)*, 465–479. 10.1007/s00267-013-0205-7

Yakovleva, N., Kotilainen, J., & Toivakka, M. (2017). Reflections on the opportunities for mining companies to contribute to the United Nations Sustainable Development Goals in sub – Saharan Africa. *The Extractive Industries and Society*, *47*(2), 426-433. https://doi.org/10.1177/1038411109105440

Young, S., & Thyil, V. (2009). Governance, employees and CSR: Integration is the key to unlocking value. *Asia Pacific Journal of Human Resources*, 11-27.

Zhai, Y., Cai, Z., Lin, H., Yuan, M., Mao, Y., & Yu, M. (2022). Does better environmental, social, and governance induce better corporate green

innovation: The mediating role of financing constraints. *Corporate Social Responsibility and Environmental Management*, *29*(5)1513-1526.

Zott, C., Amit, R., & Massa, L. (2011). The Business Model: Recent Developments and Future Research. *Journal of Management*, *37*(4), 1019-1042. ttps://doi.org/10.1177/0149206311406265

APPENDIXES

APPENDIX A

Information sheet:

Dear Sir/Ma'am,

My name is Khulekani Nhlanhla, and I am a Master of Management student in the field of Innovation Studies at the Wits Business School, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating "sustainable business model innovation and ESG performance in the South African mining industry" under the supervision of Prof. Mjumo Mzyece. The aim of this research project is to investigate how ESG performance supports or thwarts sustainable business model innovation in the South African mining industry.

As part of this project, I would like to invite you to take part in a 30 to 40 minutes semi-structured interview conducted via MS Teams or in person. This activity will involve answering no more than 10 (ten) interview questions. With your permission, I would also like to audio record the interview using a digital device (cellphone). This recording will be stored in my school one drive folder protected by a password and only the researcher will have access to this recording. It will be deleted after 1 years.

There will be no personal costs to you if you participate in this project, you will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. Your identity will be anonymous as I will not be asking for your name or any identifying information. I will be using a pseudonym to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. The data collected from this research project will be stored in my school one drive, in a password protected folder and will be kept for a maximum of 1 (one) year. With your permission the data collected from this research project may be used by other researchers in an anonymized format. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,
Researcher:
Khulekani Nhlanhla,
Supervisor:
Prof Mjumo Mzyece,

APPENDIX B

Consent form:

I, ……, agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
I agree that the researcher may use anonymous quotes in his / her research report	YES	NO
I agree that the interview may be audio recorded	YES	NO
I agree that the information I provide may be used in an anonymized format after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO

…..
…… (signature)
…… (name of participant)
…… (date)

…… (signature)
…… (name of person seeking consent)
…… (date)

APPENDIX C

Interview Questions:

The below are in the interview questions asked during interviews with interview respondents.

Interview Questions

1. What's your current role and position in your company?
2. What is your level of interaction (ESG) or sustainability in your day to day work?
3. In your experience, how have you seen companies in the South African (SA) mining sector engage in collaboration with stakeholders such as suppliers and local communities to enhance their sustainable business practices?
4. How do stakeholder (e.g., society, employees, environment, investors, government and suppliers) expectations regarding ESG performance impact SA mining companies' operations and decision making processes?
5. In your opinion, which of the three — governance, social issues, or the environment — is given more weight in the mining sector in South Africa?What are the challenges faced by the industry in integrating sustainable business practices into their operations?
6. What sustainable measures have you observed assisting any industry companies in lowering operating or capital costs?What are some of sustainability initiatives you have seen help to increase revenue in any of the companies in the industry?
7. In your experience, What are mining companies in South Africa doing to sufficiently integrate ESG intiatives in their corporate strategies?

8. South Africa has energy and Infrustructure and Regulatory Challenges, how do these challenges hinder the mining industry from contributing towards sustainable development?

Closure: *Do you have closing comments? Could you kindly suggest any other persons (current or former colleagues) to possibly interview?*
Thank you for your time, input, and for granting this interview at short notice.

APPENDIX D

The below is a list of respondents' backgrounds

Respondent	Background
1	Group Executive for Sustainability
2	Account Lead for Resources (mining and energy) clients
3	Retired Expert
4	Head of Sustainability
5	Head of Sustainability
6	Business Improvement Manager
7	Sustainability Strategy Manager
8	Sustainability Strategy Senior Manager
9	Global Corporate Sustainability
10	Responsible Investment Analyst
11	Environmental Manager
12	Executive head for SHEQ and technical assurance
13	Environmental Manager
14	Sustainability Performance and Reporting Specialist
15	Industry Expert and Researcher on Water and Environment
16	Principal Advisor for Communities and Social Performance
17	Retired Expert, Researcher, Commentator, and Consultant
18	Director of a Mining Sustainability Company
19	Economist and Sustainability Director
20	Safety Health and Environmental Systems Specialist

APPENDIX E (Ethics Clearance)

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/IS1281298/414
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

This certificate is only valid if accompanied by formal permission from the relevant stakeholder(s).

Project title	Sustainable business model innovation and ESG performance in the South African mining industry
Investigator / Researcher	Mr Khulekani Nhlanhla
Nature of Project	MM (Innovation Studies)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentialty.
Issue Date of Certificate	2023-01-27
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba ☎ +27 11 717 3976 +27 82 733 6587 pius.oba@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

30 January 2023
Date: