

**Exploring the role of dynamic capabilities as a core competency on
sustainable innovation in the mining industry**

Retselisitsoe Emmanuel Maphalla

29290199

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Abstract

The aim of this research was to explore how mining capabilities can make use of the dynamic capability theory in their attempts to achieve sustainable innovation. The results of the study were based on 12 semi-structured interviews that were conducted with participants being senior managers, executives and mining consultants. From the interviews, the participants highlighted five key dynamic capabilities mining companies need to have in order to innovate sustainably. These key dynamic capabilities were financial liquidity, experienced and skilled management, flexible workforce, nature of resource mined and stakeholders' support. To successfully build these dynamic capabilities, five key routines or processes were identified, which are; research and development, foresight, scenario planning, continuous improvement and embracing technology.

The key barriers to sustainable innovation in the mining industry were also highlighted, and these were found to be; the literacy level, employers – unions relationships, mining legislation, culture and asset intensiveness nature of the industry. Based on literature study and the results from the interviews, a dynamic capabilities for sustainable innovation framework was developed and presented as a guide that can be used by mining companies in their attempts towards innovating sustainably by making use of dynamic capability theory.

Keywords

Dynamic capabilities, sustainable innovation, adapt, triple bottom line

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Retselisitsoe Maphalla

1st December 2020

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ABBREVIATIONS

CSR: Corporate Social Responsibility

ESG: Environmental, Social and Governance

RBV: Resource-Based View

R&D: Research and Development

SHEQ: Safety, Health, Environment and Quality

VRIN: valuable, rare, inimitable and non-substitutable

VUCA: volatility, uncertainty, complexity, and ambiguity

XRT: X-Ray Transmission

1. INTRODUCTION TO RESEARCH PROBLEM

1.1. Introduction

This research explored how the mining organisations can leverage their dynamic capabilities to drive sustainable innovation in their operations. The research was grounded on dynamic capability theory and sustainable innovation. Based on studies conducted on various industries in other parts of the world on how dynamic capabilities an organisation has can enhance its sustainable innovation, the research aimed to test whether the learnings from these studies applied to the mining industry. The findings of this study brought home what dynamic capabilities are crucial for the mining organisations to drive a sustainable innovation. The subject of sustainable innovation was looked at from the perspective of the required organisational processes and routines that managers are expected to develop for their organisations to remain fit amidst the ever-changing business environment.

1.2. Background to the research problem

This study was triggered by a literature review that was conducted looking at 33 journal articles that were published in a period of ten years between 2005 and 2015 that was conducted by Amui, Jabbour, Jabbour, & Kannan (2017), with their main focus areas being dynamic capability theory and business sustainability. In their study, the authors showed that dynamic capabilities can potentially have a significant influence as a theoretical basis for understanding how organisations undertake sustainable innovation.

The conclusion that was reached by the authors was that more work still needs to be done to get to the bottom of what exactly are the key dynamic capabilities required in the workplace in relation to the organisation sustainability and the impact such dynamic capabilities have on sustainable innovation.

From this systematic literature review, the first finding was that all the studies were conducted either in manufacturing or services sectors. None of the studies were conducted in the mining sectors. Secondly, the meta-analysis revealed that all the studies were conducted either in Europe, America, or Asia, and none of them were conducted in Africa. This research therefore aimed at further exploring these two constructs which are dynamic capabilities and sustainable innovation. The research explored what dynamic capabilities were required in the mining industry, in the African context, in order to achieve a sustainable innovation that would potentially propel mining organisations, which now more than ever before are faced with a business environment that is highly competitive and dynamic in nature, to sustainable economic benefits.

1.3. The purpose of the research

The studies done showed that not much research has been done on how an organisation can make use of its capabilities to treat sustainability as a dynamic aspect that can be intertwined within organisational strategies. Even though there were many studies done on dynamic capabilities and organisation sustainability, not enough research integrating both themes has been done (Amui, Jabbour, Jabbour, & Kannan, 2017), especially in the emerging markets. The gap identified was related to how organisations in various sectors can identify the dynamic capabilities that are crucial for them to remain sustainable in the face of dynamic business environments.

The study therefore aimed to build on the current literature by exploring how organisations can develop and shape their dynamic capabilities to align with their strategies in order to enable a sustainable innovation.

1.4. The academic and business rational of the research

The findings from this study will have significant implications for academics as well as managers in the mining sector.

For the academics, the findings will add to the current literature integrating dynamic capabilities and sustainability. The research sought to address the recommendation for further studies made by Amui et al. (2017), that further research was required on how organisations can remain sustainable from a viewpoint of dynamic capability theory. The recommendations further stated that there was an opportunity to conduct further research on this subject in developing countries, and make a comparison of the findings with those from developed countries to see if similar factors apply in both contexts.

The literature review has also shown that all the studies done around the subject of dynamic capabilities and sustainable innovation were conducted in manufacturing and services sectors only. Therefore, the contribution that this research will make to the academic body of knowledge is on what dynamic capabilities mining organisations need to develop in order to successfully address the sustainable innovation issue prevalent in today's business environment. The findings from this research will therefore advance the previous findings either by increasing generalisability or introducing new capabilities due to conducting the research on a different setting.

For managers in the mining sector, the findings will provide a deeper understanding of how they can make sound and sustainable decisions in turbulent environments by applying dynamic capability theory. The research tested the three dynamic capabilities of sensing, seizing and reconfiguring first developed by Teece, Pisano, & Shuen (1997) to find out if they still hold in the current ever-changing business environment.

1.5. The scope of the research

The scope of this research was restricted to understanding how the mining industry can make good use of the dynamic capability theory to improve sustainable innovation of the mining operations. The participants selected for this research were senior managers, executives, and consultants in the mining industry who have a wide range of expertise in operations, strategy, as well as sustainable innovation.

1.6. Conclusion

This chapter looked at an introduction and problem background, the purpose of the research, both the academic as well as business rationale of research, and scope of the research was also given. As has been detailed earlier on, the research problem that the study will seek to address is identifying key dynamic capabilities that can help mining companies to become innovative in a sustainable manner.

Chapter 2 that follows will present a brief overview literature related to dynamic capabilities and sustainable innovation, and what is known in terms of the relationship between the two. Chapter 3 will outline the research methodology followed to gather data and data analysis techniques that will be used.

2. LITERATURE REVIEW

2.1. Introduction

Organisations are now more than ever before operating in a very dynamic and highly competitive business environment. In order to survive, they need to build three important skills or capabilities. They need to have an ability to *sense* the environment in terms of what opportunities and threats are there, be able to *seize* the opportunities after they have been identified, and lastly be able to easily *transform* their tangible as well as intangible resources in response to the market conditions (Roberts, Campbell, & Vijayasarathy, 2016). The ability to survive the rapidly changing market conditions requires organisations to have dynamic capabilities which will help them to develop, expand and transform their assets.

Organisations are faced with complex and volatile business environments which require that they look for ways in which they can treat sustainability as a dynamic capability that is built into the business models and strategies (Amui et al., 2017). According to Ameer and Othman (2012), sustainable practices are those that comprise adopting a long-term view and improving engagement of everyone involved when assigning tasks which are expected to benefit the entire ecosystem within which the organisation functions, including the bigger community as well as the general environment. Further literature review on the two major constructs for this study which are the dynamic capabilities and sustainable innovation is given in the sections that follow.

2.2. Dynamic capabilities

The dynamic capability theory was derived to build on resource-based view (RBV) to capture the idea that the assets and capabilities that an organisation has are supposed to be dynamic to enable easy response to the ever-changing business environment (Teece D. J., 2007). According to the RBV, an organisation's competitive advantage comes from having "the resources and competencies that are valuable, rare, inimitable

an non-substitutable (VRIN)” (Mousavi, Bossink, & van Vliet, 2019). Based on its VRIN resources, an organisation will be able to expand into suitable markets and make profit.

RBV was subjected to criticism by some researchers because it failed to explain how organisations are supposed to respond to issues related to environmental sustainability (Cheng, Yang, & Sheu, 2014). Apart from that, the resources referred to in the definition of VRIN are the inputs into the production, and as such do not have the capability to create competitive advantage themselves, which creates a need for organisations to have dynamic capabilities to integrate these resources in way that gives optimal results (Helfat & Peteraf, 2009). Another criticism given to RBV was that it does not mention how a company will develop resources and competencies in future, or how the present VRIN resources will be modified to address the changes in the market (Mousavi, Bossink, & van Vliet, 2019). It is because of all these criticisms that the dynamic capabilities theory was developed, so that it can close the gaps on RBV theory.

Teece (2007) defined dynamic capability as “the capacity to sense and shape opportunities and threats, to seize opportunities, and to maintain competitiveness through enhancing, combining, protecting, and when necessary, recognising the business enterprise’s intangible and tangible assets”. Mousavi, Bossink, and van Vliet (2018) further argued that if an organisation possesses the required dynamic capabilities, it will have a better competitive advantage which will guarantee a successful implementation of change and evolutionary fitness within the industry it operates. The dynamic capabilities give management teams in the workplace the grounding and the competitive landscape in their industries (Teece, 2014).

When an organisation has strong dynamic capabilities, it has the required knowledge and skill to develop reasonable business models that are suited to capture the future opportunities in the market (Schoemaker, Heaton, & Teece, 2018). The strong dynamic capabilities enable an organisation to sense and seize the opportunities well

ahead of its competitors, and also it to transform its business ecosystem in a manner that gives it competitive edge over its competitors (Teece D. J., 2012).

Schoemaker, Heaton, & Teece (2018) argued that for an organisation to be competitive, it needs to deeply embed the dynamic capabilities into the organisational culture and build shared values, which will then influence organisational learning, experimentation, and level of risk tolerance. Dynamic capabilities are distinctive, difficult to build and deploy, and cannot be imitated by competitors (Mousavi, Bossink, & van Vliet, 2019). The key dynamic capabilities are shown in Figure 1.

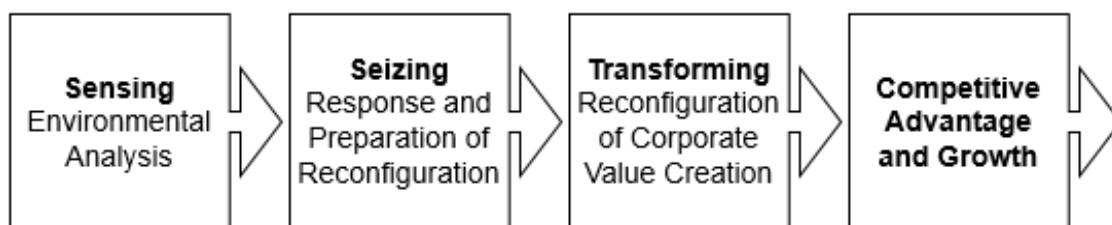


Figure 1: Dynamic capabilities (Teece, 2007)

With the rapid pace at which the global markets are changing and the technology advancing, resulting in highly competitive environment, organisations need to be able to sense opportunities in the market, seize such opportunities as they present themselves, and continuously modify their resources (Roberts et al., 2016). An organisation's ability to have competitive advantage is dependent on what strengths it has in response to the market conditions and other factors external to the organisation. The strengths referred to are the capabilities that an organisation has, which enable it to manage its resources efficiently and effectively (Mikalef, Boura, Lekakos, & Krogstie, 2019).

An organisation with strong dynamic capabilities is capable of becoming profitable in a long run, and has the ability to make effective adjustments to its business models (Teece, 2018). Dynamic capability view regards capabilities as competitive advantage an organisation has in pursuing its objectives, through a strategic re-organisation of its resources which form the cornerstone of its competitive edge in the market. (Mousavi, Bossink, & van Vliet, 2019)

The current rapidly changing and volatile market conditions place a huge pressure on the majority of capabilities that organisations build in order to have a competitive edge, and these capabilities are eroded away within a very short time period (Drnevich & Kriauciunas, 2011). It is in instances like this that the dynamic capability theory becomes handy in closing the gap by emphasising that the capabilities an organisation has need to be renewed and reorganised so that an organisation remains competitive. The dynamic capabilities a firm has will indirectly add value to the firm because it becomes easier for such a firm to adapt. Various combinations of the present dynamic capabilities can result in new capabilities which are able to shape how the market is reacting (Helfat & Winter, 2011). Literature review of the core dynamic capabilities of sensing, seizing and reconfiguring is given below.

2.2.1. Sensing

Sensing was defined by Teece (2007) as a managerial routine of scanning the environment for new opportunities and getting to know more about what customers require, the competitive landscape of the market, new technologies, suppliers in the market as well as the entire ecosystem. Sensing capability gives an indication that if an organisation needs to engage in sustainable innovation, it needs a lot of external information about the environment it operates in (Bocken, Farracho, Bosworth, & Kemp, 2014). It is managers' responsibility to sense opportunities in the market long before they become prevalent to competitors (Roberts et al., 2016).

Endres, Helm, & Dowling (2020) argued that in the process of building an organisation's dynamic capabilities, to enable it to be competitive in a very volatile business environment, the ability to sense must be regarded as the first dynamic capability to consider. For an organisation to be able to respond to the changes in the market, it has to be able to detect what opportunities there are in the market, as well as the threats that it is faced with (Protogerou, Caloghirou, & Lioukas, 2012). Most organisations recently spend significant amount of time and money trying to search for business opportunities.

According to Foss, Lyngsie, & Zahra (2013), there are numerous ways in which the capability to sense the environment can be enhanced, which include maintaining a close contact and relating very well with customers, suppliers, as well as other external partners and institutions like universities. This view was reiterated by Segarra-Ona, Peiro-Signes, & Mondejar-Jimenez (2016) when they argued that if an organisation want to be innovative in a sustainable manner, it needs to acknowledge and leverage its external partners who provide knowledge and information.

2.2.2. Seizing

Teece D. J. (2012) defined seizing as a managerial routine whereby the resources an organisation has are mobilised with the aim of capturing the opportunities that were identified through scanning of the environment. These opportunities can be captured through either introduction of new processes, products and services, or modification of current ones. Seizing include activities like sharing of knowledge, giving strategic signals to the relevant stakeholders, development of intangible value for the organisation and initiating dialogue related to sustainable innovation (Mention, Barlatier, & Josserand, 2019).

