

Investigating the values and fears of mechanisation in the South African gold and platinum industry

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COMMENTS

The reader is reminded of the following:

The researcher followed the NWU Referencing Guide: NWU Harvard in this mini-dissertation.

The mini-dissertation is submitted in line with the basic structure guidelines of the NWU.

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SUMMARY

Title: Investigating the values and fears of mechanisation in the South African gold and platinum industry

South Africa suffers from an inability to realise the full potential of its mineral endowment that could lead the nation to the prosperity of all its citizens. A number of views exist as potential solutions to a mining industry in crisis. Opinions range from radical transformation in ownership of mineral rights within the country to the adaptation of mechanised mining methods within the gold and platinum industry. This paper presents an unconventional outlook to this subject matter in challenging the prevalent inclination to adopt a mindset of either mechanising struggling operations or retaining a labour-intensive conventional mindset. Following a qualitative research study, fourteen interviews were conducted across all identified mining stakeholders. Through inductive reasoning and applying a qualitative content analysis process, categories were extracted from the collected data. The result allowed the researcher to populate a polarity map designed to navigate users through a process of applying “both-and” thinking as a supplement to conventional problem-solving techniques. The use of polarity management capitalises on the inherent tensions between the two opposing views, resulting in a sustainable competitive advantage. The implication of this exploratory study is to encourage the use of this alternative approach to the challenges within the South African gold and platinum industry. By considering the resisting stakeholders as a resource rather than an obstacle and making use of the developed polarity map creates a natural anticipation for progression in an infinite loop that is regarded as a key to sustainability. The opportunity exists to refine the developed polarity map through further research.

Keywords: Gold mining mechanisation, mining mechanisation challenges, mining modernisation, South African mining challenges, platinum mining mechanisation.

OPSOMMING

Suid-Afrika ly aan 'n onvermoë om die volle potensiaal van sy minerale rykdom te besef, ongeag die feit dat dit die land en al sy inwoners tot welvaart kan lei. Daar bestaan 'n aantal alternatiewe benaderings wat as potensiele oplossings vir 'n mynindustrie in krisis kan dien. Voorstelle wissel van die radikale transformasie van die eiendomsreg van mineraleregte in die land, tot die aanvaarding van gemeganiseerde mynmetodes binne die goud- en platinumindustrieë. Hierdie dokument verteenwoordig 'n onkonvensionele uitkyk op hierdie onderwerp en die as uitdaging van die heersende neiging om 'n ingesteldheid van sukkelende meganiese operasies of die behoud van die konvensionele arbeidsintensiewe werkswyses te aanvaar. 'n Kwalitatiewe ondersoekstudie is onderneem deur middel van veertien onderhoude met geïdentifiseerde belanghebbendes. Kategorieë is onttrek uit die ingesamelde data deur induktiewe argumentasie en die toepassings van 'n kwalitatiewe inhoudsanaliseproses. Die resultate het die navorser bemagtig om 'n polariteitskaart te ontwerp om verbruikers te begelei deur 'n proses waartydens hulle 'n "beide-en" denkwysse toepas as 'n toevoeging tot konvensionele probleemoplossingstegnieke. Die gebruik van polariteitsbestuur kapitaliseer op die inherente spanning tussen die twee opponerende sienswyses, met 'n gevolglike volhoubare kompeterende voordeel. Die doel van hierdie ondersoekende studie is om alternatiewe benaderings tot die uitdagings binne die Suid-Afrikaanse goud- en platinumindustrieë aan te moedig deur persone wat teen alternatiewe oplossings is te beskou as 'n bron eerder as 'n struikelblok. Die gebruik van die ontwikkelde polariteitskaart skep 'n natuurlike antisipasie van vooruitgang in 'n oneindige sirkel wat beskou word as 'n sleutel tot volhoubaarheid. Die ontwikkelde polariteitskaart kan deur verdere navorsing verfyn word.

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CHAPTER 1: RESEARCH PROPOSAL

1.1 RESEARCH BACKGROUND

To some people, South Africa is merely the most southern tip of a continent, synonymous with immense potential but chronic underutilisation. To others, South Africa is the continent's only hope of leading the way to economic prosperity and sovereignty. Compared to other economies, South Africa is struggling in respect of economic growth. It is a classic tale of an entity with an abundance of resources, but which is trapped in its own inability to exploit these resources and create value from them.

One of South Africa's greatest opportunities resides in the mining sector, which is estimated to be the world's fifth largest in terms of gross domestic product (GDP) and is valued as the largest metal and mineral resource in the world (Porter, 2014). For a country that is so richly endowed with mineral deposits, it is hard to comprehend that it is facing considerable challenges in alleviating the real threats of unemployment and poverty as a result of weak economic growth. The obvious question that is often asked is how to unlock this potential. It is therefore somewhat disappointing that the National Development Plan, which has a vision to reduce poverty and inequality, in an attempt to exploit existing strengths regards the mining sector as "*good for growth but not great for jobs*" (National Planning Commission, 2011, p11). Figure 1-1 is a representation of the National Development Plan and job creation matrix.

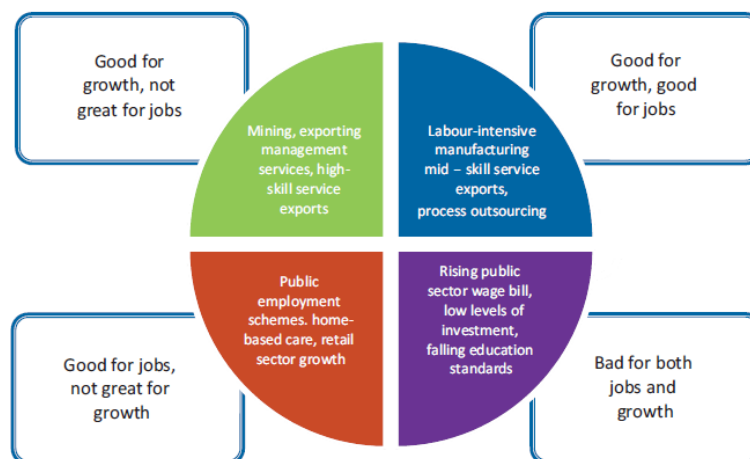


Figure 1-1: National Development Plan and job creation matrix

Source: National Planning Commission (2011:11).

Possible solutions to effectively harness the opportunities within the mining sector include very radical views, such as the policies of political parties that call for nationalisation of mines. The aim

is to transfer wealth from the minority to address the massive unemployment, poverty and inequality, as stated by the Economic Freedom Fighters (2016). Mechanisation of the mining sector as a possible remedy to create the required leverage is another broadly debated concept with many views and arguments

1.2 PROBLEM STATEMENT

According to Solomons (2015), mechanisation particularly in the platinum and gold sectors could assist in saving the South African mining industry. According to Cornish (2012), mechanisation is often associated with increased productivity and a safer mining environment. Griffith (2015) argues that mechanisation is a vital step in the sustainability of the South African mining industry. Williams (2012), however, indicates that mechanisation by implication includes labour force reduction, which is technically, socially and politically not so easy to implement. Sparks (2014) argues that the radical switch from “low wage, high employment” – on which the mining industry was founded nearly 150 years ago – to a more mechanised mineral extraction strategy that implies “high wage, low employment” will be devastating to rural areas. Reuters (2013) states that the confidence level in adopting a mechanised strategy within the gold and platinum sector to drive down costs and improve productivity is low. Faku (2012) states that companies such as Lonmin have failed to provide the planned production and cost targets in their attempts to mechanise operation, thereby abandoning these efforts and reverting back to labour-intensive conventional mining methods. He argues that, historically, the South African gold and platinum mining sector do not provide the ideal environment for mechanisation.

Despite the fact that this topic is heavily debated in the media, very little academic research has been conducted on this subject. Apart from Willis, Dixon Cox and Pooley (2004), who studied the framework for the introduction of mechanised mining, Hattingh, Sheer and Du Plessis (2010) investigated the human factors in mining mechanisation. Furthermore, Porter (2014) argues that mechanisation is focused on machinery rather than on technology and a few other papers on this subject within the South African mining context remain relatively unexplored.

The purpose of this study is to provide an in-depth look into the challenges of mechanisation within the platinum and gold industry. It is envisaged that the study would clarify why mechanisation within these sectors has inconsistent results, and provide reasons for mixed opinions surrounding this concept. It is an attempt to create a full understanding of what key success factors need to be considered in transforming the current mining industry into a modern mechanised footprint.

Essentially, this research responds to a call for new thinking about mechanisation and draws inspiration from Griffith (2015) and Vogt (2016), who have stressed the need for the boldness and

vision to “grasp the nettle game-changing innovation” (Griffith, 2015, p7) in order “to put this vital sector on a sustainable footing” (Vogt, 2016, p1). The practical importance of this topic is accentuated by the specific management problem referred to in numerous industry publications, adequately summarised by Vogt (2016), who raises the issue of whether mechanisation can save South Africa’s ailing mines.

The main contribution of the study is to investigate the attributing factors to the challenges of mechanisation within the predefined population group and to provide insight into the reasons for hindrances to the implementation thereof. Answers to this research question would assist decision makers and other stakeholders in finding adequate solutions to the current challenges faced.

The paper has five parts. First, the introduction includes the topic, the research problem, background and evidence from the literature as well as experience proving that the problem exists. Deficiencies in the evidence will also be included, detailing the area of need in relation to the problem and the lack of evidence in the literature. It will also articulate the audience who is affected and who will ultimately benefit from the study. A literature review will follow in Part Two, which will include a discussion of the theoretical or conceptual framework and an indication of shortcomings that should be avoided in the design of prior research as well as strengths to be repeated in conducting further research. In Part Three, the methodology will be discussed, which includes the participants, measuring instruments, procedures and limitations. The results will be discussed in Part Four, and a final discussion in Part Five will link the findings to the relevant research and implications thereof. Finally, limitations will be indicated and recommendations for future research will be offered.

1.3 PRIMARY RESEARCH QUESTION

What are the challenges of mechanisation within the South African gold and platinum industry?

1.4 RESEARCH OBJECTIVES

The research objectives are divided into a general objective and specific objectives.

General objective

The general objective of this research is to investigate the factors that attribute to the challenges of mechanisation within the South African mining context and to provide insight to the reasons for hindrances to the implementation thereof.

Specific objectives

The specific objectives of this research were to:

1. determine how the challenges to mechanise a mine were conceptualised within existing literature;
2. identify key themes that were considered important by the selected unit of analysis in respect of mechanisation within South African mines;
3. ascertain if there exist similarities or disparities between current literature findings and feedback from the intended qualitative study; and
4. provide a framework for the practical implementation and recommendations for future research in respect of mechanisation.

1.5 RESEARCH LIMITATIONS

The limitation of this qualitative analysis is that the findings cannot be extended to a wider population. This is because the findings of the research were not tested to discover whether they are statistically significant or due to chance. Whilst qualitative methods can examine social processes within particular contexts in considerable depth, the collection and especially the analysis of the content were time-consuming and expensive. Because this qualitative research involved a relatively small number of participants, the likelihood of using the findings by other academic researchers or policymakers is somewhat reduced. The interpretation of the researcher was also a limiting factor as personal experience and knowledge influence the observations and conclusions related to the research problem. Because the qualitative research was open-ended, the researcher was not able to verify the results objectively against the scenarios stated by the respondents. Finally, the researcher found it difficult to investigate causality between the different research phenomena as this type of research was based more on opinion and judgement than on results. Thus, this qualitative study was unique in itself and is considered difficult to replicate.

1.6 RESEARCH CONTRIBUTION

The recent deterioration of commodity prices has unmasked the distressed erosion in productivity of South African mines, as stated by Vogt (2016). Although many opinions exist on the underlying motives of this distress signal, it unquestionably threatens the survival of many mines. PwC (2014) states that this is clearly reflected in the financial indicators of companies within this sector, which saw a relative decline in the JSE mining index compared the JSE all share index. The challenges

faced in this industry are clearly highlighted in this depiction. Figure 1-2 illustrates the comparison between these two financial indicators over the period from June 2012 to October 2014.

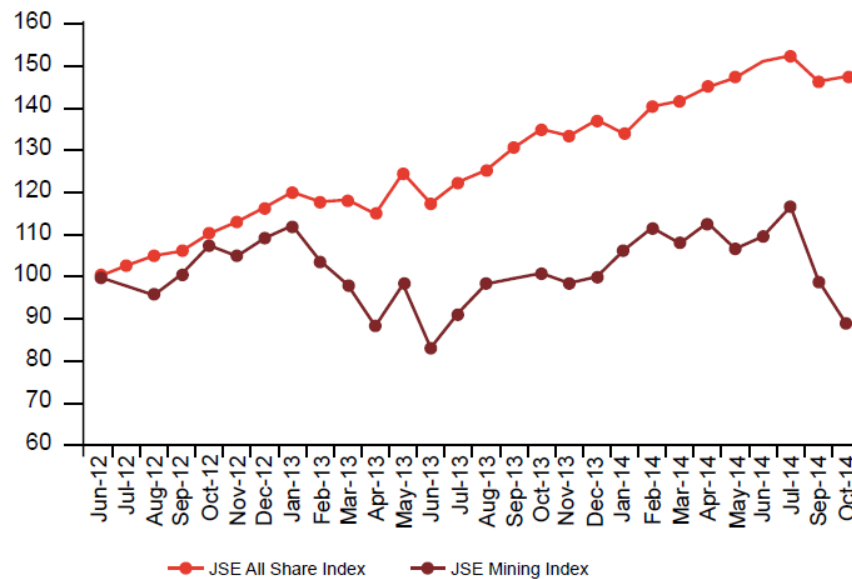


Figure 1-2: JSE All share index vs JSE Mining index indicator performance

Source: PriceWaterhouseCoopers (2014:8).

In 2013, the mining industry contributed 8.3% directly towards the national GDP (Chamber of Mines, 2014), while it contributed 21% in 1970. Despite this decline, the mining sector over the past four decades still contributed significantly toward foreign exchange earnings, economic activity and employment. According to PwC (2014), the risk exposure of this industry has not changed significantly compared to previous years. Yet, increased priority has been placed on the area of labour relations, achievable business plans, volatile commodity prices and fluctuations in foreign exchange, infrastructure, high input costs and regulatory, political and legal environment. Senkhane (2016) argues that in order for mines to remain competitive, the priority has subsequently moved towards mechanising mining operations, as it is seen as a potential solution to create a steady stream of revenue and to significantly cut costs. Stoddard (2014) states that there is a perception that labour militancy is dictating the push for mechanisation, despite the cost of converting from traditional mining methods. With such a diverse opinion regarding mechanisation as a possible solution within the South African mining industry that is in crisis, the researcher believes that there is a definite need for conducting the study with the specific aim of identifying and quantifying the challenges to modernise South African mines.

1.7 RESEARCH METHODOLOGY

The research strategy made use of the case study method that is focused on the development of a theory. A cross-sectional design was selected where primary data were gathered from semi-structured interviews at a specific point in time. The study population in this research study included all identified stakeholders within the South African gold and platinum industry. The purposeful sampling strategy was aimed at providing satisfactory representativeness by systematically selecting a small homogenous sample. It is believed that the sample size was adequate, and representative of all mining constituency as there exists the possibility of information saturation with a planned response rate of 40%. The semi-structured interview format makes use of four open-ended questions where feedback from the respondents was analysed making use of a conventional content analysis technique. The emergent concepts derived from the content analysis were used to develop a polarity map, creating a theoretical framework for dealing with polarities on an ongoing basis.

1.8 SUMMARY

The key points included in Chapter 1 commenced with a background narrative by citing literature where appropriate. The conceptual underpinnings of the study form the theoretical base from which the topic evolved, which includes the basic, historical and theoretical nature of the topic. A clear and concisely detailed explanation was given during the problem statement as well as the purpose of the study. A section has been provided that clarifies the limitations and indicates clearly how some potential problems will be controlled as well as the intended research contribution that this research study aims to provide. Chapter 1 concludes with a concise clarification of the suggested research methodology that has been applied in this research study.

The remainder of the mini-dissertation is organised in a comprehensive literature review in Chapter 2, followed by the research design and methodology in Chapter 3. Chapter 4 includes the analysis of the data, followed by findings, conclusions and implications given in Chapter 5. The content analysis coding sheets have been added in the appendices.

CHAPTER 2: LITERATURE STUDY

2.1 INTRODUCTION

It is envisaged that the study will clarify why mechanisation within the South African platinum and gold sectors has inconsistent results, and provide reasons for mixed opinions surrounding this concept. It is an attempt to create a full understanding of the key success factors needed to be considered in transforming the current mining industry into a modern mechanised footprint. Therefore, this research responds to a call for refreshed outlook on mechanisation. The practical importance of this topic is accentuated by the specific management problem referred to in numerous industry publications, adequately summarised by Vogt (2016), who raises the issue of whether mechanisation can save South Africa's ailing mines.

This chapter's scope includes an assessment of the South African economy and how it performs against other sovereign nations. The role of mining within the economy is also reviewed with specific reference to the gold and platinum sectors and its relative competitiveness within the global mining industry. The purpose of the literature study also includes exploring the ideology of mechanisation as a possible remedy to South Africa's ailing mining industry. Alternative strategies are considered within the mining sector to combat poverty, unemployment and inequality, also presented in this chapter, emphasising the fact that the South African mining industry finds itself at the crossroads.

2.2 THE SOUTH AFRICAN ECONOMY

According to Janse van Rensburg, McConnell and Brue (2011), the national income accounting measures the overall performance of a particular economy. Accounting subsequently enables economists to measure the health of the economy by comparing production levels at frequent intervals, tracking the economy's growth patterns through trend analysis and formulating policies to reach growth objectives.

The GDP is the most recognised monetary measure to quantify such performance. The GDP determines the total market value of all final goods and services produced in a given year within the borders of the country (Janse van Rensburg et al., 2011).

Faulkner and Leowald (2008) argue that an economy's growth is complex due to a range of factors that influence this fundamental variable. These factors include:

- labour productivity
- market structures

- regulation and other microeconomic structures
- economic growth in trading partners
- macroeconomic management of the economy through the business cycle
- political factors

To create a holistic overview of South Africa's growth trends, it is also imperative to review the history of the country's economy. It is undisputed that South Africa's economic development had been dominated by colonialism and apartheid from 1948 to 1991 through racially exclusive political and economic systems that were based on the exploitation of natural resources, most notably gold (Faulkner & Leowald, 2008).

Economic growth essentially pivoted around changes in commodity prices and low productivity as well as the low employment approach towards production that took the advantage of limited competition. The effect thereof was the development of a large African working class in the mining and manufacturing industries living in geographically isolated communities with low education levels and limited means of self-generating economic development. Faulkner and Leowald (2008) argue that by 1990 the supply cost of labour had escalated due to these factors, where the high-skilled, predominantly white labour market suffered from excess demand and insufficient supply and the low-skilled labour market was characterised by massive excess supply with low productivity and income levels. The financial system that was developed facilitated capital-intensive industries, such as mining, with many financial houses being created around this industry that were capable of generating large surplus profits. Subsequently, finances were rationed for the manufacturing, machine goods and technology industries (Faulkner & Leowald, 2008) that relied more on self-generating earnings for investment than on bank lending or capital markets.

Monetary policy in the 1980s was geared around rigorous exchange controls which prevented capital from crossing the border. In addition, large public spending in an effort to extend social structure and increase subsidies to industries resulted in a large budget deficit and rising debt levels. Debt increases, combined with a lack of export capacity, resulted in inflation reaching a peak of almost 21% in 1986 (Faulkner & Leowald, 2008). Consequently, in the decade prior to 1994, South Africa experienced one of the worst periods of economic growth since the end of the Second World War.

This downturn trend in economic growth from the early 1970s was reversed in 1994 when economic policy reforms were aimed to reintegrate with the world economy to re-establish a basic

level of political certainty. Public spending shifted away from industry subsidies towards focusing on social grants to the poor with a new political dispensation. However, these observed improvements in South Africa's growth performance do not compare with other growth champions that succeeded in sustaining an average growth rate of 7% per annum for over 25 years (Faulkner & Leowald, 2008).

In the period between 2008 and 2015, growth rates were more volatile, not only in South Africa but also globally. Recovering from the financial crisis in 2009 where South Africa and a number of developed countries recorded negative growth rates, the country never reached levels above the 3.5% real GDP mark. The real GDP year-on-year growth is illustrated in Figure 2-1.

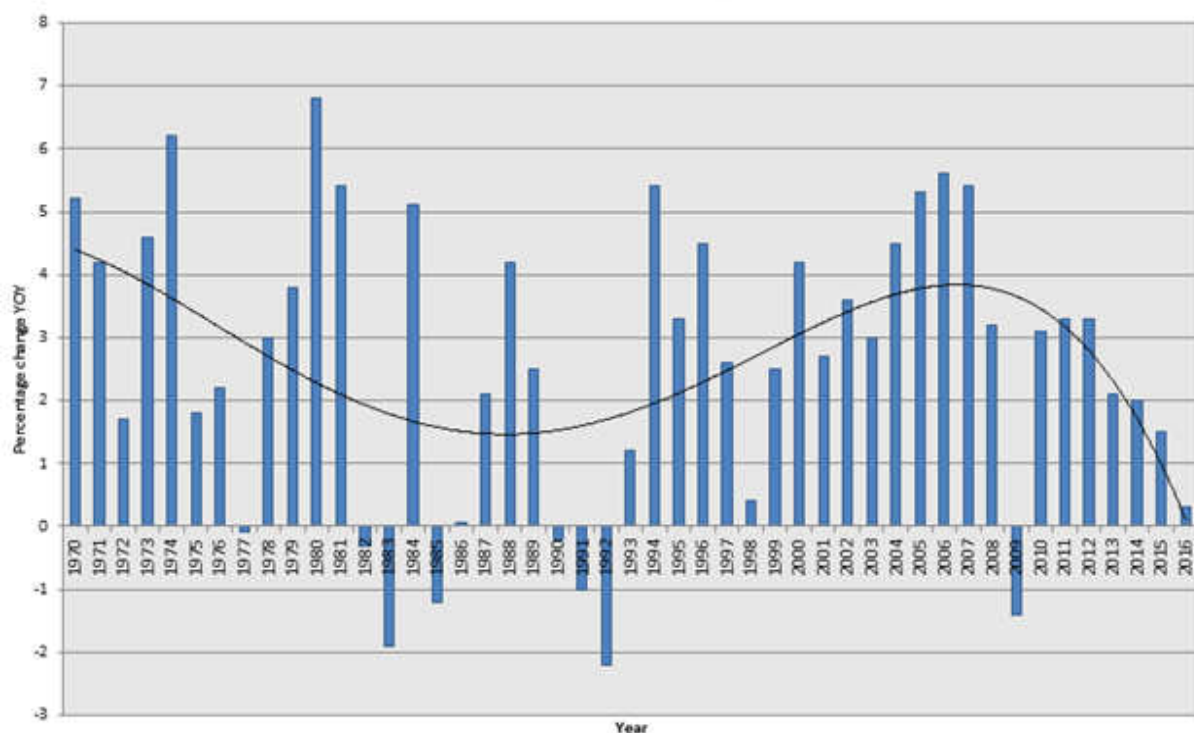


Figure 2-1: South Africa real GDP year-on-year growth

Source: Author (2017) adapted from Faulkner and Leowald (2008:29), Stanlib (2016:3) and StatsSA (2017:20).

According to News24 (2014), the reason for low growth rates is a mixture of critical factors that have led to the economic decline. These factors include:

- credit bubble
- excessive government spending
- corruption

- labour unrest
- sluggish overseas markets
- lack of foreign direct investment (FDI)

News24 (2014) reports that low interest rate environments generally inflate credit and asset bubbles. South Africa had two particularly low interest rate periods, namely the 2004–2006 period and the post-2008/9 crisis period, both of which led to rapid credit growth above the rate of economic growth. Unsecured loans are the fastest growing segment in the country's credit market, contributing to the growing household and personal debt (Figure 2-2).



Figure 2-2: Proportion of indebtedness per income group (2013 & 2015)

Source: Anonymous (2016).

According to News24 (2014), unsecured loans have become popular as credit providers can charge up to 31% on interest per annum. This makes these riskier loans far more profitable for banks than mortgage and car loans in a low interest rate environment.

In addition, News24 (2014) states that after the 2008/9 global financial crisis, government began to run large budget deficits to boost the country's economy aimed at social services of the poor,

such as healthcare and education. Gumede (2017) adds that the gross government debt exceeded 50% of the GDP in 2016, reaching this level for the first time since 1999, as illustrated in Figure 2-3.

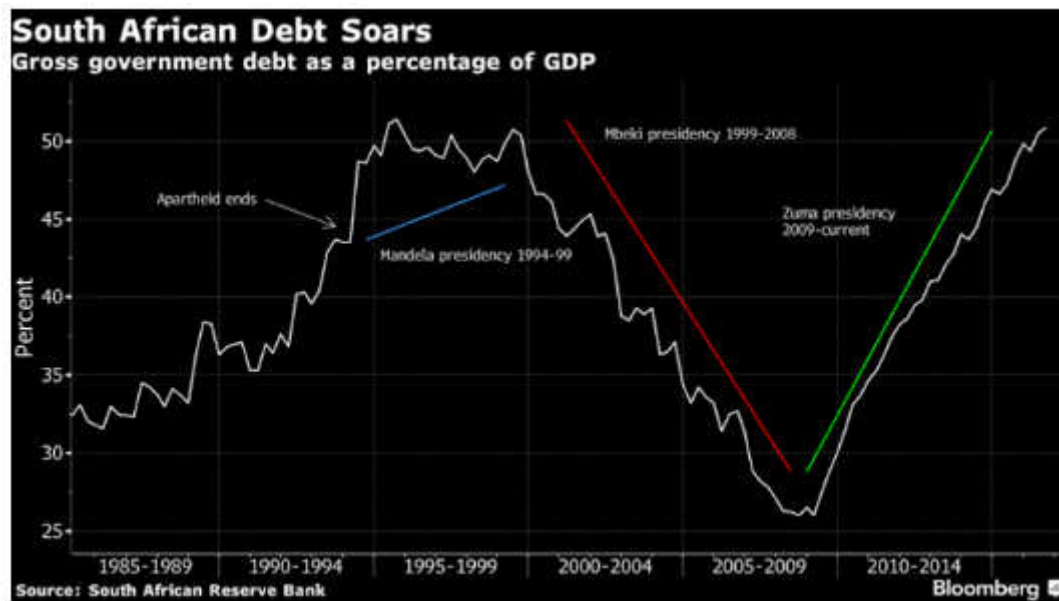


Figure 2-3: Government debt as a percentage of the GDP

Source: Gumede (2017) adapted from Bloomberg.

According to the Reserve Bank (2017), South Africa's total external debt now stands at \$142.8 billion. This is 45.4% of the GDP, which is \$314.39 billion, according to Trading Economics (2017). This is the highest debt level since the 1980s. The country's debt burden is further exacerbated by corruption, which is a moral and political issue that needs to be dealt with decisively (News24, 2014).

South Africa's inability to attract adequate investment opportunity directly into local business (foreign direct investment) can be attributed to the credit downgrading over the past few years as well as the country's reliance on European and U.S. markets. This is evident in the positive correlation between the real GDP growth rates of South Africa and these two developed countries, as illustrated in Figure 2-4.

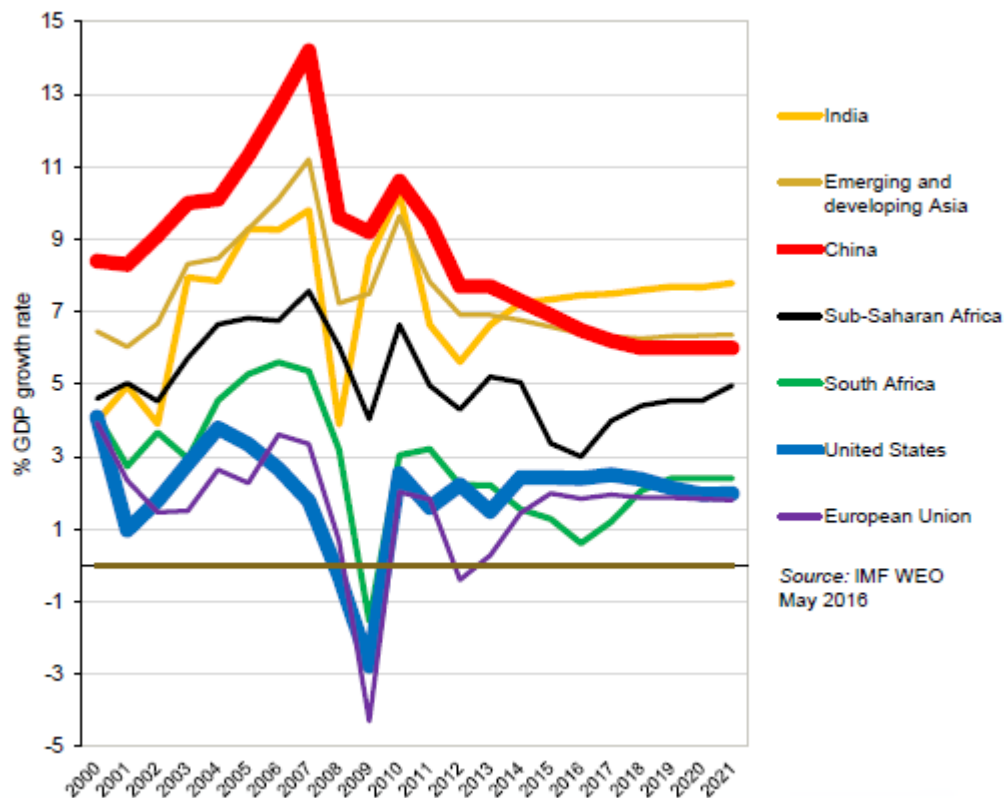


Figure 2-4: GDP growth rates per key region or country

Source: Baxter (2016:22).

Persistent sluggish economic environment in Europe and the United States coupled with lower commodity prices had an equally negative impact on South Africa. The correlation diminished from 2013 onwards, with the expectation to regain its former correlation in 2018. This could be a result of the demise of the so-called “emerging market boom”. Prior to 2013, with relatively low interest rates within developed countries such as Western Europe and America, investors seeking a higher return on their investment have turned to emerging markets such as South Africa as possible investment opportunities. This resulted in an unprecedented emerging markets bond boom estimated at \$4 trillion (News24, 2014). However, in May 2013 the Federal Reserve announced a programme for downsizing the U.S. Federal Reserve, which influenced investors to abandon emerging market and to reinvest in recovering Western economies. This sudden mass exodus of funds affected currencies and bond markets worldwide as well as South Africa where the rand dropped with over 18% by the end of 2013.

A sovereign credit rating, according to Luüs (2017), gives investors insight into the level of risk associated with investing in a particular country, which also includes political risk. Considering the credit ratings of the three major rating agencies since 1994 (Figure 2-5), South Africa has moved closer to sub-investment grade (Gumede, 2017).

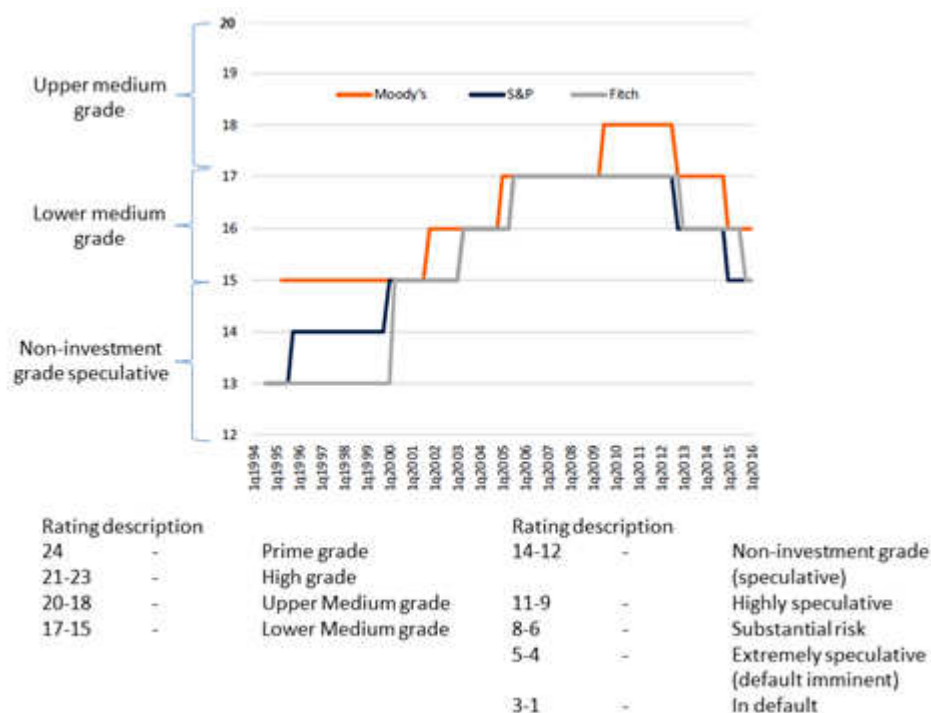


Figure 2-5: SA sovereign risk – major risk ratings agencies

Source: Author (2017) adopted from Luüs (2017).

Luüs (2017) states that studies have indicated that the GDP per capita tends to explain 80% of the changes in the assessments of countries made by credit rating agencies. A downgrade in ratings by rating agencies would increase inflation, which holds a severe threat for the macroeconomy (Luüs, 2017) and could lift bond yields and interest rates much higher, causing more pressure on the currency and negative effects on the stock market. This will create a vicious spiral where growth outlook will decline even further and possibly lead to another ratings downgrade.

Faulkner and Leowald (2008) indicate that growth accounting allows us to break growth down into the accumulation of factors of production and a residual that reflects technological progress or total factor productivity (TFP). By employing a primal growth approach and using factor shares to condition the relative contribution of capital and labour, South Africa's real GDP growth can be disseminated into three sources, as illustrated in Figure 2-6.



Figure 2-6: Decomposition of growth

Source: Author adapted from Faulkner and Leowald (2008:7).

Table 2-1 illustrates the structural shift in the sources of South Africa's economic growth where the accumulation of factor inputs (capital and labour) have diminished in importance (Faulkner & Leowald, 2008) while technological progress has increased.

Table 2-1: Decomposition of South Africa's economic growth 1970–2016

Time period	Real GDP growth	Capital	Labour	Total factor productivity
1971-1984	3.01	2.23	1.45	-0.67
1985-1994	0.85	0.44	0.77	-0.36
1995-2000	2.85	0.59	0.47	1.79
2001-2007	4.27	1.11	0.93	2.23
2008-2016	1.93	0.40	0.29	1.24

Time period	Real GDP growth	Capital % of GDP	Labour % of GDP	Total factor productivity % of GDP
1971-1984	3.01	74.1%	48.2%	-22.3%
1985-1994	0.85	51.8%	90.6%	-42.4%
1995-2000	2.85	20.7%	16.5%	62.8%
2001-2007	4.27	26.0%	21.8%	52.2%
2008-2016	1.93	20.9%	14.8%	64.3%

Notes: The contribution of the growth in factor inputs to real GDP growth is calculated by multiplying their growth rates (i.e. capital stock and employment growth) by their respective shares of factor income. As in the Solow model, TFP growth is calculated as the residual.

Source: Author adapted from Faulkner and Leowald (2008:39), World Bank (2017) and Burger (2015).

In addition, Burger (2015) argues that the share of labour in aggregate income has declined significantly since 1993. Real wages have increased slower than productivity due to financialisation and the more aggressive return-orientated strategies applied by industry have translated into investors requiring higher rates of return on capital. According to Burger (2015), this has led to an increased adoption of capital-augmenting labour-saving technologies that have reduced labour share of total income.

According to Burger (2015), international studies indicate that the declining labour share has been a general trend globally, which has been caused by technological change during the past three decades. Technological advances have increased productivity of physical capital relative to that of labour, resulting in wages becoming stagnant or having grown slowly. Thus, the augmentation of capital's productivity through technological progress leads companies to substitute capital for labour.

Burger (2015) attempts to explain why industries have implemented capital-augmenting labour-saving technology by investigating the factors that determine wages. This is illustrated in Figure 2-7.

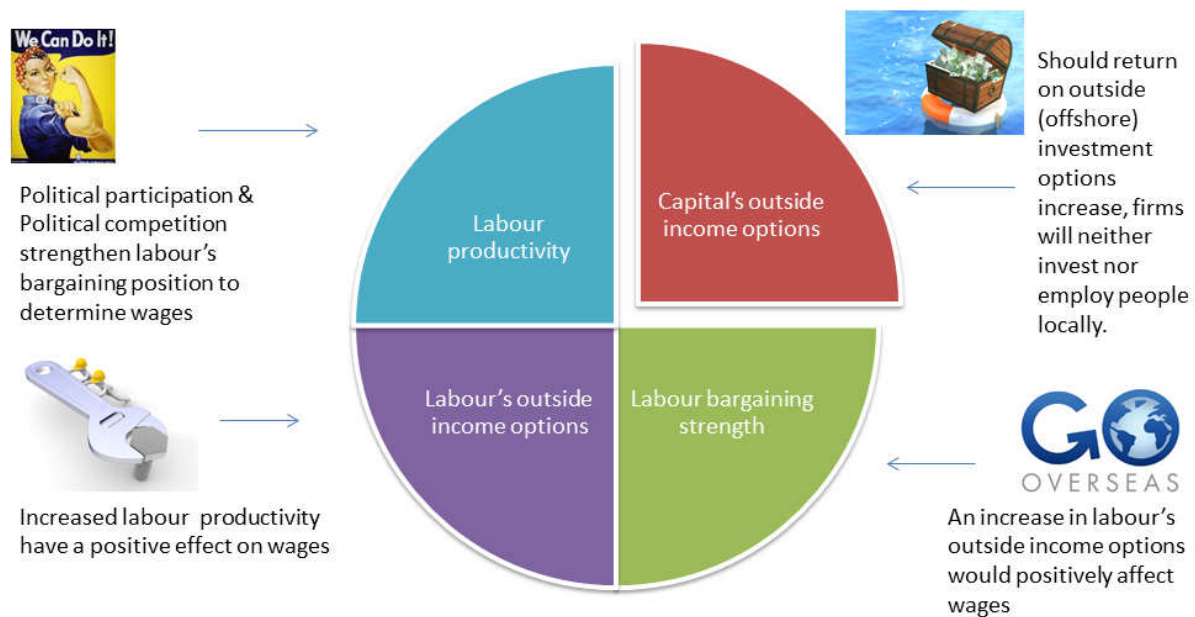


Figure 2-7: Factors influencing wages

Source: Author adapted from Burger (2015:3).