For an organisation to seize opportunities, it has to uphold and configure external networks by providing employees with sufficient internal resources and certain incentives aimed at encouraging them to create and keep contacts with individuals external to the organisation who are stakeholders to the business (Lutjen, Schultz, Tietze, & Urmetzer, 2019). It is up to each organisation to decide whether or not the interaction between their employees and these external networks are formalised and/or regulated (Ritter & Gemunden, 2003).

The seizing capabilities involves development of new products, processes or services, and the implementation of new innovations through integration of various activities, making use of different resources and competencies (Mousavi, Bossink, & van Vliet, 2018). Lieberherr & Truffer (2014) further argued that seizing capabilities gives

organisations an opportunity to develop and improve competencies which enable them to deploy resources in the process of exploiting all the opportunities in the market. The seizing capabilities are therefore strengthened by developing strong internal capabilities, paying attention to the best practices and using them where applicable, as well as collaborating with external sources of knowledge and information about the market (Darmani, Niesten, & Hekkert, 2017).

2.2.3. Reconfiguring/transforming

Reconfiguring refers to the managerial routines which focus on orchestrating and deploying the tangible and intangible resources an organisation has in order to match the ever-changing business environment (Mousavi et al., 2018). This process also involves renewing processes and practices in an organisation to keep it fit and well-structured to match the changes taking place in the market. Mousavi et al. (2018) further argued that reconfiguring exercises also help an organisation to ease the rigidity and resistance to change developed through a momentum gained by being used to the current processes and resources accumulated over a long period of time.

Teece D. J. (2007) argued that organisations need to ensure that their tangible and intangible assets are regularly realigned in order to establish strategic fit between what needs to be done and what resources are available to do the job. Organisations also need to ensure that their inner processes and systems are well aligned to the external environment or the ecosystem within which they operate. According to Schoemaker, Heaton, & Teece (2018), organisations operating in an environment where there is volatility, uncertainty, complexity, and ambiguity (VUCA), need not only realign themselves and adapt to changes, but also need to try to reshape and transform their ecosystems so that they can enjoy full benefits from their realigned business models.

The reconfiguring process also involves renewal of company day-to-day routines and processes so that they are always aligned with changes taking place in the market (Mousavi, Bossink, & van Vliet, 2018). When the company is continuously renewing

its routines and processes, it becomes capable of responding quickly to any unexpected event that poses potential harm to the business (Teece D. J., 2007).

According to Dangelico (2015), there are three major shifts in business operations that need to take place in a configuration process. Firstly, there needs to be a shift and improvement on organisation's value chain, secondly a change is needed to ensure good management practices, and thirdly there needs to be a change on how the organisation interacts with its external stakeholders like suppliers, customers, communities, and government to maintain good relationships. Organisations need to form cross-functional teams whose purpose will be to enable innovation to happen in a sustainable manner (Mousavi, Bossink, & van Vliet, 2018).

2.3. Building dynamic capabilities

The failure of management to recognise the tremendous shifts taking place in the business environment can result in loss of competitive advantage. As Semke & Tiberious (2020) argued, organisations are operating in a VUCA world whereby their processes and resources need to be flexible and configurable to address the ever-changing environment. The rapid rate at which new changes occur has made the market conditions to be very volatile and complex in nature. When the business environment is in chaos with emerging markets and new industries evolving, it is the responsibility of managers to ensure that their organisations can survive throughout the uncertain times by becoming more resilient and adapt to the dynamic environment (Teece, 2007).

According to Giniuniene & Jurksiene (2015), dynamic capabilities can be grouped into two processes; the strategic and operational. Under the strategic processes, an organisation needs to sense and seize opportunities that are presented by the changing environment. The organisational processes on the other hand involve reconfiguring of organisation's internal and external competencies in response to the changing environment.

Building dynamic capabilities is seen as a means to protect organisations against getting obsessed with best practices but rather focus on continuously scanning the environment in order to assess how vulnerable their business models are to this external environment (Schoemaker, Heaton, & Teece, 2018). Once there is a feeling that the model is vulnerable, an organisation needs to build and align its internal and external abilities in order to address the challenges which are likely to negatively affect the position held by the organisation in the market (Teece D. J., 2007). As Schoemaker, Heaton, & Teece (2018) argued, developing dynamic capabilities is like building a bridge that connects the present moment to the future an organisation would like to have, and an inability to have dynamic capabilities will result in an organisation failing to adapt to changes taking place in the market.

When managers want to capture all the actions that will assist them in decision-making relating to how organisations can maintain a sustainable growth in future, they can use strategic foresight. Strategic foresight was defined by Vecchiato (2015) as a combination of routines, processes and techniques used by a company to sense how it is likely to evolve and what response mechanism must be in place to address the potential future changes. Through a strategic foresight process, managers can explore how various scenarios are likely to play out in future so that decisions can be made in an informed manner and engage innovative processes so as to remain fit and profitable in a long run as a business (Semke & Tiberious, 2020).

Strategic foresight has its grounding in dynamic capability theory and it plays a crucial role in helping managers to observe how the environment within which the organisation operates keeps on changing. Since strategic foresight looks at how the external factors are likely to influence the future of the organisation, it enhances the sensing capability related to the threats and opportunities and also enhances the seizing capability by giving an organisation a first mover advantage over its competitors (Vecchiato, 2015). Strategic foresight is therefore one of the best techniques that should be used to enhance an organisation's dynamic capabilities.

When looking at the subject of strategic foresight from dynamic capabilities angle, some insights on how to engage strategic foresight practices can be gained. As Schwarz, Rohrbeck, & Wach (2019) pointed out, strategic foresight practices can be enhanced through training of managers on how to have a long-term view of the business and environment around it and make informed decisions when surrounded by uncertainty about the future, and also how to reconfigure tangible and intangible assets in order align the business model to the business environment. The assets an organisation has must be such that they are easily renewed or adjusted based on the market need.

2.4. Sustainable innovation

The term innovation was first defined by Shumpeter in 1934 as new products, new processes, new supply channels, new business opportunities, or new business structures and manner in which the business is organized (Giniuniene & Jurksiene, *Dynamic Capabilities*, 2015). Cillo, Petruzzelli, Ardito, & Giudice (2019) defined sustainable innovation as a process of developing new product, services, processes and technologies with the intention of improving the well-being of the society, conserving the natural environment and at the same time improving the financial well-being of the company.

As Pellegrini, Annunziata, Rizzi, and Frey (2019) pointed out in their study, sustainable innovation can be viewed as a concept that is associated not only with new products, practices or processes, but also emphasises the significance of purposefully changing values and philosophy of the the organisation. Sustainability practices enable organisations to create opportunities to be in charge of economic, environmental, and societal risks through a long-term value creation (Chakrabarty & Wang, 2012).

According to Boons, Quist, Montalvo, & Wagner (2013), the three sustainability aspects, which are environment, social and financial need to form part of the business model right from the beginning when the idea is generated up until when the product is out on the market. This implies that when managers make all their business

decisions and implement innovations, they must always apply a sustainable approach which takes financial, social and environmental aspects into consideration. An organisation which innovates in a sustainable manner is expected to achieve not only the economic benefits, but also to deliver a good performance on environmental and social issues both now and in future.

An organisation that wants a sustainable innovation must direct their focus not just on becoming competitive, but doing so in a very sustainable manner (Mousavi et al., 2018). Companies can engage in sustainable innovation in many ways, including assessing their main activities and deciding how their key tangible and intangible assets as well as their competencies can be reconfigured to successfully match the dynamic market conditions (Dangelico, 2015). The issue of reconfiguring the assets and competencies addressed in the above argument therefore shows that the subject of sustainable innovation is related to the dynamic capabilities which are characterised by sensing, seizing and reconfiguring as has been discussed earlier on.

Sustainable innovation helps an organisation not only achieve its goals related to adding value to the social elements of the society, but also the environmental value as well as maintaining favourable economic returns (Adams, Jeanrenaud, Bessant, & Denyer, 2016). To advance the discussion on sustainable innovation, the following two theories, stakeholder theory and the market-based capabilities theory will be discussed.

2.4.1. Stakeholder Theory

The stakeholder theory says that an organisation functions within a network of parties that have different stakes in activities that it undertakes (Weidner, Nakata, & Zhu, 2020). This network signifies some intricate relationships that an organisation need to take care of, sometimes requiring that deliberate sacrifices be made by one party in favour of another. If for instance an organisation manufactures a cheap product from the plastics which cause pollution, the financial-oriented customer become happy, but the environmentalists get angry with the product because it would increase carbon

footprint. According to Parmar, et al. (2010), these are types of decisions that show moral dilemmas where there is a benefit gained by one party and harm caused to another.

2.4.2. Market-based capabilities theory

Suoniemi, Meyer-Waarden, Munzel, Zablah, & Straub (2020) defined market-based capabilities as an organisation's ability to comprehend what the customers require and be able to develop products and services that meet customers' expectactations. The market-based theory says that the activities that an organisation undertakes to be able to create sustainable innovations are very much dependant on a set of skills and knowledge which are known as capabilities (Weidner, Nakata, & Zhu, 2020). These capabilities are crucial when processes or tasks that are aimed at developing and delivering the products or services throughout the value chain are being undertaken, and these capabilities must be superior in nature so that they will enhance the competitvness of the organisation.

2.5. Dynamic capabilities for sustainable innovation

Some studies on dynamic capabilities and sustainable innovation have been conducted before, even though these studies were mainly under manufacturing and services industries. The sensing capabilities enable organisations to take a full scan of the environment in order to be informed on new technologies being introduced, trends being follwed by the industry and all other players in the ecosystem, and new demands and markets are arising (Mousavi, Bossink, & van Vliet, Dynamic capabilities and organizational routines for managing innovation towards sustainability, 2018). Being familiar with all this kind of information will enable organisations to identify gaps in their business models and allow them to start innovating towards addressing those gaps. Horbach, Rammer, & Rennings (2012) further argued that organisations that want to achieve sustainable innovation must be aware of the potential opportunities which can improve their sustainability. This awareness through sensing can be gained

from various sources of information, either being from within the company, from the market, from institutions, as well as the public at large.

The seizing capabilities on the other hand give an organisation a chance to develop competencies and utilise their assets appropriately in order to remain competitive (Teece D. J., 2007). According to Lieberherr & Truffer (2014), one of the things that organisation can do to seize new opportunities is to develop new products or put in place new production processes. Apart from that, Mousavi, Bossink, & van Vliet (2018) explained that the process of seizing comprises building inhouse capabilities through research and development (R&D) and training, implementing the best industry practices and standards, as well as collaborating with other industry players and experts to build sustainable innovations.

The dynamic capabilities required for the reconfiguring process include modifying and redesigning the processes that organisations used in their innovation initiatives (Hall & Vredenburg, 2003). The reconfiguring capabilities comprise of the ability to integrate the resources and assets an organisation has, as well as the collective knowledge and learnings from individuals within the company (Pavlou & El Sawy, 2011). As Okhuysen & Eisenhardt (2002) argued, the ability to integrate multiple learnings into purely new dynamic capabilities helps organisations to assess how different individuals fit into the business structures, how they act towards one another and how the activities performed within various units fit together.

2.6. Dynamic capabilities framework

There is some past research done with the aim of identifying what pragmatic routines can be utilised in the reconfiguration of current operational processes in order to keep up-to-date with the ever-changing business environment. Galunic & Eisenhardt (2001) argued that dynamic capabilities can be regarded as a set of tools with which the current operational capabilities an organisation has can be reconfigured. This view was also supported by Teece D. J. (2007) who argued that the main purpose of dynamic capabilities is to enable reconfiguration of organisations' operational

capabilities into a set of new capabilities aimed at ensuring that such organisations remain relevant and competitive in a turbulent business environment.

The research in dynamic capabilities has made use of various labels to name similar capabilities, and sometimes the same label has been used to refer to different capabilities. In order to address this inconsistency in naming dynamic capabilities, Pavlou & El Sawy (2011) conducted a research aimed at reconciliation of these capabilities, and came up with four main group of dynamic capabilities which are sensing, learning, integration and coordination, shown in Figure 2. These dynamic capabilities serve the role of reconfiguring the current capabilities an organisation has into new ones which are well suited to the changing business environment (Teece D. J., 2007).

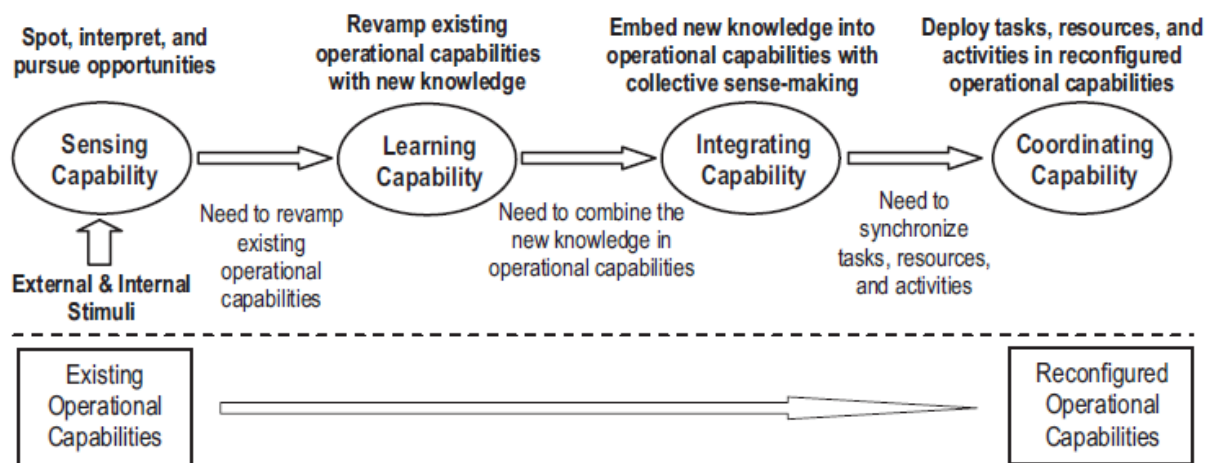


Figure 2: Dynamic capabilities framework (Pavlou & El Sawy, 2011)

The four dynamic capabilities highlighted, together with the organisational routines falling under each capability, are summarised in Table 1. Schilke (2014) defined organisational routines as various means undertaken by organisations in the deployment of their dynamic capabilities.