Burger (2015) argues that as owners of capital are increasingly opting to invest offshore through globalisation and financialisation, downward pressure is placed on local cost and consequently the share of income allocated to labour. Less investable funds subsequently lower capital-output ratios and, together with higher required rates of return, firms are pressurised to implement capital-augmenting labour-saving technologies that reduce labour income share. This is evident in considering the relationship between the capital-output ratio and labour share, as illustrated in Figure 2-8.

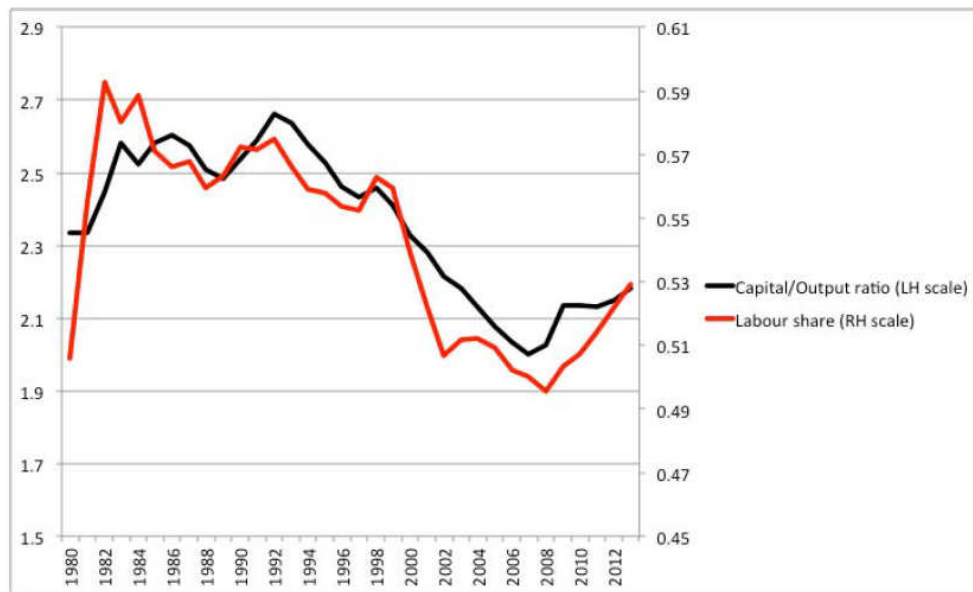


Figure 2-8: South Africa's labour share and the capital-output ratio

Source: Burger (2015:4).

Observations of South Africa's labour share and capital-output ratio appear to be positively correlated (Burger, 2015). The statistical analysis indicates that changes in the labour share adjust to changes in the capital-output ratio and not vice versa. Thus, the demand in a higher rate of return by financial investors via a lower capital-output ratio pressurises firms to implement capital-augmenting labour-saving technology.

Burger (2015) posits that when South African firms implement capital-augmenting labour-saving technology, wages will not keep up with average productivity in a one-to-one relationship. This is evident, as illustrated in Figure 2-9, where wages growth fell short of productivity growth for the past two decades and a growing share of the output went to capital.

$$\text{Average labour productivity} = \frac{\text{Total income created (capital + labour)}}{\text{Average number of workers}}$$

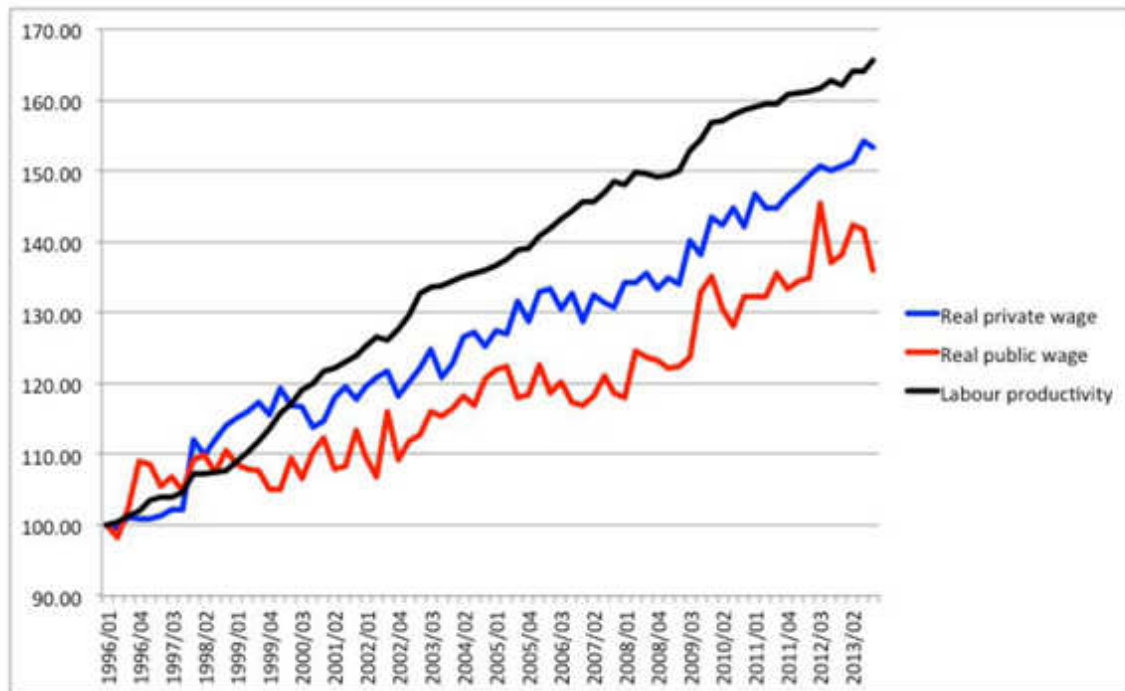


Figure 2-9: Labour productivity and real wages

Source: Burger (2015:6).

A falling labour share contributes to a deteriorating income distribution because capital income is more concentrated than labour income. Burger (2015) indicates that redistributive measures such as minimum wages, welfare benefits and progressive income taxes do not necessarily undermine economic growth. Strauss and Isaacs (2016) argue that by increasing the labour share by instituting a national minimum wage, the United Nations Global Policy Model (GPM) projects a rise in consumption expenditure, which in turn stimulates output and GDP growth.

Brown (2009) cited the OECD published figures, which indicate that since 1990 TFP growth has become the main source of future economic growth. Figure 2-10 illustrates that China has by far the fastest annual rate of TFP growth of around 4%. No other country in history has enjoyed such rapid efficiency gains (Brown, 2009).

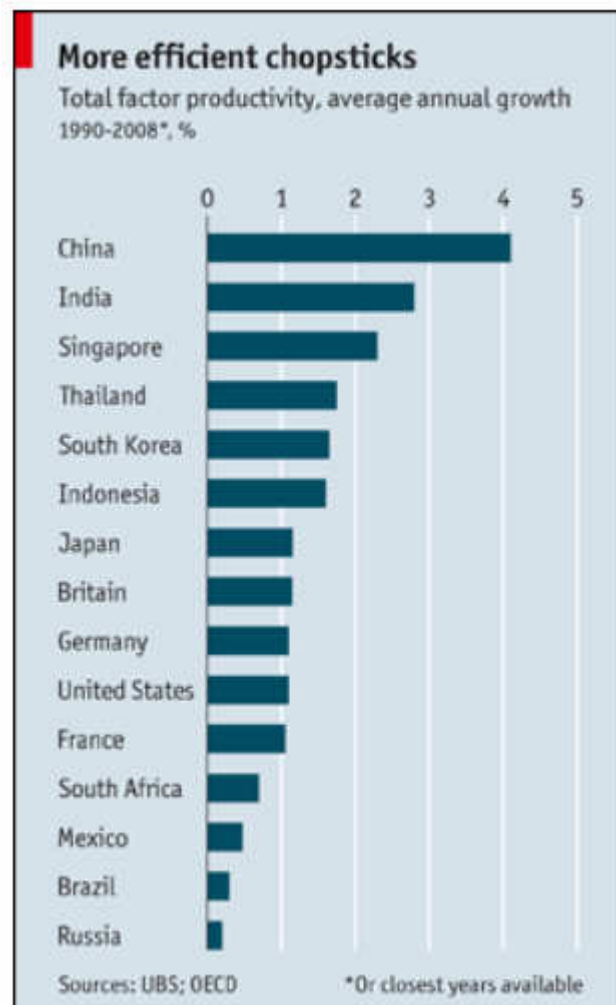


Figure 2-10: Total factor productivity annual growth rate 1990–2008

Source: Brown (2009).

India and other Asian emerging economies also enjoyed faster productivity growth, contributing to the particularly high GDP growth rates of these countries, as illustrated in Figure 2.4. Brown (2009) argues that the most important determinants of long-term productivity growth include:

- the rate of adoption of new technology;
- the pace of domestic scientific innovation; and
- change in the organisation or production.

Various factors influence the above determinants. Examples of these factors are openness of an economy to foreign direct investment and trade, education level and the flexibility of labour markets. Despite the level of China's technology still lagging behind that of the USA, it has seen the fastest rate of improvement over the past decade (Brown, 2009). China's TFP growth is almost

twice as fast as that of Japan and South Korea during their peak periods of economic growth because China started from a low base and is more open to foreign investment than many of these emerging economies.

The financial health of domestic firms and governments also matters for productivity growth as weak balance sheets constrain the availability of capital for new technology and innovation (Brown, 2009). Burger (2015) states that there are three types of productivity-enhancing technologies, namely:

- (Physical) capital-augmenting progress;
- Labour-augmenting progress; and
- Technological progress or TFP, which augments labour and capital together.

If capital and labour are complements instead of substitutes, the augmentation of the productivity of capital through technology causes a higher demand for labour per unit of capital used (Burger 2015). In almost all cases of augmentation, progress that does not result in a decrease in labour share requires specific types of labour skills that complement the new technology.