Table 1: Definitions of the capabilities and their basic routines; reproduced from (Pavlou & El Sawy, 2011)

Capability	Definition	Basic routines
Sensing capability	The ability to spot, interpret, and pursue opportunities in the environment.	<ul style="list-style-type: none"> • Generating market intelligence • Disseminating market intelligence • Responding to market intelligence
Learning capability	The ability to revamp existing operational capabilities with new knowledge.	<ul style="list-style-type: none"> • Acquiring, assimilating, transforming, and exploiting knowledge
Integrating capability	The ability to embed new knowledge into the new operational capabilities by creating a shared understanding and collective sense-making.	<ul style="list-style-type: none"> • Contributing individual knowledge to the group • Representation of individual & group knowledge • Interrelation of diverse knowledge inputs to the collective system
Coordinating capability	The ability to orchestrate and deploy tasks, resources, and activities in the new operational capabilities.	<ul style="list-style-type: none"> • Assigning resources to tasks • Appointing right persons to right tasks • Identifying synergies among tasks, activities, and resources • Orchestrating activities

2.7. Conclusion

It has been shown through literature review that dynamic capabilities an organisation had enabled it to remain ahead of the competition. The dynamic capabilities, which can be enhanced by a strategic foresight exercise, enable a company to know what is likely to happen in future and act accordingly. The insights on the likely future changes will then enable managers to start innovating their systems and processes in sustainable manner so that the changes that occur do not find them unprepared.

3. RESEARCH QUESTIONS

The research questions that the study will seek to address are restated below:

Research question 1:

What are the key dynamic capabilities mining companies need to have in order to remain competitive?

This question was intended to understand how the participants understood the concept of dynamic capabilities as well as how it related to the mining industry in general. The clear understanding shown by the definition given, which remains within the boundaries of the concept, would then ensure that the discussion will be continued with a clear understanding of what exactly is the main theme of the study.

Research question 2:

What processes or routines must be undertaken by mining companies to enhance the development of these key dynamic capabilities within their management team?

In this research question, the researcher sought to understand whether there are any key processes or routines that, if performed properly, will result in improved dynamic capabilities within the company. These routines would then be expected to have a direct link to the identified dynamic capabilities, which mean that failure of an organisation to undertake these routines will result in loss of dynamic capabilities.

Research question 3:

What is the level of sustainable innovation taking place in the mining industry in comparison to other industries?

The purpose of research question 3 was to get an idea of how mining companies are performing with regards to innovating in a sustainable manner. The literature from chapter 2 showed that sustainable innovation is a type of innovation that takes into

account the three major elements, which are social, environmental and financial elements. The innovation that focuses on financial gains and neglects other two aspects is not sustainable in a long run, and might lead into criticism from external stakeholders, which can result into the company being forced to close down.

Research question 4:

What are the key barriers and enablers of sustainable innovation in the mining industry?

Sustainable innovation is a very crucial thing to be done by mining companies. For companies to be innovative in a sustainable manner, they need to know what the barriers and enablers to sustainable innovation are. Apart from that, it was important to know whether these barriers and enablers apply across all mining companies in a similar manner or whether they vary depending of different dimensions like company size, location, product, and many more.

Chapter 4, which is the next section, will outline the research methodology followed to gather data and data analysis techniques that will be used.

4. RESEARCH METHODOLOGY

4.1. Introduction

The aim of this chapter is to give a detailed description of the research methodology used in this study to address the research questions discussed in chapter 3. The research methodology used was informed by the literature review from chapter 2. This literature review also formed the basis for designing the interview guide which was used to gather data, making use of semi-structured interviews which were conducted virtually as a result of restrictions on movement due to Covid-19. The research methodology used was formulated in a manner that takes cognisance of data reliability and validity. The subsequent results and analysis of results sections were also approached with these two issues in mind. The research methodology also ensured a total compliance to ethical practices as required by the university.

4.2. Research methodology and design

The research philosophy for this study followed an interpretivism domain. Saunders and Lewis (2012) argued that interpretivism is applicable for research project where social phenomena are studied in their natural environment. The findings from an interpretive paradigm are not meant to offer “the” solution, rather to show the idiosyncrasies that individuals have in their normal everyday lives (Phoenix, et al., 2013). The study sought to understand how managers, executives, mining specialists and consultants in the mining sector perceived the role of dynamic capabilities towards sustainable innovation. Using the interpretive paradigm, the researcher generally relied on the views of the respondents who were knowledgeable in the subject discussed (Kankam, 2019).

In this research, a qualitative inductive approach was followed. An inductive approach seeks to gain some insights on what meanings individuals attach to events, and through data collection and analysis, theoretical themes reflecting the experiences of individuals within a certain context are developed (Saunders & Lewis, 2012). As

Thomas (2006) argued, an inductive approach is used when there is a need to consolidate and summarise raw data, establish relationship between research objectives and summarised findings from the raw data, and come up with a framework that forms the basis of processes evident from the raw data.

This research made use of mono methods because of time constraints. Saunders and Lewis (2016) defined mono method as a research design which makes use of only one data collection technique.

Literature has shown that even though the dynamic capability theory and sustainable innovation have been researched extensively, there is still insufficient research around which dynamic capabilities need to be developed in order to effectively address the sustainability challenge in turbulent environments (Amui et al., 2017). This research made use of exploratory design. Exploratory design is conducted where the researcher wants to get an insight about a specific topic that requires some clarity (Saunders & Lewis, 2012).

The research strategy used tried to address the gaps in the body of knowledge, in a way that is as efficient and practical as possible (Erbe, Reichmuth, Cunningham, Lucke & Dooling, 2016). As Saunders and Lewis (2012) highlighted, the chosen strategy was determined by research questions and objectives the study sought to answer, the existing knowledge regarding the topic, time allocated to do the study and other resources available, and researcher's own philosophical leanings.

Because of limited time related to completing this research project, the researcher conducted a cross-sectional study, which compared various variables as snapshots at a single point in time (Saunders & Lewis, 2012).

The questionnaire guide was discussed on one-on-one semi-structured interviews whereby executives, managers, and other mining experts with a clear understanding of dynamic capabilities and sustainable innovation in the mining industry were asked to participate. Saunders and Townsend (2016) pointed out that qualitative interviews

land themselves to greater ecological validity, offering rich insights and enabling a researcher to understand some complex realities within the companies. Semi-structured interviews conducted enabled the researcher to explore and get some insights about the research topic by identifying some general themes from interviews (Saunders & Lewis, 2012).

4.3. Population

According to Saunders and Lewis (2012), A population is defined as a full set of members or elements forming a data set, and can also be organisations and places. Welman, Kruger, and Mitchell (2005) defined a population as a group of potential participants to whom the findings of the research can be generalised. The authors further argued that it is only when the generalisation of the findings from the sample to the population can be made that the research findings have meaning beyond the constrained setting in which they were originally obtained. The selection of the population for this research was guided by level of knowledge and experience individuals in the mining sectors have on the two concepts forming the core of this research, which are dynamic capabilities and sustainable innovation.

For this study, the population was made up of upper-level managers and other experts in the mining industry who are involved in making strategic decisions which influence the long-term direction the mining companies take. As Bonn and Fisher (2011) argued, one of the main roles of upper-level managers is to scan the environment with the aim of collecting some useful information and analysing it by building cognitive models and mental representations of their perceptions and the decision they make. In order to establish sustainable organisations, upper-level managers are expected to take into consideration various aspects of sustainability and build them into their corporate, business as well as functional level strategies when strategic decisions are being made.

4.4. Unit of analysis

Welman et al. (2005) defined units of analysis as the major entity that is being studied, which can either be humans, groups, companies or institutions, human products, or events. The sample unit for this study comprised senior managers, executives and other mining experts who are involved in decision-making processes related to business sustainability and strategy formulation in the mining industry.

4.5. Sampling method and size

It is not practical to collect data from the entire universe. Saunders and Lewis (2012) argued that a sample needs to be selected which is a subgroup representing the selected population. The two sampling methods that can be used in qualitative research are probability and non-probability sampling. The difference between these two sampling methods is that while one can calculate the probability of any member of the population being included in probability sampling, the same cannot be done for non-probability sampling (Welman et al., 2005).

For this study, non-probability sampling was used. To carry out this sampling method, the person conducting the research relied on his own judgement when choosing a sample which enabled the research questions to be answered as best as possible (Saunders & Lewis, 2012). The study used purposive sampling technique. This was defined by Saunders and Lewis as a non-probability sampling technique in which the sample members are selected based on researcher's judgement on various reasons and premises. The main premise guided the selection of the sample members was their experience and knowledge of how sustainable innovation can be built into strategic decision making, as well as the understanding of how dynamic capability theory is applied in the mining sector.

When it comes to the sample size, one of the factors that is quite crucial is transparency of collected data and ensuring that enough depth to answer the research purpose and enough breadth to allow integration within the responses have been

achieved (Saunders & Townsend, 2016). Patton (2015) also maintained that sample size is influenced by what research users and peer reviewers regard as a credible research, as well as time and resource constraints. Three semi-structured pilot interviews were conducted to test whether interview questions yielded the expected answers. In a case whereby the responses from the pilot interviews failed to meet the purpose of the research, some of the interview questions were either removed, reworded, or entirely new questions introduced.

A heterogeneous population was used for this study. Even though all participants were from the mining industry, the heterogeneity defined the fact that they were of different gender, working for companies mining different commodities implying different challenges, and having different tenure serving as senior managers or executives. Saunders and Lewis (2012) argued that where the research questions will be directed to a heterogeneous population, the sample size required is between 12 and 30 participants.

Initially when the interviews were started, the researcher did not predetermine how many interviews will be conducted, because the decision on the number of interviews would be guided by whether new insights were still emerging from each additional interview. The sample size that was eventually archived in this study was 12 participants, and as Saunders and Townsend (2016) suggested, interviews continued until such point whereby saturation or informal redundancy has been reached. As Saunders and Lewis (2012) explained, data saturation is reached when any additional data collected gives very view or no further insights in answering the research questions and objectives.

In this study, saturation was reached at interview 11, whereby no further new insights were obtained. Each and every new insight that emerged from the interviews were allocated a code in ATLAS.ti software. In order to reaffirm that that saturation was really reached with interview 11, an additional interview which was interview 12 was conducted, and it also yielded no additional insights. The number of new codes that were created from each interview is given in Figure 3.

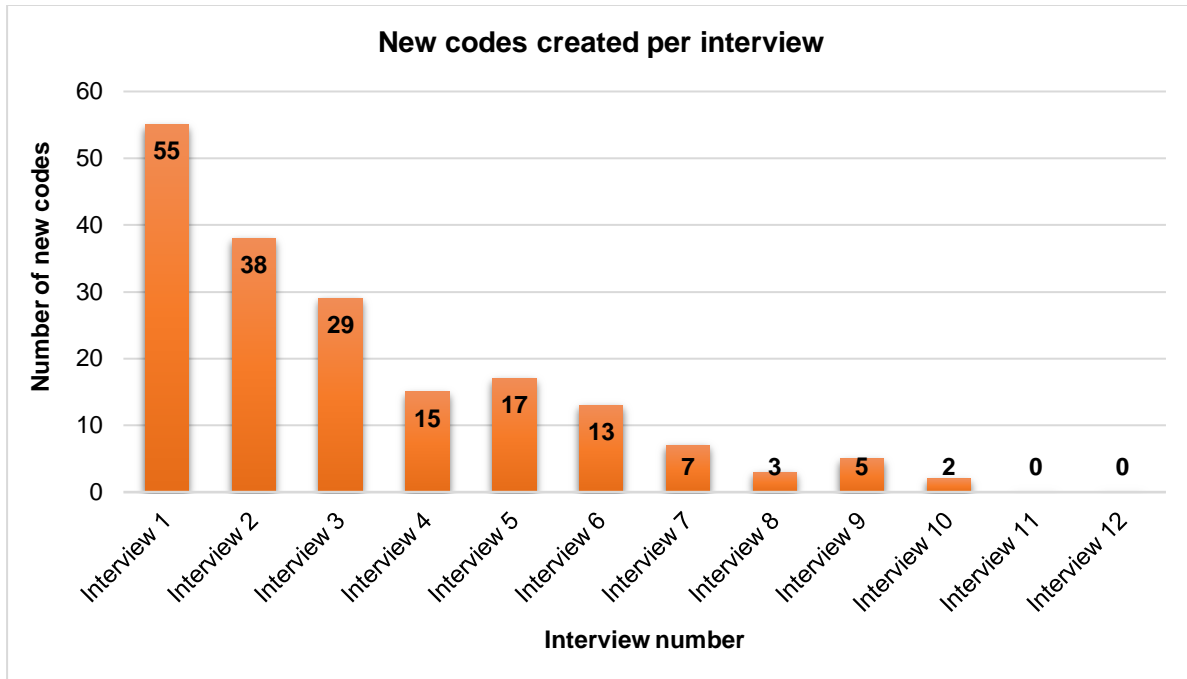


Figure 3: Number of new codes created from each interview

4.6. Measurement instrument

The study made use of one-on-one virtual semi-structured interviews to collect primary data. A questioning guide, which was drawn based on literature research and structured in such a way that it answers the research questions, was used as a measuring instrument. A semi-structured interview is a form of collecting primary data characterised by asking predetermined questions that follow no specific order, related to particular themes on which the research is based. In this type of interview, some questions contained in the questionnaire may be omitted if the researcher feels like they are not relevant to certain interviewees, and more questions not in the questionnaire may be asked to get a deeper insights on some aspects that the interviewee has pointed out (Saunders and Lewis, 2012). The questionnaire schedule that was used as a guide in the interviews is shown in Appendix A.

4.7. Data gathering process

Before continuing with data gathering, the research obtained Ethical Clearance approval from the University's Ethical Committee, shown in Appendix B, to ensure that the interviews will be conducted in an ethical manner. After getting the approval, the next step was data gathering process which involved first of all identifying potential participants and sending them invitation to participate through an email in which the background to the study was given. In the invitation, they were assured of being treated anonymously and with all due confidentiality throughout the study. As soon as they have accepted the invitation, they were asked to pick a date and time that was convenient for them to do the interview. Once the date and time have been set, an email with research information sheet and generic questions forming part of the questioning guide were sent to the participants so that they got a feel for what to expect in interviews. The informed consent form shown in Appendix C was also emailed to them to sign to show that they have volunteered to take part in the interviews. After signing this form, they emailed it back to the researcher.

On the day of the interview and before the interview started, the researcher once again gave a background and objectives of the study and what is expected from them as participants. After that, participants were allowed to ask any questions they have in order to gain more clarity. As per consent form that had been emailed to them prior to the date of interviews, the participants were assured anonymity and confidentiality, and they were made aware that they had a right to quit an interview at any time they wanted to do so without being asked why. As soon as the participants were happy with all the explanations made, an interview was started.

The interviews took between forty five minutes and an hour, and with the participants' permission, an audio-recordings of the interview was done so that they could be transcribed and analysed after interviews. Due to the lockdown conditions whereby movement was restricted with the aim to minimise the spread of Covid-19, all the interviews were conducted online through video call platforms like Zoom, Skype, or

whichever medium was convenient for both the researcher and interviewee at that time.

4.8. Analysis approach

There are two commonly used data analysis approaches used in qualitative research, which are content analysis and thematic analysis. Content analysis was described by Vaismoradi, Turunen, and Bondas (2013) as an analysis approach used to systematically code and categorise huge amounts of word-processed data into word patterns, showing their frequencies and structures. On the other hand, thematic analysis was defined by Braun and Clarke (2006) as an analysis approach used to “identify, analyse and report” themes from the collected textual data. For this study, both content analysis and thematic analysis approaches were used.

After transcribing and word-processing the audio recordings from interviews, ATLAS.ti software was used for data analysis. Before data analysis was commenced, the researcher dedicated enough time to read and fully understand the meaning of the transcribed data. After gaining a clear understanding of the data, data was coded, and then themes related to each one of the study objectives were developed.

4.9. Quality controls

Saunders and Lewis (2012) argued that there are five questions to be asked by the researcher to test the validity of research findings. Firstly, the researcher must check whether there is a logical flow from findings to the conclusions. Secondly, the researcher must check whether there is consistency between summarised findings and collected data. Thirdly, the researcher must check whether there is compatibility between data collected and methods used. Fourthly, the researcher must check whether the research methods used are aligned to the research strategy employed. And lastly, the researcher must check whether the research strategy, research questions and objectives are linked.

Saunders and Lewis (2012) referred to validity and reliability of data collected as a degree to which the intended variable was precisely measured through the data collection methods used by the researcher. In order to show validity and reliability of the research findings, the researcher used triangulation. Cresswell and Miller (2000) defined triangulation as a validity procedure that can be used by the researcher to find convergence amongst various information sources in order to develop themes and categories from the collected data.

The use of literature research, existing theories, interviews with relevant participants, and personal observations in a qualitative research enabled the comparison with the findings to be made so as to assess the validity of the themes or categories that have emerged from the study (Lewis, 2009). Apart from triangulation, after establishing themes and categories from the data, the researcher searched for data that disconfirms the themes and categories that have emerged. This search for disconfirming or negative evidence is another procedure that can be used to determine the credibility of research findings (Cresswell & Miller, 2000).

4.10. Limitations

One of the shortcomings of using purposive sampling is that if two differing studies were to be conducted on one problem, they may each go on and obtain such a sample in different ways, and as a result, it is not possible to justify to what degree those chosen samples will be a good representation of the selected population (Welman et al., 2005). This therefore means that the findings from the research cannot be generalized to the broader population. Another reason why qualitative research findings generalizability is limited is because it uses a much smaller sample size in comparison to the quantitative research (Taran, Boer, & Lindgren, 2015).

The majority of the participants had their mining background in South Africa, some of them have worked in other African countries, and a few of them have worked or are working overseas. Even though the study gives rich data related to African context, especially South Africa, its transferability to overseas countries is limited. Another

limitation of a qualitative research is that it is prone subjectivity and biases from the researcher when analysing the finding (Saunders & Lewis, 2012). To minimise this issue of bias, Saunders and Lewis argued that the researcher must support all the claims made with evidence and give a full justification for all methods used, which is what was done in this research.

5. RESULTS

5.1. Introduction

In this chapter, the results will be presented, based on the 12 semi-structured interviews that were conducted. The results presented will link up to the literature review from chapter 2 and seek to answer the research questions for this study which are highlighted in chapter 3. To come up with the results given in this chapter, the researcher first of all transcribed the interviews into word documents. After all the interviews have been transcribed, they were imported into the ATLAS.ti software. From ATLAS.ti, the researcher then carefully read all the transcripts just to make sense of what has been said.

After the first round of reading the transcripts was done, the researcher started reading them again for the second time, this time making notes on the margins of ATLAS.ti about the important points mentioned in the transcripts. After this notes making process was done for the first three transcripts, the researcher went through them again and assigned codes to the notes highlighted. Codes that seemed to be related were then grouped into categories. The rest of the remaining transcripts were then quoted using these developed quotes, and additional quotes were added where there are some new insights that did not relate to the existing quotes.

5.2. Details of interview participants

Table 2 shows the details of interview participants, their mining experience, their positions, as well as some other additional background information related to their career in mining.

The first section in this chapter will give details of the interview participants. The second section will be where the results from the qualitative semi-structured interviews are presented, in relation to the study research questions from chapter 3. To maintain consistency and golden thread between literature review, research questions and the results, the consistency matrix shown in Appendix D was used.

Table 2: Details of interview participants

Interviewee name	Years in mining	Position held	Additional information
Participant 1	30	General Manager	Participant 1 is a general manager with extensive knowledge in metallurgical solutions in the mining industry, having worked at senior management positions in various big companies including De Beers, Trans Hex Group Limited, Kimberley Diamonds Limited, Firestone Diamonds and later on GM at Lucapa Mothae mine.
Participant 2	21	Mineral Resources Manager	Participant 2 is Mineral Resource Manager at Gem Diamonds with expertise in the field of geotechnical engineering. He has over 15 years in various managerial positions, and has completed managerial programs in some of the top business schools in South Africa.
Participant 3	34	Chief Surveyor	Participant 3 is an experienced mining expert with background in mining and surveying. He has vast amount of experience leading mining and survey teams in various countries throughout Africa.
Participant 4	9	Plant Production Manager	Participant 4 is a technical expert in the field of mineral processing, and is also responsible for among others HR, HRD, Labour Relations and Employee Relations at Anglo American.
Participant 5	28	Chief Executive Officer	Participant 5 among his senior management positions served as General Manager of a joint venture between De Beers and Anglo Gold Ashanti, Vice President of Pala Investments in Switzerland, and CEO of Firestone Diamonds.
Participant 6	13	Section Manager	Participant 6 is an experienced mining engineer with good operational excellence and leadership skills. Having served in different management roles spanning different functions in the mining department, coupled by several management course undertaken at top business schools in South Africa, this

			candidate was well placed to offer some rich insights on the topic under discussion.
Participant 7	22	Specialist Caving	Participant 7 is an experienced mining engineer with extensive knowledge in mine planning and scheduling. His expert knowledge in block caving has seen made him lead the planning departments in various mines in South Africa, Indonesia as well as Australia.
Participant 8	12	Section Manager	Participant 8 is a Section Manager with vast amount of knowledge in operations management and continuous improvement. In his career at in the diamond mining industry, he has been a key play in performance improvement to the mining department that he worked in and in other various departments.
Participant 9	16	SHEQ Manager	Participant 9 has successfully led the Corporate Social Responsibility (CSR) initiatives and resolved disputes between host communities and the mines while working at Storm Mountain Diamonds mine and later on at Firestone Diamonds mine.
Participant 10	14	Mining Consultant	Participant 10 has managed underground and opencast operations up to a mining manager level. He has formed part of the stay-in-business and capital projects on various leadership roles.
Participant 11	19	Senior Process Manager	Participant 11 is a metallurgy expert who has experience managing process plants operating in iron ore, gold and diamond. He has also completed his Master of Business Administration as part of his general management development.
Participant 12	25	Continuous Improvement Consultant	Participant 12 is a continuous improvement consultant with vast amount of experience in manufacturing, construction and mining industries. He has worked with various companies in many countries including South Africa, Botswana, Tanzania, and Namibia.

A total of 12 interviews were conducted, and all of them were conducted through zoom meetings platform because of restricted movement as a result of Covid-19. Before an interview was conducted, a research brief, interview questionnaire and a consent form were emailed to each participant. The research brief and interview questionnaire were aimed at giving an introduction to the study concepts and a guide in terms of what will be covered in the interview.

After familiarising themselves with the content of the research and the questionnaire, the participants were requested to sign the consent form and email it back to the researcher. The countries in which the participants have worked included South Africa, Lesotho, Botswana, Siri Leon, DRC, Mozambique, Switzerland, Indonesia, and Australia.

The participants were selected based on their experience in the mining industry, knowledge and understanding of the sustainable innovation either based on their exposure to and having worked with sustainable innovation projects. Apart from that, another basis for selecting the participants was their high level understanding of how mining companies are run, either on operational or strategic level.

Apart from that, the participants chosen had years of mining experience ranging from 9 years to 34 years. This wide age spectrum was selected in order to get a sense of whether there is consensus on the interpretation of dynamic capabilities and sustainable innovation amongst mining individuals from various age groups. This heterogeneity in sample selected for the study provided richness in the kind of data collected.

For the rest of the report, the participants will not be presented with their names. Instead, they will be referred to as participants 1 to participants 12, and the naming order has nothing to do with the order given in Table 2.

5.3. Results: Research Question 1

In this section, the results for research question 1 will be given, based on the responses obtained from question 1 and question 2 of the interview schedule.

Research question 1:

What are the key dynamic capabilities mining companies need to have in order to remain competitive?

5.3.1. How the concept of dynamic capabilities was defined

Most of respondents viewed dynamic capabilities as the ability to change and adapt to the changes taking place in the work environment. Even though definitions were made from different standpoints, the overall meaning assigned to the concept of dynamic capabilities was along the same lines. Some of the definitions of dynamic capabilities, given by participants, are highlighted below:

Participant 1: *“I see dynamic capabilities as all elements of your work systems that allow you to quickly adapt to a changing environment, if and when it is needed. All those elements that you need to change, or that can change. And obviously, you can change your resource, you can change how you treat your resource, how you mine your resource, sell it or market it. So it's, it's all those tangible factors.”*

Participant 8: *“I think it is the ability of an organisation to adapt or to have, you know, skills and resources and experience to address any changes that may affect the business.”*

Participant 4: *“So in broad terms, I would define dynamic capabilities as kind of the resources, the assets, the knowledge, and the other structures*

within an organisation that can be configured and reconfigured over time, dynamically, in order for the organisation to achieve its desired outcome.”

From all the definitions given, it was clear that the participants perceived dynamic capabilities as something to do with changes that an organisation undertakes in order to align itself to the conditions in the market. This involves changes in a whole lot of things including resources, systems, processes, skills, knowledge, assets, and many other elements in the organisation.

5.3.2. Key dynamic capabilities in the mining industry

There were various views from the participants on what are the key dynamic capabilities that mining companies need to have in order to remain competitive. The different views given were however grouped into five major categories, which are; financial liquidity, experienced and skilled management, flexible workforce, nature of the commodity mined, and stakeholders’ support, as shown in Figure 4.

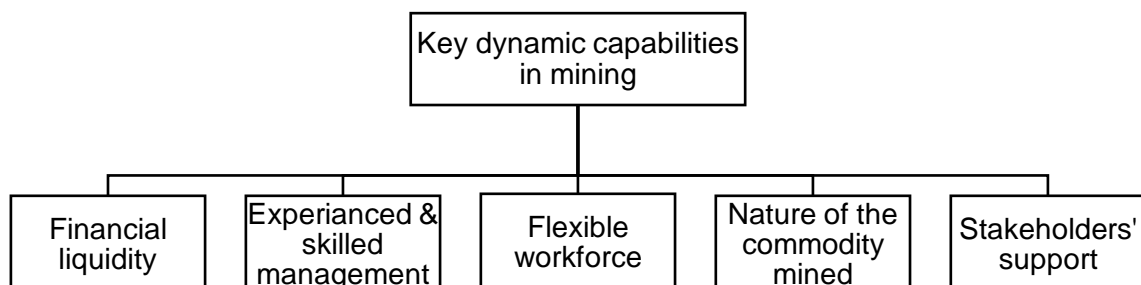


Figure 4: Key dynamic capabilities required by mining companies to remain competitive as highlighted by participants (Author’s creation)

5.3.2.1. Financial liquidity

The availability of funds to finance change that helps an organisation to remain competitive was highlighted by seven of the participants as one key dynamic capabilities. Their view was that the mining industry is very asset intensive by nature, and a lot of changes that are undertaken to accommodate the ever-changing market conditions require a substantive amount of money to implement.

Participant 7: *“I would say financial liquidity is one of the key dynamic capabilities. I say that in the light of, any change that is required in the mining environment is normally quite costly, and one needs to be able to fund the changes that are required for business transformation. You can have all the weird and wonderful ideas in this world and have plans and see what you have to do, but if you cannot pay for it, you cannot do it. So financial liquidity is a key factor for me.”*

Availability of enough funds to finance change initiatives was highlighted as being very crucial for a mining company to remain at the forefront of the latest developments and be competitive. One of the participants actually pointed out that in one of the organisations he worked, there was always a budget for funding all innovative ideas from the employees.

Participant 8: *“I ran a projects department for one of large companies in Botswana. If anyone came up with a bright idea, we immediately had funding to trial and test the idea. That is the advantage of having enough funds, you are always able to put them to good use in those projects that will have a positive outcome on the performance of the company.”*

This therefore shows that if the company has restricted funds, it is very much limited in terms of financing some of the required changes in the organisation. The general feeling has been that most mining companies usually do not readily have enough funds to finance some of the unexpected changes that need to happen as a result of shifts in the market. However not all changes require significant amount of money to be implemented, and companies need to take advantage of these low hanging fruits while still addressing the challenge of funding for other bigger changes.

5.3.2.2. Experienced and skilled management

The second dynamic capability that was highlighted by four of the participants is the experienced and skilled management that has the ability to lead change. This managers must be able to take each and every employee along with them throughout the change process, by ensuring that the objectives of the change are clearly explained and the required future state vividly painted out.