2.3 THE ROLE OF MINING IN THE SOUTH AFRICAN ECONOMY

Mining in South Africa contributed 7.8% towards the total GDP in 2016 (StatsSA, 2017). This contribution towards the economic growth since 1950 has experienced an upward surge, peaking at 21% in 1980 mainly due to the high gold price, followed by a steady decline from 1987 to single digit contributions for the last three decades, as illustrated in Figure 2-11.

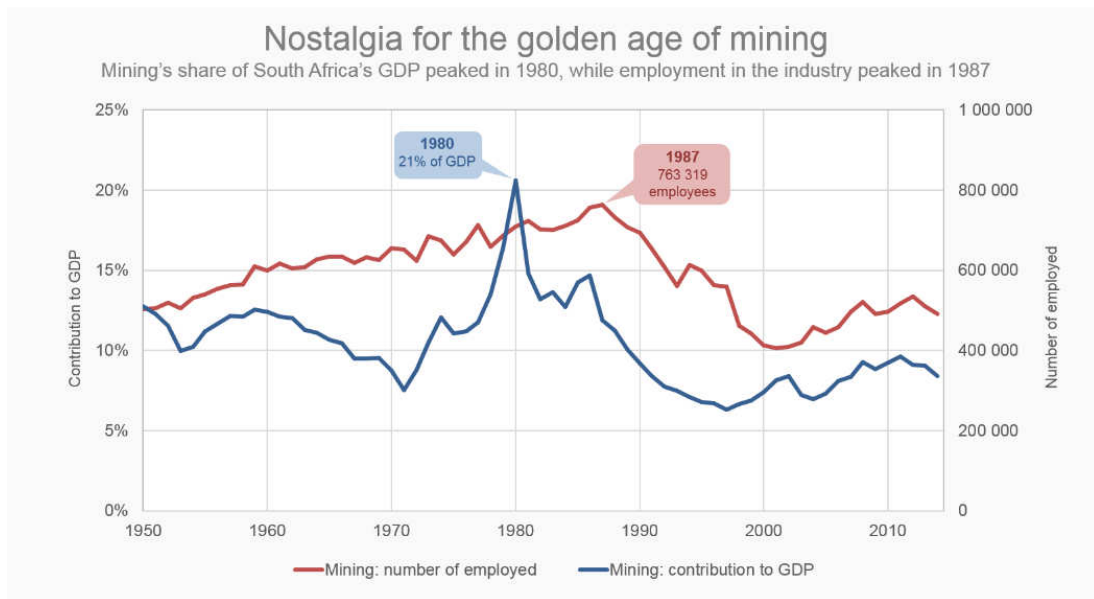


Figure 2-11: Mining industries' contribution towards the country's GDP and employment statistics 1950–2015

Source: StatsSA (2017).

Employment numbers within this industry (Figure 2.11) have a positive correlation to the mining's contribution towards the GDP, emphasising the labour intensity within this industry. The industrial landscape within South Africa has also changed significantly since the golden age of mining in 1980, as illustrated in Figure 2-12.

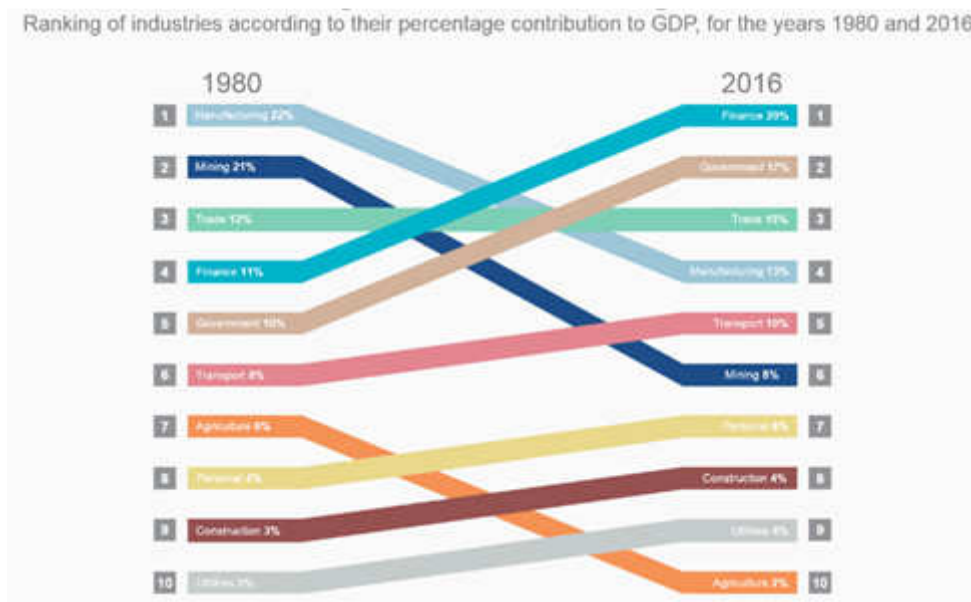


Figure 2-12: The fall of mining and manufacturing in South Africa 1980 versus 2016

Source: StatsSA (2017a).

Mining was the second most influential industry in 1980, falling to sixth place in 2016. As primary and secondary sectors in the economy have waned (StatsSA 2017), tertiary industries have taken centre stage. Finance gained the most ground, rising from fourth place in 1980 to becoming the largest industry in 2016. Despite that mining has lost some of its shine, it is still an important employer, employing an estimated 490 146 individuals (StatsSA, 2017). The platinum group metals (PGM) industry employs the largest workforce (41%) followed by gold (21%) and coal (20%), as illustrated in Figure 2-13.

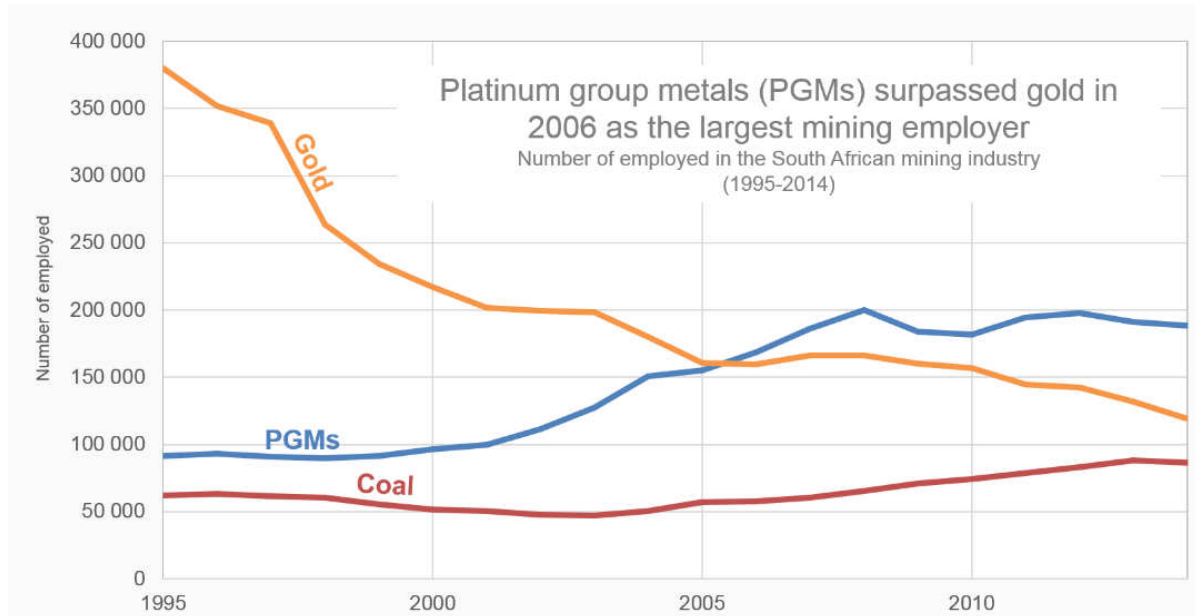


Figure 2-13: Number of employed in the South African mining industry (1995–2014)

Source: StatsSA (2017b).

2.4 THE ROLE OF THE GOLD SECTOR WITHIN THE SOUTH AFRICAN ECONOMY

From historical trends, the once prominent gold industry has lost ground not only in the employment sector but also in the overall economy. Prior to 2007, South Africa held the number one spot as top gold producer in the world (George, 2008). By 2016, South Africa had dropped to seventh place, with China currently as the world's top gold producer (George, 2008), as illustrated in Figure 2-14.

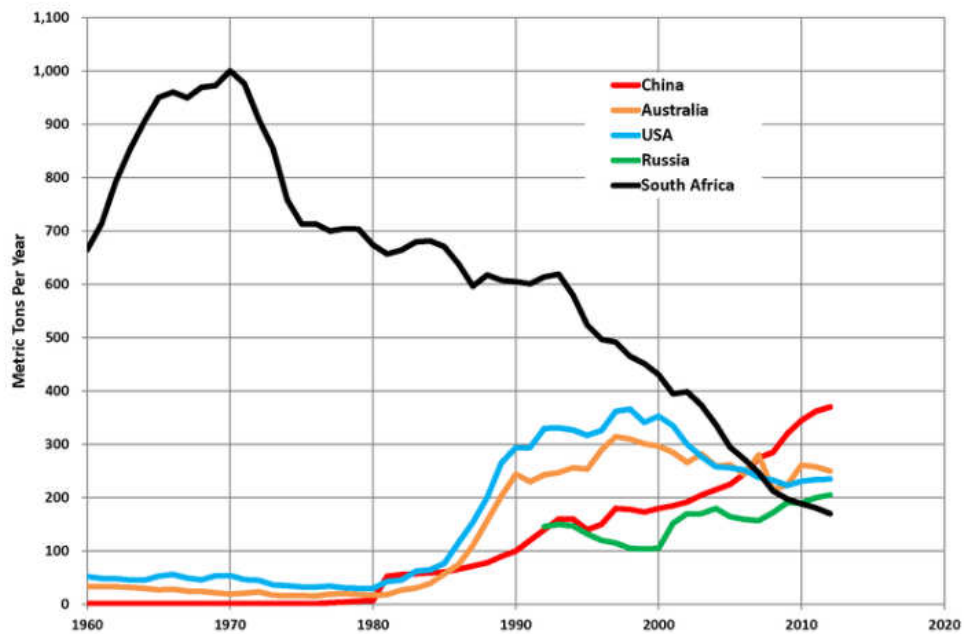


Figure 2-14: Top gold producing countries 1960–2016

Source: Thomsen (2016).