Participant 1: *“You need skilled and experienced management to lead the change. The employees are mostly comfortable with change if the leadership convinces them, engages them, consults them, and leads them into understanding why change it’s good for the business. So your management people need to be inspiring, credible individuals with people management skills to lead change to be effective.”*

Three of the participants had a view that if a mine has inexperienced management team in this usually very dynamic environment, such management will be slow to act and will mostly likely make wrong decisions. This then means that an organisation will not be able to do as well as it probably can. When an organisation has skilled, experienced, credible and strong management team in a dynamic environment, that can really play in its favour and things can very quickly work well.

The term management and leadership were used interchangeably in most of the times during the interviews, even though in theory the two are different. It was stressed in various occasions that having dynamic capabilities refers to having leadership skills that will enable good and quick decision-making.

Participant 6: *“I think you need leadership that is more agile in the sense that decisions cannot take long to be approved and you know, in this fast changing world that we live in, you need things to turn around quickly.”*

The importance of the management being able to make quick decisions was highlighted by most of the participants. The longer the decision takes to be made, the more chances that it will not be applicable when it is finally made, due to additional changes that took place already in the market.

5.3.2.3. Flexible workforce

Three participants argued that one aspect that builds on organisation's dynamic capabilities is the flexibility of the workforce. Since the employees are always at the forefront of any change and need to be able to see it through, it is important that they are flexible enough to abandon their comfort zones and status quo for the sake of bringing beneficial changes to the organisation.

Participant 9: *“Another capability that I see very crucial is, you need a flexible workforce that is accepting of necessary change. I've seen many times, especially in a unionised environment where the workforce can be very obstinate and be difficult. Even if the change is a good change. They push against change, just for the sake of wanting to go anti-management, not for any other good reason. So your workforce needs to be flexible, and open to accept.”*

One participant further argued that when it comes to unions, they are there to serve a good intention of making sure that employees are treated fairly and with due justice, but even though some employees tend to misuse their right as union members by trying to drive their personal motives under the umbrella of the unions.

Two participants had a view that employees need to be willing to embrace the latest technology in mining, which not only results in more efficiency and productivity, but also helps the job to be done more safely.

Participant 2: *“Technology is continuously improving big time in the mining industry. Across all the activities in the mining industry, there is*

some level of technology used. So your personnel must be open and exposed to new technology at all times, so that they can be able to use top of the line technology in the best way manner to get the results.”

5.3.2.4. Nature of the resource mined

The nature of the resource mined was also mentioned by two participants as a dynamic capability. This relates more especially to commodities like diamond, whereby within one mine, you can have a wide spectrum of diamonds with various qualities and sizes. In some other mines, the resources allow the mines to profitably mine both low and high grade sections when the market is booming, and only mine the high grade sections when markets are depressed. This flexibility to mine different grades under different market conditions was seen as a dynamic capability a mine might have.

Participant 3: *“Okay, like I said before, with mining it is not so easy to do changes because you are stuck with the resource that you have got, like in diamond mining, for instance, if you know customers want a certain type of diamond, it would make a business sense to focus to mine only that type. If your flexibility is limited in terms of what quality you can offer, because the resource is what it is, and you cannot change it, then your chances to adapt to the changing environment are limited.”*

Reference was made to some of the diamond mines that had to be closed down during Covid-19 lockdowns because of the market sector they serve was highly sensitive to the impact of the virus.

5.3.2.5. Stakeholders’ support

The last dynamic capability for mining companies that was mentioned by two of the participants is that mines need stakeholders support in order to achieve rapid decision making. Stakeholders support means the stakeholders across the spectrum, not just from the foreign direct investment. Mines need stakeholders

support from government side, the legislative environment, the social environment, unions, employees and then rest of the supply chain.

It was also highlighted that for some mines in certain areas, government is a shareholder, normally free carry, but they are also the regulators so there could be conflict. And that normally makes for very slow decision making. In this kind of a setting, it becomes very difficult to make some high level decisions quicker because the government is very slow in making decisions.

Participant 12: *“Companies that survive changing environment are the companies that can very swiftly make good decisions and implement them. And unfortunately, the shareholder models where the government is also involved have shown me over the 30 years that I've been working in diamond mines, that those processes are very slow when the government is involved.”*

It is the responsibility of the mines therefore to ensure that engagements are made with all these stakeholders in order nurture good relationships.

5.3.3. Summary for Research Question 1

In general, the definition of dynamic capabilities given by participants showed that there was a clear understanding of the concept. Dynamic capabilities were defined as any form of change either on resources, processes, systems, skills, or knowledge that a company need in order to overcome changes in the market. From the interviews, the participants mentioned some of the main dynamic capabilities that mining companies need to have in order to remain competitive. These dynamic capabilities are; financial liquidity, experienced and skilled management, flexible workforce, nature of the commodity mine, and stakeholders' support. These were seen as the key elements that mining companies can leverage in order to be able to survive the changing business

environment. In absence of any of these elements, it was indicated that it would become almost impossible for such a company to remain competitive.

5.4. Results: Research Question 2

In this section, the results for research question 2 will be given, based on the responses obtained from question 1 and question 2 of the interview schedule.

Research question 2:

What processes or routines must be undertaken by mining companies to enhance the development of these key dynamic capabilities within their

5.4.1. Routines towards developing dynamic capabilities in mining

This section highlights some of the main routines that need to be undertaken by mining companies in order to strengthen their dynamic capabilities. These can be referred to as all those activities that must form part of day to day assignments both managers and employees need to undertake to achieve best results. The five routines, as derived from the interviews are; research and development, foresight, scenario planning, continuous improvement and embracing technology. These routines are shown in Figure 5.

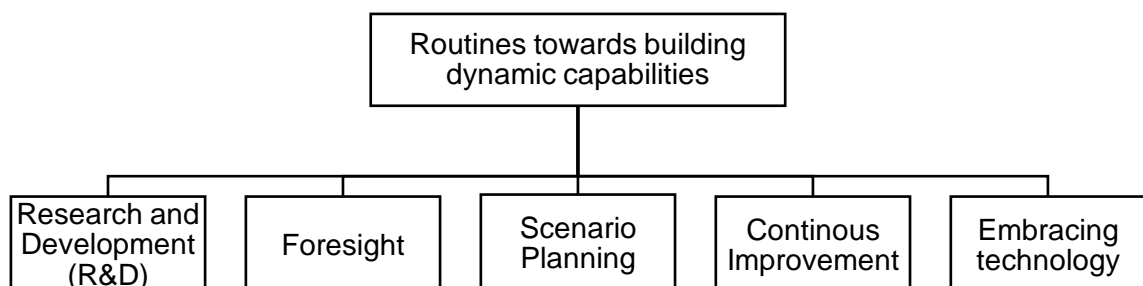


Figure 5: Key routines that mining companies need to undertake to boost their dynamic capabilities (Author's creation)

5.4.1.1. Research and Development (R&D)

Research and development was highlighted by five of the participants as one important aspect related to building dynamic capabilities for mining companies. The participants however argued that research and development component was still missing in most mining organisation, especially because of lack of funding. The challenge has been identified mostly among the smaller players. Bigger mines usually do not have this as a challenge, because they have enough funds to finance R&D so that they can become leaders in terms the latest developments and technology.

Participant 10: *“Doing R&D in most companies is dependent on availability of funding, right. Many of the big corporates with lots of money have dedicated R&D sections, where they drive technology. They are very innovative in terms of trying to improve the efficiency.”*

5.4.1.2. Foresight

One participant alluded to the fact that the ability to foresee the need to change, in other words, to be receptive to trends and related work and market factors, and to anticipate what to do to survive and thrive, are key ingredients to successful management, over dynamic market environment. He pointed out that mines need to have the ability to foresee the need to change. If they do not see the need to change, then they have lost even before they have started.

Participant 11: *“If leaders lack the foresight, to be able to, you know, implement the right strategies that enable businesses to respond to future challenges, you know, challenges, you will find that most businesses in mining would actually die. So, to answer your question, I think yes definitely, foresight is one very important aspect.”*

5.4.1.3. Scenario planning

Two of the participants mentioned that the key ingredient for mines to be dynamic is to have a baseline scenario that is realistic. What is often done by some other mines is that they define scenarios as baselines which are not entirely realistic. They take top end optimism on all factors into account. So if the plan works in the end, that works well and it's great. But it is all know that the stars almost never all line up, there's always one or two issues that catch you.

Participant 5: *“You do not throw up a baseline scenario based on optimism. Your baseline must be realistic. But what we often do is we have these optimistic plans that are geared to impress shareholders and to secure funding, and then we often do not deliver on those plans.”*

So mines needs to draw up very solid and realistic baseline scenario plans whereby if things go well then they do well, and when things go sour, they always have a some mitigation plan in place.

5.4.1.4. Continuous improvement

Two participants mentioned that engaging in continuous improvement is one key routine required by mining companies in order to remain competitive.

Participant 8: *“Different mines are now engaging in what we call continuous improvement, and that's the approach whereby the mind-set of the people that you are working with is now becoming important.”*

Participant 7: *“To be more specific mining companies on a daily basis need to look at their processes and implement things such as business transformation and continuous improvement.”*

Once the continuous improvement process has advanced people's performance to the certain level, the changes made must be locked at that level while looking for other new ways to achieve an even higher level of performance.

One participant mentioned that if there are changes to be done, there are lot of things to look at like value easy metrics to see what value the mines can get out implementing those changes. The amount of effort to bring those changes must be considered, and once the company has made a decision implement changes, milestones must be set, and progress must be monitored and measured on an ongoing basis.

5.4.1.5. Embracing technology

Ten participants made reference to technology as one of the levers that mining companies need to utilise as a means to build their dynamic capabilities. Mining companies are exposed to a whole range programs and systems used in different departments like human resource, operations, security, finance, and many more. It therefore best for mining companies to decide which technologies are best suited for them and then start using them.

Participant 10: *“In one of the overseas countries that I worked at, we had autonomous trucks that drove from loading area to tipping area all by themselves, operated through a control centre that is located two provinces away.”*

This is one instance where technology is opening opportunities that never existed before, whereby people are removed from the source of danger and efficiencies are improved significantly in mines where the level of safety risk involved deemed the mines impossible to be run.

5.4.2. Summary for Research Question 2

In this section, the key routines related to building dynamic capabilities by mining companies were discussed. According to the responses from the interview, the five key routines mentioned were; research and development, foresight, scenario planning, continuous improvement and embracing technology. A clear focus by management on these routines will ensure a good balance on which the dynamic capabilities can be based. The difference between the dynamic capabilities and the routines is that dynamic capabilities represents the capabilities that companies need to build into their business model to enable them to respond to the changes in the market, while the routines are all those activities that need to continuously be undertaken in order to enhance the dynamic capabilities.

5.5. Results: Research Question 3

In this section, the results for research question 3 will be given, based on the responses obtained from questions 6, 7, 8 and 9 of the interview schedule.

Research question 3:

What is the level of sustainable innovation taking place in the mining industry in comparison to other industries?

5.5.1. How the concept of sustainable innovation was defined

The concept of sustainable innovation was defined in various ways by different participants. Some participants referred to sustainable innovation in terms of all those type of innovations aimed at sustaining the company's competitive edge in the market.

Participant 6: *"I would say, it is innovation that allows a business to fully exploit opportunities of now, and also of the future without compromising the competitiveness of the business."*

Other participants defined sustainable innovation in term of any change which has a direct impact on the triple bottom line, consisting of three parts which are; social, environmental and financial.

Participant 4: *“Ok, I see any change that adds value to the three pillars of economics, the social impact, and the environmental impact of the business as sustainable. If any of those three pillars suffer with any change you make, that change will not be sustainable.”*

One participant mentioned that he has never heard of the term sustainable innovation in the mining industry. Instead, he is familiar with Environmental, Social and Governance (ESG) which happen to be used quite often especially by investors in trying to undertake responsible investment approaches.

Participant 12: *“Yeah, I’ll be honest, I’ve never heard of sustainable innovation within the mining industry. So that’s a foreign term to me. The latest focus over the last couple of years has been on ESG for mining companies, environmental, social and governance. So shareholders and consumers of the products, measure companies in terms of the ESG rating and ESG impact.”*

One participant took a view that the mining process, which involves extraction of non-renewable resources from the ground, is not a sustainable process at all. As far as he was concerned, it does not matter how much innovation there is in mining, as long as it is aimed at an unsustainable activity, then such innovation cannot be regarded as sustainable.

Participant 3: *“By its very nature, mining is not a sustainable action. You’re mining a non-renewable resource, and you have an impact and as much as you try to reduce the impact, that does not make it a sustainable operation.”*

5.5.2. The level of sustainable innovation in mining

Most participants' view was that mining companies in the African context are not really innovative, but have a potential to be innovative. One participant argued that the history and the context does not support innovation. Because of bad safety records mines have previously been known for whereby many people were killed, the industry has now become very conservative. This then means that quite a lot of innovation takes place in improving the safety, but innovations that improve other aspects seem to take quite long to be adopted. A point was made that almost all the innovations used in the mining industry in Africa come from overseas countries like USA, Canada and Australia.

Participant 4: *“I think mining companies are innovative. But in the African context, I would say we are a bit more cautious and maybe less innovative and willing to open up new opportunities in terms of how we do things.”*

One participant had a view that there has been many innovations in mining over the last 30 years. These innovations happened across multiple elements of the industry, and they had direct positive impact on the industry.

Participant 7: *“Yes I can think of many technological social environmental diamond selling changes that impacted the diamond industry positively and sustainably over the past 30 years. XRT, HPRC, small medium enterprises, open tendering. Those are all examples of things I can immediately think of.”*

One participant pointed out that the latest industrial revolution is a driver for innovation in the mining industry.

Participant 11: *“I think in the last five to 10 years, there's certainly been a change in the mind-set towards innovation, because, and I suppose it's being fuelled as well by the fourth industrial revolution and technology.”*

5.5.3. Summary for Research Question 3

From the responses obtained from the interview, it was clear that different participants had different ways of defining sustainable innovation. Some participants looked at it from the internal process point of view whereby it looks at all the changes that enable a business to exploit the current and future market, while some of them looked at it from the triple bottom line point of view. When it comes to whether they think mining companies are innovative enough, the general view was that mining in the African context is trailing behind and needs to catch up as far as innovation is concerned, compared to other continents.