According to StatsSA (2017b), gold production and sales have decreased by 48,5% from 2005 to 2014, yet the sales value has increased by 152,1% (Figure 2-15).

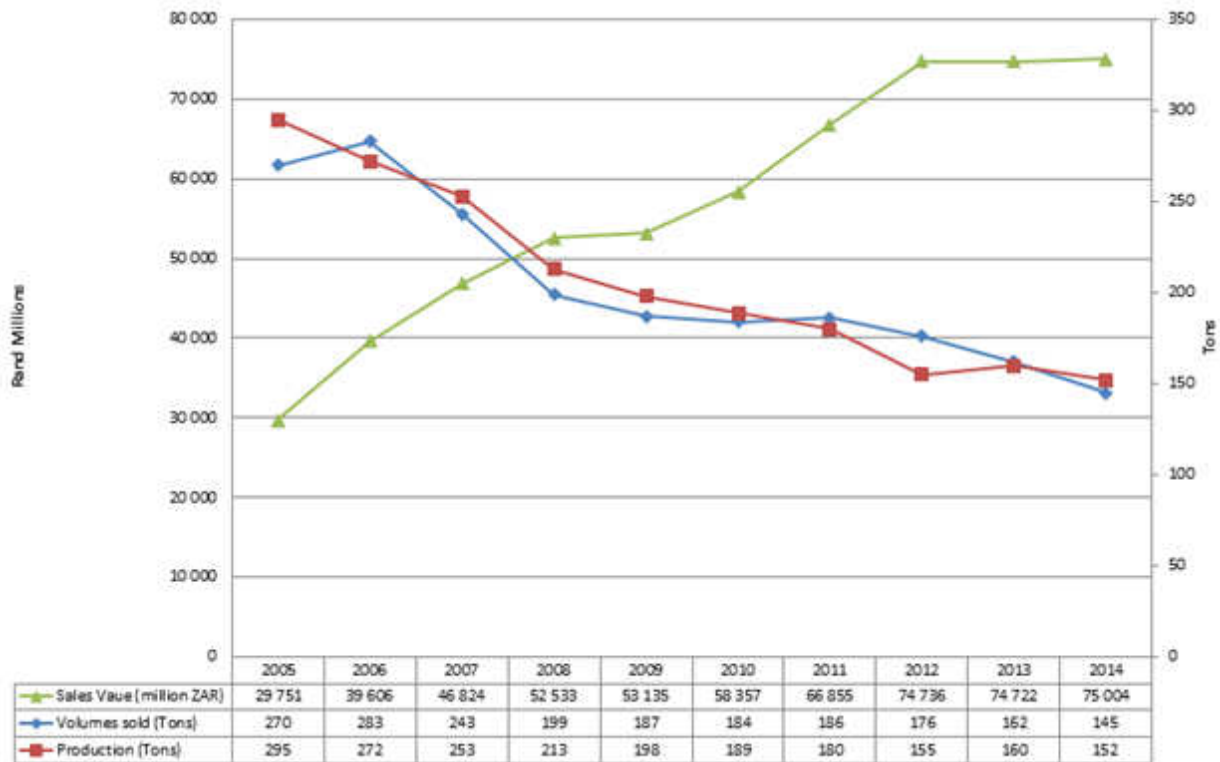


Figure 2-15: South African gold production, sales and sales value 2005–2014

Source: Author adopted from StatsSA (2017b).

Letourneau (2014) argues that despite the fact that South Africa in 1986 produced roughly 64% of the world's gold output, it accounted for little over 6% in 2014. This steady year-on-year decline is mainly contributed to aging mines, no new discoveries being made, deteriorating grades and mines going deeper and deeper into the ground. In addition, labour strikes have plagued the South African mining industry over the past few years, negatively affecting production levels and investor sentiment.

According to Fedderke and Pirouz (2002), the declining importance of gold and uranium mining in the South African economy is not only one of declining importance relative to the two other principal mining sectors (coal, diamond and others) but also one of declining absolute output levels in real terms.

The sales value of this commodity is a function of the exchange rate as well as the gold price. By eliminating the exchange rate from the sales value, a trend emerges that needs to be put in a global perspective. This is due to the fact that South Africa's gold production makes up a small percentage of global output levels. According to Thomsen (2016), the gold price experienced an unprecedented rise since 2001. This is not believed to be as a result of a trend closely related to world gold production since 1900, as illustrated in Figure 2-16.

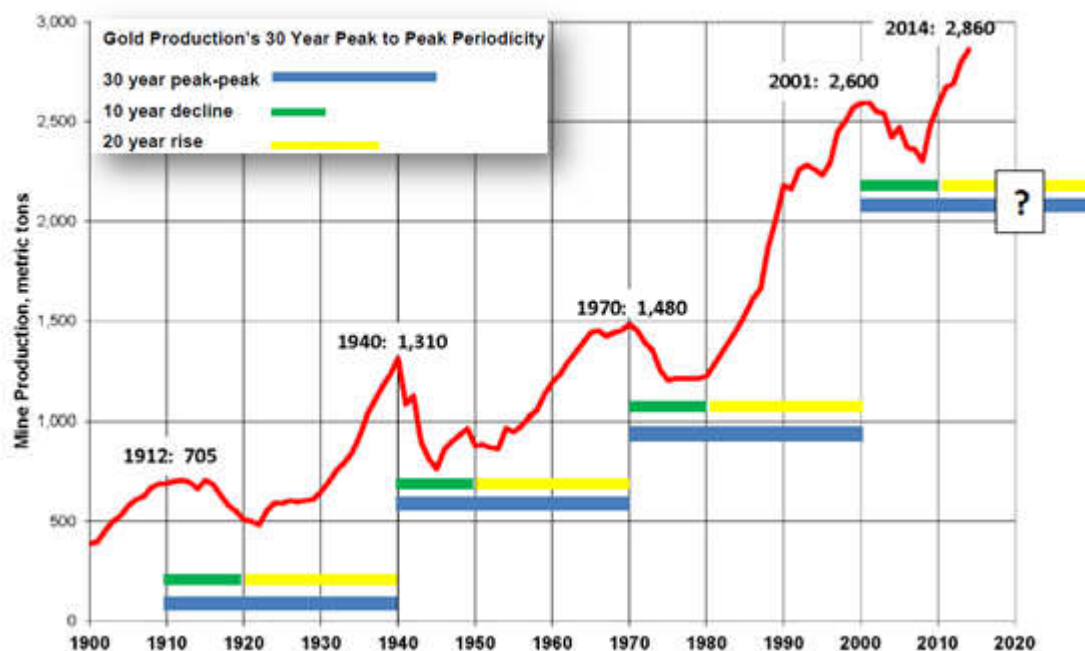


Figure 2-16: Historic world gold production

Source: Thomsen (2016:5).

Thomsen (2016) states that an interesting trend emerges when considering global gold production. Within subsequent 30-year cycles since 1910, a 10-year drop in production is followed by a subsequent 20-year rise. This is mainly as a result of “new” gold from new deposits that have continuously been found, increasing production output. ETF securities (2016) argue that gold is not very responsive to changes in supply and demand but is largely attributable to a number of global economic forces. This is mainly because, unlike other precious metals, gold’s usage is dominated by investment applications where 40% of gold produced each year is used in investments, 50% is used in jewellery and 10% is used in industrial applications.

The U.S. dollar as the world’s foremost reserve currency (ETF securities, 2016) has a tremendous impact on financial markets worldwide and, by extension, on the price of gold. If the U.S. dollar is being debased, the gold price tends to react inversely. Therefore, whenever the value of the U.S. dollar drops, many investors rush to gold as an alternative currency. The gold price and U.S. dollar correlation can be seen in Figure 2-17.

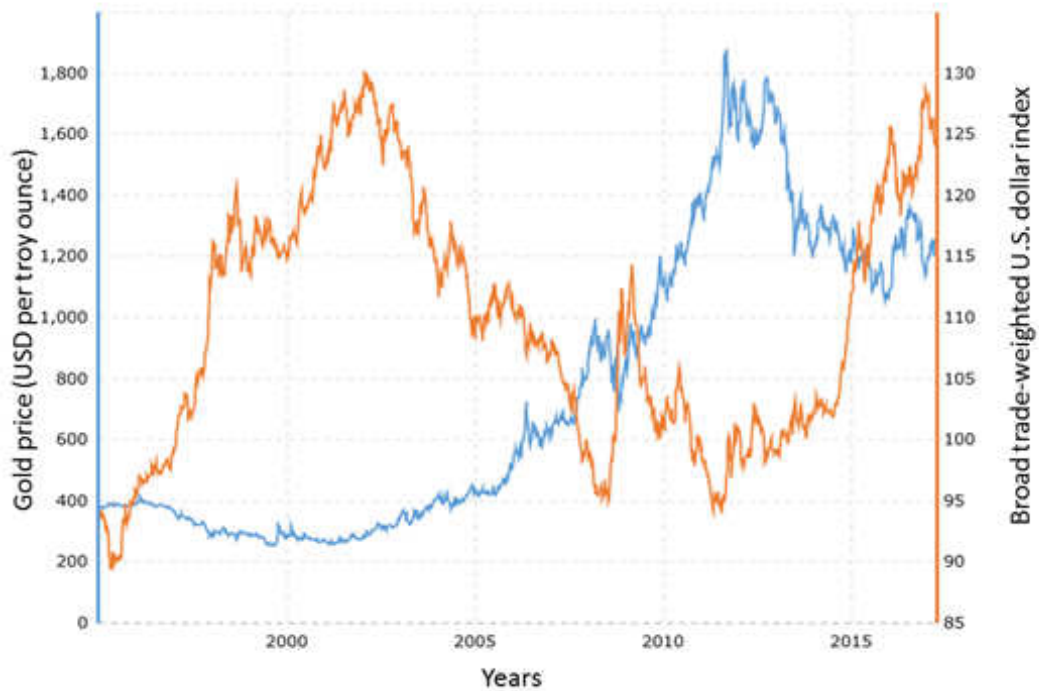


Figure 2-17: Gold price and U.S. dollar correlation

Source: Macrotrends (2017a).