5.6. Results: Research Question 4

In this section, the results for research question 4 will be given, based on the responses obtained from questions 10 and 11 of the interview schedule.

Research question 4:

What are the key barriers and enablers of sustainable innovation in the mining industry?

5.6.1. Barriers to sustainable innovation in mining industry

The general perception from research question 3 responses was that mining companies are not innovative enough. The participants were therefore asked in question 4 to comment on what they see as major barriers to sustainable innovation. Seven main barriers derived from the interviews were; literacy level, employers-unions relationships, mining legislation, culture, and asset intensiveness, as shown in Figure 6.

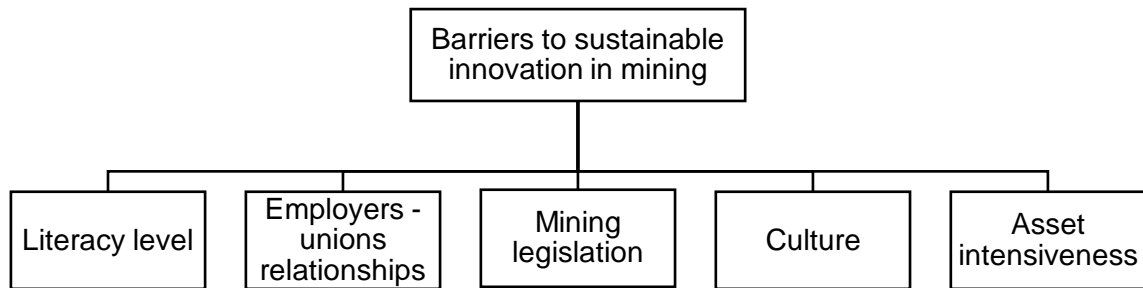


Figure 6: Main barriers to sustainable innovation in mining (Author's creation)

5.6.1.1. Literacy level

Three participants mentioned the literacy level, especially computer illiteracy as one of the barriers to innovation in mining. Most of the low band employees in the mining industry barely have Grade 12 as their highest qualification. When new technologies are introduced, these employees are the ones at the risk of being taken out of the job market and being replaced by new technology, especially if they cannot be retrained for other emerging duties.

Participant 9: *“Our people are not skilled to that level whereby they can operate certain things. for instance, if I want to introduce certain technologies, like operating machines remotely, it becomes a challenge to use an operator who has never used a touch screen before, you know, and that would mean I need to hire someone who more literate and can navigate the applications easily.”*

This situation often results in resistance to change, since the employees who are affected by these latest technologies feel that they are at a risk of losing their jobs.

5.6.1.2. Employers - unions relationships

It was found through the responses given by the participants that part of the reason why there is adoption of some of the latest technologies and innovation is because the relationship between employers and employees is not good.

Participant 12: *“The mining environment we operate in is highly unionised, which is not a bad thing. And you need unions to keep the system fair. However, the relationship between employers and the labour unions is usually not a healthy one.”*

This poor relationship sometimes is due to external factors like the failure of government to enforce better working conditions for mine employees. Because of this uncondusive working conditions, there is always mistrust between unions and employers, often resulting in rejection of some technologies which are perceived as threatening employees’ jobs.

5.6.1.3. Mining legislation

One of the participants highlighted that it takes quite some time for regulations to be amended in order to align to the latest technologies. An example cited was that of the introduction of drones for taking measurements in the mining industry. The adoption of this technology became a challenge, flying a drone in mining contravened many of the regulations related to aviation.

5.6.1.4. Culture

Two of the participants mentioned culture as one of the barriers to innovation. The area in which one was born and grew up moulds their behaviour and perceptions of certain things, and from innovation point of view some countries are by nature more innovative than others.

Participant 11: *“I think then maybe the one barrier, which I’m very cautious about, is cultures of the different companies and perhaps different countries. The mining industry in South Africa does not create an environment that is conducive for innovation. We are so used to taking innovations from other countries and not develop our own.”*

5.6.1.5. Asset intensiveness

Three of the participants highlighted the fact that mining is an asset intensive business, whereby a lot of money is held up in tangible assets and infrastructures like plant and big machinery. These assets are normally financed on loans, and the expectation is that they must give positive return on investment. It often becomes a challenge if a section of the plant or some of the big machinery needs to be replaced or modified by the latest upgraded units, which normally also comes at an additional cost. Assets are normally very specialised as well and cannot be bought “off the shelf”.

Participant 2: *“When we first constructed our plant, we did not incorporate one of the latest mineral extraction technology because it was still on its trial stage. Now the technology is in the market, and a lot of redesign is required on our plant infrastructure if we want to introduce that technology now.”*

One of the participant mentioned that innovation is great, innovation is often costly, and they cannot afford those costs to bring sustainable change, as the mines are so marginal and they are straggled by affordability.

5.6.2. Dynamic capabilities as enablers of sustainable innovation

Participants were asked whether they think there is a relationship between the dynamic capabilities that mining companies build and the resulting sustainable innovation that is observed in their operations. All the participants agreed that the relationship exists between these two concepts, and more often than not, having

dynamic capabilities leads into building a sustainably innovative work environment. Companies with more dynamic capabilities were said to be more innovative than those with less dynamic capabilities.

Participant 5: *“I definitely think there is a link. And I think if you have the dynamic capabilities, you are honestly inherently innovative. But I think you are more likely to then say, okay, fine, then what do I do about what I'm sensing, and then that pushes you to start thinking of different ways. And that's where innovation comes from. So I do think that definitely they talk to each other.”*

5.6.3. Summary for Research Question 4

The purpose of research question 4 was to find what the barriers and enablers of sustainable innovation are in mining. The five key barriers that have been identified are; literacy level, employers – unions' relationships, mining legislation, culture and asset intensiveness. These barriers were relevant especially to the majority of mines operating in Africa, especially South Africa. This follows from the statements that were made in the previous question saying that mining companies in Africa are less innovative compared to other continents. The barriers as highlighted are both internal and external to the mining companies, which means that to address them would mean involving the bigger ecosystem and several stakeholders.

5.7. Conclusion

In this chapter, the results from the interviews have been presented, based on the research questions outlined in chapter 3. To answer research question 1, which asked about the dynamic capabilities required by mining companies to remain competitive, the participants highlighted five key dynamic capabilities, which are; financial liquidity, experienced and skilled management, flexible workforce, nature of the resource mined, and stakeholders' support.

Research question 2 asked about the processes or routines that mining companies need to undertake in order to improve their dynamic capabilities. Five routines were identified by the participants, which are; R&D, foresight, scenario planning, continuous improvement, and embracing technology. From the interviews, it was mentioned that small companies are the ones that normally do not undertake all these routines, especially R&D and embracing technology. This is mainly due to insufficient funds to finance these routines. It is the responsibility of the management to ensure that all these routines are in place in the mining companies regardless of the size of the company, to help them to remain competitive.

Research question 3 asked the participants whether they would regard the mining industry as innovative. The majority of participants mentioned that African countries are still lagging behind compared to other continents when it comes to innovation in mining. Although there have been some significant innovations that revolutionised how most of the tasks and processes are undertaken in mining, the rate of change is very slow compared to the rest of other industries.

Research question 4 asked about the key barriers and enablers of sustainable innovation in the mining industries. There were five major barriers identified, and these were; literacy level, employers – unions relationships, mining legislation, culture, and asset intensiveness. According to the participants, the dynamic capabilities mentioned in research question 1 have a direct link to a company's sustainable innovation, and most importantly they are enablers of sustainable innovation.

In the next chapter which is chapter 6, the discussion of the results from chapter 5 will be presented.

6. DISCUSSION OF RESULTS

6.1. Introduction

In this chapter, the discussion of the results presented in chapter 5 will be given. The discussion will be based on and try to answer the research questions presented in chapter 3. As part of discussion, the results obtained from the interviews will be compared the what is in the literature, and where no literature exists to support the results, the discussion will then build on the body of knowledge related to dynamic capabilities for sustainable innovation.

6.2. Discussion: Research Question 1

Research question 1:

What are the key dynamic capabilities mining companies need to have in order to remain competitive?

Research question 1 sought to find out what the participants regarded as the key dynamic capabilities that mining companies need to have for them to be competitive. In this fast paced business environment, some of the capabilities that businesses build get washed away or become obsolete very quickly. This means that businesses need to continuously try to renew or build new capabilities so that they can get ahead of their competitors.

6.2.1. How the concept of dynamic capabilities was defined

When asked to define dynamic capabilities, participants generally defined it as the ability of an organisation to change either its resources, systems, skills, knowledge, or many other elements in order to adapt to the changes taking place in the work environment.

6.2.2. Key dynamic capabilities in the mining industry

Based on the responses given by the participants, there are five key dynamic capabilities that mining companies need to have in order to be competitive. A discussion of each of these dynamic capabilities, based on research question 1, will be given below.

6.2.2.1. Financial liquidity

According to the literature, organisations must aim to maintain financial liquidity so that they can be able to respond to the changing business environment, as this changing business environment makes it difficult for them to improve their value proposition while making use of the current assets configurations (Jiangnan, 2020). Seven of the participants mentioned that the availability of cash to finance change initiatives in dynamic business environment is very crucial in ensuring that a business stays afloat.

The idea of financial liquidity was supported by literature, whereby Zollo & Winter (2002) argued that building dynamic capabilities involves costs related to configuring and assigning resources to the change initiatives. According to Teece D. J. (2012), these increased costs resulting from continuously building dynamic capabilities will likely affect the financial performance of an organisation in a negative manner. It is important therefore, especially in highly dynamic business environment, that companies maintain a good balance of financial liquidity in order to be able to cover these additional transaction costs which result in reduced profits.

6.2.2.2. Experienced and skilled management

It was participants' view that mines need to have skilled and experienced management to lead the change. High uncertainty in the market makes it unlikely that whatever business strategies organisations are using now will continue to be relevant in future. Managing organisations in a VUCA world requires a manager

who has an open mind-set and a 360 degree view of what trends the market is following. According to Schoemaker, Heaton, & Teece (2018), organisations need to have leaders who are like classical musicians who are able to closely follow the scripted business strategy when it is working well, and also be like jazz musicians with the ability to improvise within the boundaries of possible themes that are likely to emerge as a result of unanticipated change.

One participant mentioned that if a mine has inexperienced management team in this very dynamic environment, such management will be slow to act and will mostly likely make wrong decisions. From the literature, it was shown that the management with poor leadership skills is always unable to sense, interpret and respond to unclear potential opportunities or threats in the market (Krupp & Schoemaker, 2014). A good management team is able to monitor not only the internal business operations, but also the outside market, other industries, direction the new research is taking, new business models developed, as well as other nitty-gritties of the business ecosystem.

6.2.2.3. Flexible workforce

Flexible workforce was highlighted by three participants as one of the key dynamic capabilities mining organisation need to have. It was mentioned that when employees are flexible, they are more likely to be willing to engage in change. According to Bode & Signh (2018), when employees get engaged in change efforts, they gain knowledge and skills that enable them to have positive contributions towards business strategic decisions and effective implementation of those decisions.

When employees engage in full participation towards organisation's change initiatives, they enhance the key dynamic capabilities. These dynamic capabilities were defined as the ability to *sense* the environment in terms of what opportunities and threats are there, to *seize* the opportunities after they have been identified, and lastly to easily *transform* their tangible as well as intangible resources in response to the market conditions (Teece D. J., 2014).

6.2.2.4. Nature of the resource mined

It was mentioned by one participant that mining companies only mine what is on the ground, and once the mining operation has started the mines are forced to stick with what the resource offers. Some mines are able to produce more than one product, like copper ore produced together with lead and zinc. This ability to mine different ore types then becomes a dynamic capability because if there is a drop in prices of one metal, the operation can still be able to survive on the profits from other metals. Mines that have only one commodity might not see the nature of the resource mined as a dynamic capability, because there is nothing they can do about it.

6.2.2.5. Stakeholders' support

Two of the participants highlighted the importance of stakeholders' support in enabling quick decision making in the mines. It is important to establish strong relationship which is grounded in trust and inclusion with the stakeholders, as this will make it easier for them to communicate their demands and share any other relevant information like technology advancements and global market conditions (Harrison, Bosse, & Phillips, 2010). When a company has a clear understanding of its stakeholders and open communication channels, it is well positioned to communicate the need for change in a manner that will be accepted and supported by the stakeholders.

One of the latest trends in the mining industry has been a strengthening bargaining power amongst the communities within which the mines operate. This shift is being fuelled by the need for mining to show support for social and environmental elements and to mine the resources in a sustainable manner. For any mining company to start the mining activities or even upgrade the existing mine operations through either technology advancement or increasing capacity, it needs to be approved by the local communities and be given what is termed a 'social license' by those host communities. This therefore highlights the

importance of stakeholders in ensuring that an organisation has the relevant dynamic capabilities for a sustained growth in changing business environment.

6.2.3. Conclusion from Research Question 1 discussion

From the discussion given above, it is clear that there is literature which supports each of the five mentioned dynamic capabilities as being really necessary for survival of mining companies. Even though literature does not describe these five elements as dynamic capabilities, it highlights an important aspect that they are crucial in enabling an organisation to respond to the market changes. Different participants pointed to different dynamic capabilities as being priorities to them. This shows that various mines need to decide which dynamic capabilities to prioritise based on various factors like the location of the mine, type of commodity, mine size, the mining method used, and many other factors either economic, environmental or social.

6.3. Discussion: Research Question 2

Research question 2:

What processes or routines must be undertaken by mining companies to enhance the development of these key dynamic capabilities within their

Research question 2 was aimed at identifying those underlying routines mining companies need to do for them to maintain strong dynamic capabilities. These refer to tasks or assignments that must be fulfilled either daily, quarterly semi-annually or even annually to ensure that the organisation is capacitated to navigate the turbulent business environment.

6.3.1. Routines towards developing dynamic capabilities in mining

Five key routines that mining companies need to undertake in order to be build their dynamic capabilities were mentioned by participants, in response to the research question 2. A discussion of each of these will be given below.

6.3.1.1. Research and Development (R&D)

Research and development was mentioned by some of the participants as one of the key routines required to enhance dynamic capabilities in mining. Companies need to form R&D teams in order to improve organisational learning. Giniuniene & Jurksiene (2015) defined organisational learning as the operational process whereby information is acquired and converted into knowledge, and errors resulting into variances between the plan and the actual performance are rectified. Mining companies need to view organisational learning as a routine through which their dynamic capabilities can be integrated into their internal business processes.

6.3.1.2. Foresight

Participants mentioned that mining companies must have a foresight. Foresight, which is sometimes also referred to as strategic foresight, is defined by Dominiece-Diasa, Portnova, & Volkova (2018) as an act of developing a forward view aimed at sensing opportunities and helping in decision-making that positions the company well for the future. It involves the scanning of the business environment to observe and make analysis the factors that trigger change and the emerging trends that will shape the company's survival in future.

Companies should not only scan and analyse the changes and trends, but must also make an evaluation of how these changes and trends are going to affect them. The finding from the interviews therefore confirm the literature by Semke & Tiberious (2020) which stated that strategic foresight is a set of practices and

routines undertaken by companies to enhance their dynamic capabilities so that they can remain competitive in volatile business environments.

6.3.1.3. Scenario planning

Scenario planning was mentioned by two participants as one process that mining companies need to do to build strong dynamic capabilities in their organisations. Suddaby, Coraiola, Harvey, & Foster (2020) defined scenario planning as a form of strategic planning that is associated with tools and techniques that organisations need to manage future uncertainties. The one premise on which scenario planning is based is that even though it is impossible to predict the future, there are other events that can be predetermined (Varum & Melo, 2010).

Companies can use scenario planning for different reasons, but this tool's main application is in identifying opportunities and threats related to the strategy, testing of the strategy to determine how robust it is in withstanding unanticipated events, and shaping of the strategy to align with the market developments (Haarhaus & Liening, 2020). This therefore shows that scenario planning builds on the first pillar of dynamic capabilities, which is the ability to sense the environment.

6.3.1.4. Continuous improvement

In answering the questions related to routines for improving dynamic capabilities, two participants mentioned continuous improvement as one key routines. As Teece D. J. (2018) argued, the competitive advantage for companies no more comes from the processes they use, rather from how good such companies are in improving those processes continuously. The three complementary continuous improvement methodologies that companies can use are Lean, Six Sigma, and Theory of Constraints.

Literature further showed that through continuous improvement, a company can be able to make rapid and interconnected changes to their processes so that the

performance of the organisation can be improved (Kohlbacher, 2013). It can therefore be confirmed that then findings from the interview are in line with the literature with regards to continuous improvement being on process required for organisations to build their dynamic capabilities.

6.3.1.5. Embracing technology

Out of the 12 participants interviewed, 10 actually mentioned that technology is one of the levers that mining companies need to utilise as a means to build their dynamic capabilities. Rezazadeh, Karami, & Karami (2016) argued that companies that are technology-driven companies are able to perform well in their technical ability and flexible to adapt in an environment that is technologically competitive.

There has been a tremendous uptake of technology in mining in the last couple of years. Even though it was mentioned by some participants in the interview that the latest technology is normally expensive, it has been seen in most areas that the benefits obtained from use of technology far outweigh the cost. Aragon-Sanchez & Sanchez-Marlin (2005) argued that technology-driven companies are usually innovative and able to create some of the basic elements that enable them to gain competitive advantage.

6.3.2. Conclusion from Research Question 2 discussion

The five routines mentioned in this section are crucial in ensuring that an organisation's dynamic capabilities are kept in good shape. As can be seen these five routines have two major focus areas, which is what needs to be done now (embrace technology, continuous improvement) as well as what to expect in future (R&D, foresight, scenario planning). This highlights an important point that for organisations to make better decisions today, they need to have an idea of what is likely to happen in future.

6.4. Discussion: Research Question 3

Research question 3:

What is the level of sustainable innovation taking place in the mining industry in comparison to other industries?

In Research Question 3, the research wanted to understand the opinions of participants regarding the level of sustainable innovation in the mining industry. The researcher first wanted to test and understand how the participants defined sustainable innovation so as to ensure that the subsequent discussion can be easily aligned to their definition.

6.4.1. How the concept of sustainable innovation was defined

There were different views expressed by participants regarding the definition of sustainable innovation in as far as the mining industry is concerned. Even though the majority of participants associated sustainable innovation with any change that enables the company to exploit current and future opportunities with the aim of improving the bottom line, one participant mentioned that he has never heard of the term sustainable innovation, he knows of ESG instead. Both views however, even though expressed in different ways, still point to the same direction, meaning that there is no significant difference between sustainable innovation and ESG.

Cillo, Petruzzelli, Ardito, & Giudice (2019) defined sustainable innovation as “innovations in which the renewal or improvement of products, services, technological or organizational processes not only delivers an improved economic performance, but also an enhanced environmental and social performance, both in the short and long term have the capacity to generate positive social and environmental impacts.”

A company's sustainable innovation is not a straight forward mechanical process; it is also influenced by the ecosystem within which the company operates, and requires an ongoing consideration of the economical societal as well as environmental aspects (Hseih, Lin, Lu, & Rong, 2017). This explanation therefore ties back to the ESG, which also highlights the three key elements that contribute to companies' sustainability.

6.4.2. The level of sustainable innovation in mining

Most of the participants were of the opinion that mining companies are not innovative enough, especially in the African context, compared to other continents like Australia and America. This lack of innovation was a result of multiple factors like the mining history, inequality, lack of skills, illiteracy, and lack of enough resources to support innovation. There was however a consensus that over the last couple of year, there has been an improvement in innovation in the mining industry, which is mostly fuelled by Industry 4.0.

Other participants' view was that mines cannot have a sustainable innovation because mining itself is unsustainable operation, due to the factor that non-renewable resources are being extracted from the ground with adverse environmental impacts in most cases. This point was reiterated by Lokuwaduge & Heenetigala (2017) by saying that although mining has positive economic impact on community through job creation, it also has negative impacts on the environment like depleting non-renewable resources, transforming natural landform, and other impacts on the health and safety of the workers as well as the host communities.

Considering the fact that mining has negative environmental and social impacts, it always becomes a problem for most mines to continue holding the 'social license' because their operations affect agriculture, health and environmental issues, and usually there is poor engagement with the locals which then results in disapproval of the mining operations by such local communities. Literature

around sustainability in mining however pointed out that a mining operation can only be regarded as sustainable if it meets the demands of various stakeholders including the local communities, suppliers, trade unions, government, customers, and also prevent environmental impacts while at the same time creating a positive return on shareholders' investments.

6.4.3. Conclusion from Research Question 3 discussion

Mines today are expected to target not only the economic gains in their operations, but also to have a contribution and responsibility towards environmental as well as social issues. This is the true essence of sustainable innovation. There are rules and regulations relating to the conservation of environment and the required level of engagement with the local communities and other stakeholders. Failure to observe these rules results in a mine being denied its right to operate.

There is still a lot to be done on sustainable innovation in mines in Africa, compared to other continents. Government also need to play their part in creating work environment that will enhance sustainable innovation. Since employees play a significant role in bringing innovation in a sustainable manner, they need to be subjected to the work environment conducive for innovation and be empowered.

6.5. Discussion: Research Question 4

Research question 4:

What are the key barriers and enablers of sustainable innovation in the mining industry?

The purpose of research question 4 was to gain an understanding of the barriers and enablers of sustainable innovation in the mining industry. The responses

given by the participants were based on interview question 10 in the interview schedule.

6.5.1. Barriers to sustainable innovation in mining industry

Five key barriers that hindered mining companies to achieve high levels of sustainable innovation were mentioned by participants, in response to the research question 4. A discussion of each of these barriers will follow.

6.5.1.1. Literacy level

It was mentioned by one participant that the majority of workforce in the mining industry, especially in the African context, do not have college qualifications. This presents two challenges when it comes to sustainable innovation in a company. Firstly, because of their low level of education, these employees are said to be more likely to resist some of the innovations introduced in the industry due to the fear that such innovations will jeopardise their jobs. Secondly, employees without college qualification will generally be less innovative than those with college degree, as education enhances innovation.

Because of the 'social license', mining companies are forced to look no further than the local communities for the majority of their workforce. This therefore means that they are responsible for the learning and skills development of the community, which can either be done in a form of in-house learning or through other external skills development companies or institutions of higher learning. This comes at a cost to the companies and calls for significant amount of money.

6.5.1.2. Employers - unions relationships

It was highlighted in the interviews by one of the participants that the relationship between mining companies and unions is usually not a healthy one. There might be several reasons for these poor relationships in different mines, ranging from minimum pay issues, working conditions, poor engagements and communication,

and many more. These poor relationships then become a barrier to innovation, in a sense that it discourages employees' full engagement and participation towards sustainable innovation practices.

The literature on the impact of trade unions on innovation in South Africa is not fully developed. Studies conducted in USA (Bradley, Kim, & Tian, 2017) have shown that most firms prefer to take their investments to the areas which are less unionized or not unionised at all, because they perceive trade unions as barriers to innovation. Studies conducted in Chile (Cabaleiro & Gutierrez, 2019) on the other hand were inconclusive in regard to whether trade unions have any impact on company's innovation, pointing out that it all depends on the various factors like type of innovation and the level of unionisation. Mining companies therefore need to have a full understanding of the impact of trade unions on their operations and see how they can improve the relationship in order to benefit from it.

6.5.1.3. Mining legislation

Mining legislation was seen by one of the participants as a barrier to sustainable innovation. This view was specifically related to the fact that technology advances very fast, and for some of the latest technology to be approved, they need to be regulated first. Quick adoption of these kinds of technology is therefore affected by the fact that it usually takes a long for regulations to be amended due to the traditional processes of rulemaking followed in most countries. .

This problem was also highlighted in literature by (Barefoot, 2015), who argued that legal institutions are experiencing a pacing problem, which is defined as an instance whereby innovation and technology are advancing quicker than the relevant regulation, thereby causing a mismatch. This therefore means that governments must improve times taken to adjust the regulations in order to address this disconnect and ensure that regulations related to innovation do not become obsolete before being signed off.

6.5.1.4. Culture

One participant mentioned culture as one of the barriers to sustainable innovation in the mining industry. The claim made was that the mining environment in Africa does not nurture an innovative compared to the Western cultures. It was mentioned that in Africa, people are more comfortable using other people innovations than developing their own. It was unclear however as to whether this mining culture with low level of innovation was associated with low education level highlighted in section 6.5.1.1.

According to Tian, Deng, Zhang, & Salmador (2018), organisational culture is a key element towards company success in organisational innovation. Companies need to enhance organisational innovation by building both an innovation-oriented culture and learning culture. Stock, Six, & Zacharias (2013) defined innovation-oriented culture as a series of cultural values, norms and artifacts that improve an organisation's innovation, while learning culture is comprised of the ability to acquire information, to interpret such information and then engage in rational behavioural changes. Mining companies therefore need to follow these steps in order to facilitate their innovation processes.

6.5.1.5. Asset intensiveness

It was mentioned by three participants that the mining industry is very asset intensive by nature. This is seen as a barrier to sustainable innovation, because to introduce some of the latest technology and innovation requires that sections of the fixed infrastructure or machinery be modified, if not replaced altogether which then results in massive capital outlay. This therefore means that it becomes very difficult for those mines with lack of sufficient funding to implement these changes, which then keeps them out of competition.

When mining companies want to introduce new innovations, some of their assets get in clash with these new innovations and the required business models. The literature is in support of this idea. Wadin, Ahlgren, & Bengtsson (2017) argued

that ownership of these assets which are usually known as conflicting assets, reduces a company's desire to innovate because of large investments required and the need to realign the rest of resources and capabilities with the new business model. This therefore presents a barrier to innovation, which managers need to bear in mind with every change needed by the company.

6.5.2. Dynamic capabilities as enablers of sustainable innovation

Participants were asked whether there is a relationship between dynamic capabilities that an organisation has and the sustainable innovation taking place in that organisation. All the participants mentioned that there is a relationship between these two constructs, with 10 of them saying that dynamic capabilities lead to sustainable innovation, while two of them said that it can go both ways. This would then imply that without the necessary dynamic capabilities, a company will not be able to achieve the expected level of sustainable innovation. This relationship exists irrespective of the company size or type of commodity mine.

6.5.3. Conclusion from Research Question 4 discussion

For organisations to maintain high levels of sustainable innovation, they need to be aware of some of the major barriers hindering them to achieve their success. These barriers, as identified by the participants, are; literacy level, employers – unions relationship, mining legislation, culture, and asset intensiveness. Organisations need to address each barrier in a manner that not only stops it from being a barrier no more, but also turns it into an enabler of sustainable innovation. For instance, if it is known that in most cases culture (either national or organisational) is a barrier to sustainable innovation, an organisation must place more focus on building organisational culture which will be supportive of its innovation initiatives.

There is not much literature done to test how dynamic capabilities relate to sustainable innovation especially looking at the mining industry. From literature

research, it was found that both dynamic capabilities and sustainable innovation are two crucial elements required for an organisation to be successful. The findings from this study showed that having necessary dynamic capabilities enables an organisation to be innovative in a sustainable manner.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Introduction

The purpose of this study was to explore the role of dynamic capabilities as a core competency on sustainable innovation in the mining industry. From the results obtained in this study, it was found that dynamic capabilities play a very crucial role in enabling mining companies to thrive in a volatile environment. Dynamic capabilities were defined by Teece D. J. (2014) as the ability to *sense* the environment in terms of what opportunities and threats are there, to *seize* the opportunities after they have been identified, and lastly to *transform* tangible as well as intangible resources in response to the market conditions.

7.2. Research findings

The results from this study showed that there are five key dynamic capabilities that mining companies need to have, which are; financial liquidity, experienced and skilled management, flexible workforce, nature of the resources mined, and the stakeholders' support. These five dynamic capabilities are linked to the key dynamic capabilities of sensing, seizing, and transforming, and this link was supported by various studies related to dynamic capabilities, as shown in chapter 6. To illustrate this relationship, the Dynamic Capabilities for Sustainable Innovation framework will be presented, based on the literature study and the results from chapter 5.

7.3. Proposed framework

Based on literature search and the results from the interviews, the dynamic capabilities for sustainable innovation framework shown in Figure 7 was proposed.

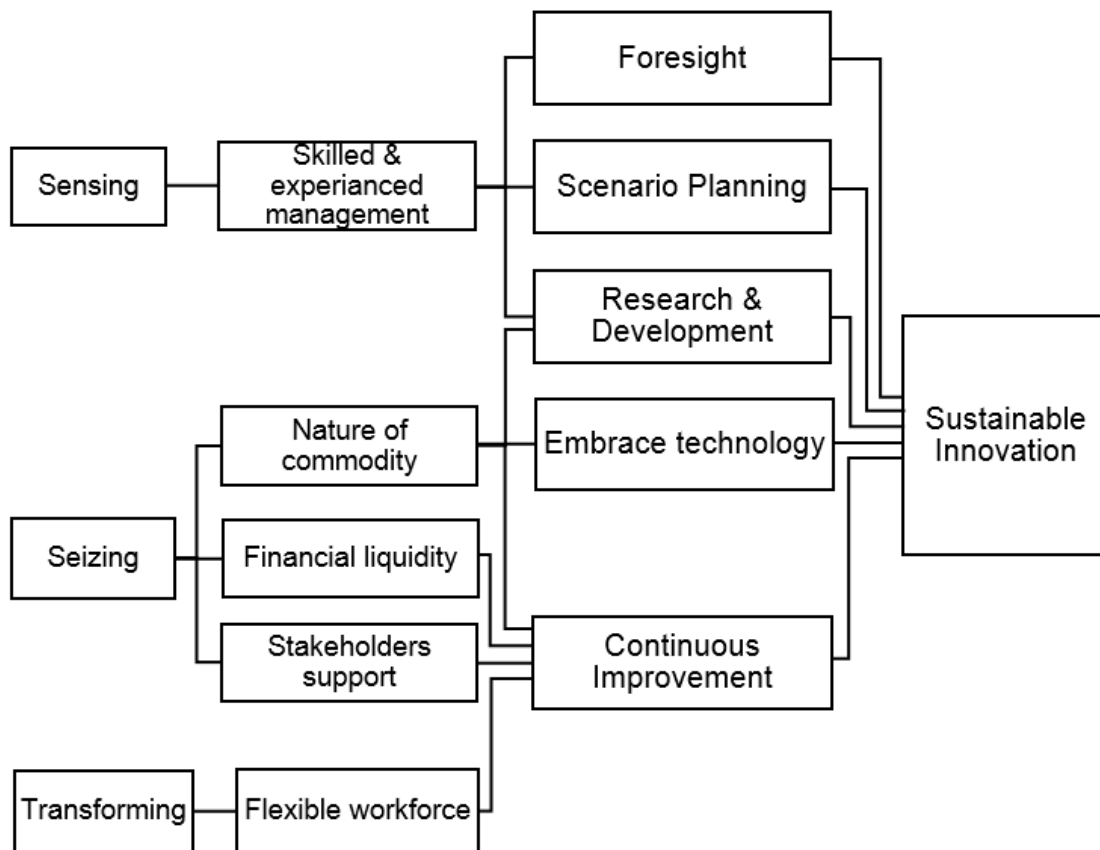


Figure 7: The proposed dynamic capabilities for sustainable innovation framework (Author's creation)

This framework seeks to explain how the dynamic capabilities mining companies have can lead to sustainable innovation. The framework also highlights the processes and routines that are required to enhance these dynamic capabilities. The explanation of how the framework works, and how it creates a connection between dynamic capabilities and sustainable innovation, is given below.

7.3.1. Dynamic capabilities

First of all, this framework acknowledges that the dynamic capabilities of sensing, seizing and transforming developed by Teece are still applicable and hold true for the mining industry, based on the findings from the interviews. Asked what the key dynamic capabilities are in the mining industry, the participants mentioned five capabilities which are; skilled and experience management, nature of the

commodity mined, financial liquidity, stakeholders support and flexible workforce. Based on the literature study, these five dynamic capabilities were grouped into three categories represented by Teece's dynamic capabilities of sensing, seizing and transforming. Further discussion on how this linkage is given below.

7.3.1.1. Sensing

The skilled and experienced management was categorized under sensing capabilities. One of the biggest roles of management in every company, especially senior management, is to sense the environment for any opportunities or threats. Even though the mid-level managers down to the front-end employees are still welcome to sense the environment, the nature of their roles requires them to put more focus on internal day-to-day operations and ensure that tasks are undertaken effectively and efficiently.

For the management to get better at sensing, three processes were mentioned by the participants. These processes are; foresight (also referred to as strategic foresight), scenario planning, and research and development. The idea of regarding foresight as a process that enhances the sensing capability was supported by Dominiece-Diasa et al. (2018) who argued that foresight is an act of developing a forward view aimed at sensing opportunities and helping in decision-making that positions the company well for the future.

Scenario planning was also identified as a process related to the sensing capability. According to Bowman (2016), scenario planning is an organised analytical process used by companies to develop various futures that will enable managers to imagine the potential future scenarios so that relevant strategy and policy adjustments can be made. Since the scenario planning process looks into the future, it enables managers to make a full scan of the environment and grab opportunities before they become visible to the competitors.

Managers are also responsible for R & D aimed at sensing of the environment. From literature, it was found that R & D improves organisational learning. Mining

companies need to assign dedicated individuals to undertake R & D on various aspects that affect their performance.

7.3.1.2. Seizing

Three of the five dynamic capabilities which are; the nature of the commodity mined, financial liquidity and stakeholders' support, were categorized under seizing capability. Teece D. J. (2012) defined seizing as a managerial routine whereby the resources an organisation has are mobilised with the aim of capturing the opportunities that were identified through scanning of the environment. Whatever opportunities have been identified must be applicable to the commodity that is being mined, and it is management's responsibility to ensure that suitable mining methods are used to extract this commodity.

Management also needs to consider the environmental impacts associated with mining the commodity, as well as ensuring that all those impacts are mitigated. The three major processes associated with efficiently and sustainably mining the commodity were highlighted as conducting R&D, making use of the latest technology, and engaging in continuous improvement initiatives. Since the mining company do not have luxury to modify the resources they have, the only competitive advantage they can get id through ensuring that those resources are mined in the best manner possible.

Financial liquidity was also mentioned as one of the dynamic capabilities needed by mining companies. For any business to run successful, it needs to have cash to run the operations and finance capital projects. Companies need to prioritize cash generation at operational level before resorting to external sources of finance. That is why continuous improvement becomes a critical process to ensure that the optimal operational performance is achieved.

Stakeholders support is also one key aspect in a sensing process. Stakeholders like customers, suppliers, consultants, legal institutions, local communities, employees, and financial institutions form part of the ecosystem within which

mines operate. If a mine continuously improves and maintains healthy relationships with all the stakeholders, they will become a good source of information that will enable it to seize the opportunities in the market.

7.3.1.3. Transforming

The last dynamic capability mentioned was flexible workforce, which was categorized under the transforming capability. Mousavi et al. (2018).defined transforming as managerial routines which focus on orchestrating and deploying the tangible and intangible resources an organisation has in order to match the ever-changing business environment. The transforming capabilities involve the ability to renew, realign, and reshape the processes and practices in order to adapt to the business environment. For all these to happen, mines need to have flexible workforce.

7.3.2. Sustainable innovation

According to the framework, if all the five routines or processes supporting the dynamic capabilities are undertaken, mining companies will be able to innovate in a sustainable manner. Based on literature, sustainable innovation is a type of innovation that places major emphasis on the triple bottom line which talks to social, environmental and financial aspects. The framework captures all three aspects under seizing, whereby social, environmental and financial aspects are incorporated under stakeholders' support, nature of commodity mined and financial liquidity respectively.

Innovating towards sustainability is not an easy task, and mining companies need to be aware of some of the major barriers they will likely be faced with. Five of these barriers highlighted by the participants were; literacy level, employers – unions relationships, mining legislation, culture and asset intensiveness nature of the mining business.

7.4. Managerial implications

The interview conducted comprised participants with experience from different commodities like coal, diamond, iron ore and gold. This means that their views were based on whichever commodity they have experience working on. It is well known that different commodities respond differently to various market conditions. For instance, in times when the global markets are depressed and there is a lot of uncertainty in the economy, the price of gold tends to increase as the demand gets high due to investors considering it as a 'safe haven' for them to hedge their bets against unstable financial markets. Under similar market conditions, the demand for other commodities like diamond drops, since they are seen as more of a luxury goods.

The variability in market behaviour shown above therefore means that the level of importance off each dynamic capability will also depend on the type of commodity being mine. Managers should acquire full knowledge of the markets and the ecosystem within which their businesses operate, so that they can know where to place more sensors, what kind of opportunities are most likely in their segments, and what systems and processes in their businesses present better chances of easy transformation to align with the changes in the market.

The dynamic capabilities for sustainable innovation framework illustrated in this chapter can be used by management of mining companies to ensure that their organisations always stay ahead of the game in terms of adjusting their dynamic capabilities to match the business environment, instead of always playing a catch-up game.

7.5. Research implications

From the literature review, it was shown that most of the studies done on the topics of dynamic capabilities and sustainable innovation were in the manufacturing and services industry. In most of the studies, the two constructs

were studied separately, not shedding light on how one influences the other. Apart from that, none of the studies were conducted in Africa. This research therefore brief the gap by studying the two constructs and how one influence another in the mining setting.

7.6. Research limitations

There were several limitation related to this study. The nature of the study was exploratory, which implies that the results obtained here cannot be generalized to other industries. The results from this study were based on only 12 interviews, which is a small sample size. The study was qualitative, and as such there is high chances of the researcher being biases when analysing the results. Another limitation is that the interviews were all con ducted virtually over the zoom meetings platform due to the restricted movements as a result of Covid-19 pandemic.

7.7. Conclusion

Mining companies are now operating in a VUCA-type world, where there so much volatility in the market. This then means that mining companies need to have not only ordinary capabilities, buy some really strong dynamic capabilities that will give them competitive advantage. In this research, the four research questions were formulated, and responses to the questions given based on the results from interviews. The study was able to establish a link between dynamic capabilities and sustainable innovation, and a framework to be used as a guide in relating these two constructs was developed.

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APPENDICES

Appendix A: Interview Questionnaire

Interview schedule

The draft list of questions that will be used during the interview is given below;

Questions

Dynamic capabilities

1. How would you generally define dynamic capabilities?
2. From your experience in the mining industry, what would you regard as dynamic capabilities necessary for the success of the business?
3. Why would companies operating in similar industry and under similar work environment normally have different dynamic capabilities? What are the key factors underpinning the topic of dynamic capabilities?
4. Most mining companies still operate on the principle that the best way to do things is to follow best practices instead of always trying to find new ways of doing things. Do you believe this is the case? And if yes, is this the right way to work, especially considering the fact that mines more than ever before are operating in dynamic business environments?
5. One of the old definitions of dynamic capabilities is that it is the ability to sense, seize and transform. How important are these key actions to the mining industry operating in modern times? And how often are senior managers applying these actions on their daily basis?

Sustainable innovation

6. From your experience in the mining industry, what would you define as a sustainable innovation required for the success of the business?
7. According to your knowledge and experience, do you think mining companies are innovative enough? Do they create a work environment

that encourages employees to be innovative? And in what aspects do we see this innovation in the workplace?

8. How often do you hear the word innovation come about in the discussions and conversations between the employees in the mining industry, especially in management meetings?
9. Can you think of one instance whereby a sustainable innovation in the mining industry was applied, and had a direct link to the improved economic value to the organisation?
10. What would you see as barriers to innovation in the mining industry? And how can these barriers be overcome by mining companies?
11. Do you think there is a relationship between the dynamic capabilities that mining companies build and the resulting innovation that is observed in their operations?


Appendix B: Ethical Clearance Approval

24/11/2020 Ethical Clearance Approved - 29290199@mygibs.co.za - Gordon Institute of Business Science Mail

☰ Gmail ethical clearance

4

Ethical Clearance Approved Inbox x

 **MastersResearch2020** <MBAResearch2020@gibssa.mail.onmicrosoft.com>
to me

**Gordon Institute
of Business Science**
University of Pretoria


**Ethical Clearance
Approved**

Dear Retselisitsoe Emmanuel Maphalla,

Please be advised that your application for Ethical Clearance has been approved.
You are therefore allowed to continue collecting your data.
We wish you everything of the best for the rest of the project.

[Ethical Clearance Form](#)

Kind Regards



Appendix C: Consent Form

Interview Consent Form

Exploring the role of dynamic capabilities as a core competence on sustainable innovation in the mining industry

I am currently a student at the University of Pretoria's Gordon Institute of Business Science and completing my research in partial fulfilment of an MBA.

I am conducting research on dynamic capabilities and sustainable innovation as a core competency on sustainable innovation in the mining industry. Our interview is expected to last about 45 minutes. **Your participation is voluntary, and you can withdraw at any time without penalty.** All data will be reported without identifiers. If you have any concerns, please contact my supervisor or myself. Our details are provided below.

Researcher name: Retselisitsoe Maphalla Research Supervisor: Thea Pieterse

Email: 29290199@mygibs.co.za

Email: theap@gold.co.za

Phone: +266 5662 5025

Phone: +27 (0)82 891 8207

Signature of participant: _____

Date: _____

Signature of researcher: _____

Date: _____

Appendix D: Consistency Matrix

Research Questions	Literature review	Data collection tool	Analysis technique
Research Question 1 What are the key dynamic capabilities mining companies need to have in order to remain competitive?	Section 2.2. (Teece, 2007; Teece, 2012), (Mousavi et al., 2018)	Interview guide	Thematic analysis
Research Question 2 What processes or routines must be undertaken by mining companies to enhance the development of these key dynamic capabilities within their management team?	Section 2.3. (Vecchiato, 2015)	Interview guide	Thematic analysis
Research Question 3 What is the level of sustainable innovation taking place in the mining industry in comparison to other industries?	Section 2.4. (Dangelico, 2015)	Interview guide	Thematic analysis
Research Question 4 What are the key barriers and enablers of sustainable innovation in the mining industry?	Section 2.5	Interview guide	Thematic analysis