The gold price is much less responsive to the traditional forces of supply and demand, with the most powerful price driver for gold being the trade-weighted dollar that is measured in terms of a basket of 26 foreign currencies. Other price drivers include consumer price index (CPI) inflation, nominal yields on 10-year U.S. treasuries, investors' sentiment and the position in the economic cycle (ETF securities, 2016).

Another interesting fact is that despite that South Africa has been experiencing a terminal decline since the 1970s (see Figure 2-14), StatsSA (2017b) reports an increase in the number of years to depletions since 2005. This trend is illustrated in Figure 2-18.

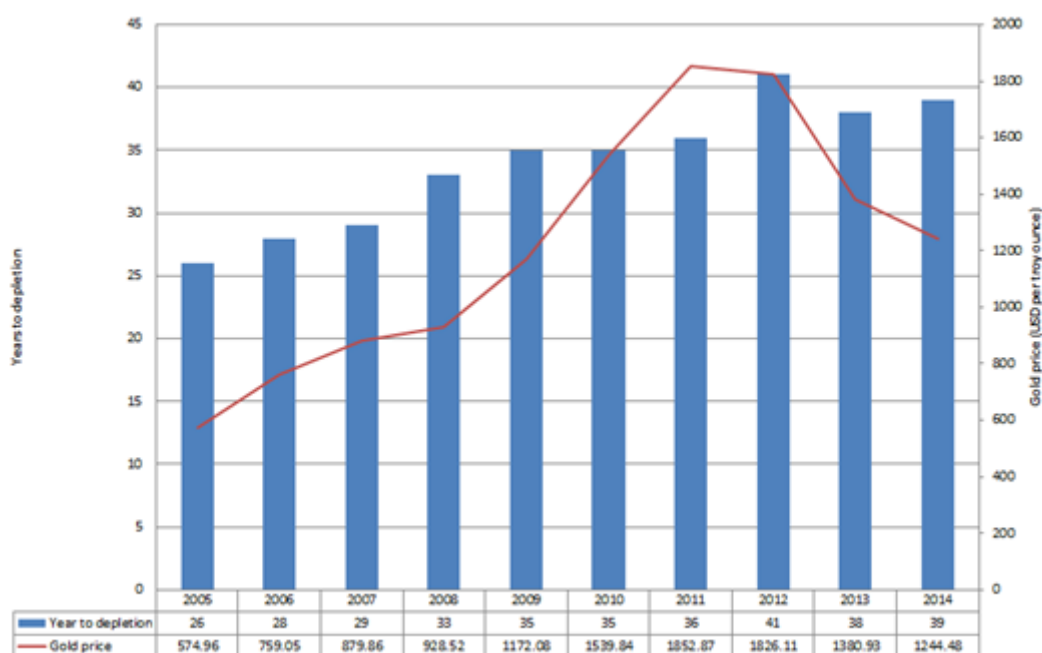


Figure 2-18: Gold resource reserves vs gold price

Source: Author adapted from StatSA (2017b) and Macrotrends (2017b).

Gold reserves fell by 22,8% from 7 772 tonnes in 2005 to 6 000 tonnes in 2014 (StatsSA, 2017b) but years to depletion have increased by more than 50% for the same period. The increase in years to depletion could be as a result of continued lengthening of tail of life of mine estimates, driven by higher commodity prices and putting downward pressure on cut-off grades. Cut-off grade is defined as the minimum grade required for a mineral to be economically mined or processed (Queens University, 2015). This assumption is supported by considering South African gold reserves as a function of volumes produced and comparing it against stated reserves for the same year, as illustrated in Figure 2-19.

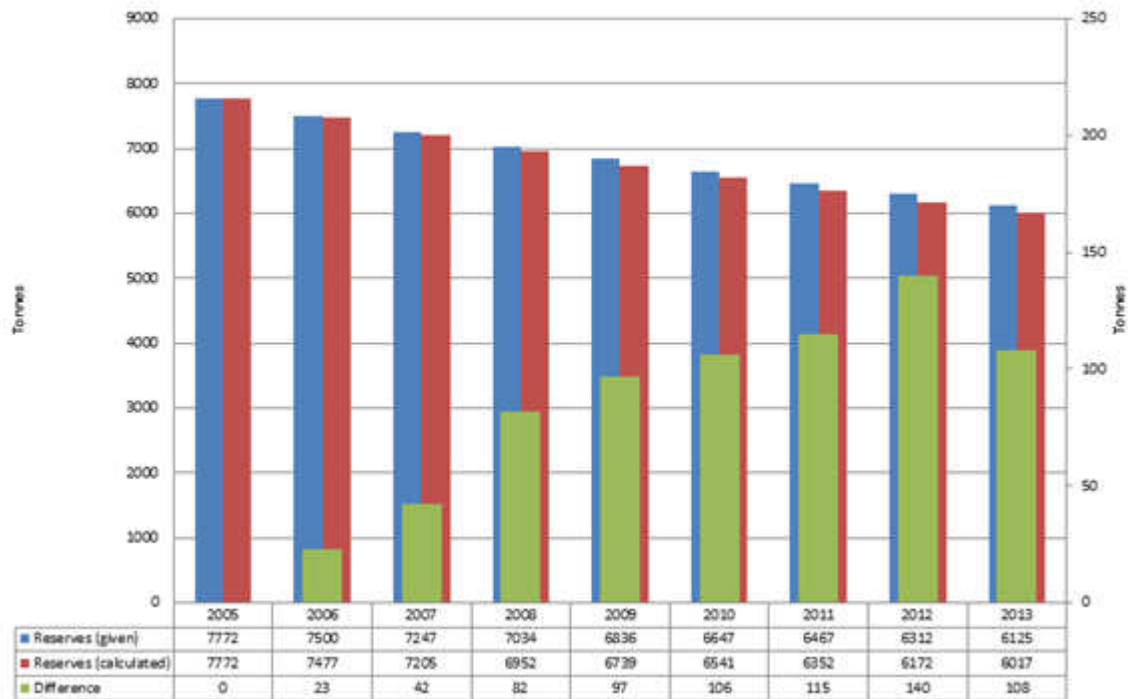


Figure 2-19: South African gold reserve comparison

Source: Author adopted from StatSA (2017b).

The difference between the calculated reserves (based on the 2005 reverse base) and the actual stated reserve follows a similar trend as gold price fluctuation (Figure 2.18). This perceived positive correlation between commodity price fluctuations and reserve base relates to the relationship between these two variables. According to Queens University (2015), the grade tonnage curve is a visual representation of the impact of cut-off grades on mineral reserves, where the curve displays the tonnage above the cut-off grade and relative grade of a desposit relative to cut-off grade, as illustrated in Figure 2-20.

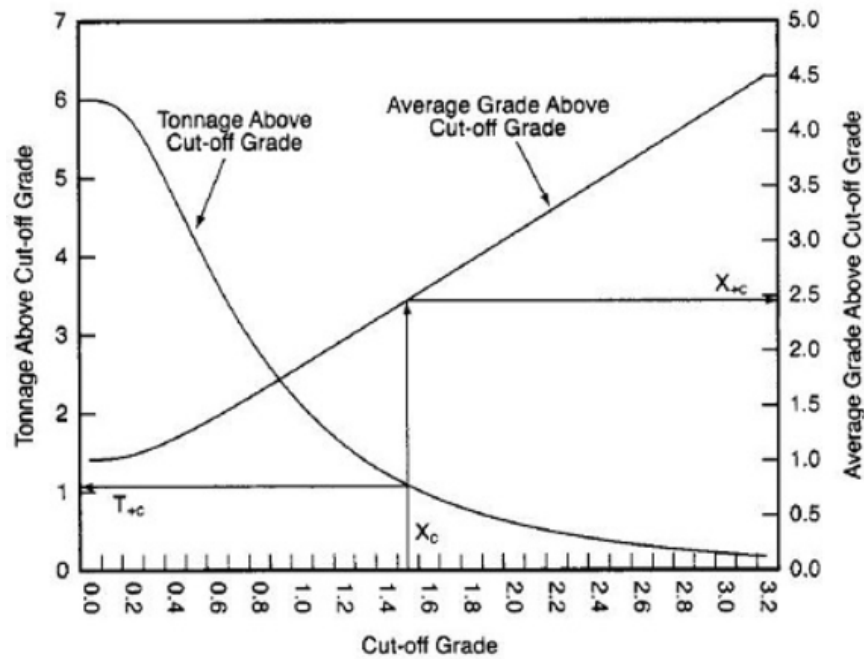


Figure 2-20: Example of a grade tonnage curve

Source: Queens University (2015).

The curve indicates that as the cut-off grade is lowered ($T+c$), the tonnage of the deposit increases. This is because the standard used to distinguish between ore and waste has become less selective, according to Queens University (2015). Another aspect is that as the cut-off grade decreases, so does the average grade of the ore mined. It is therefore not surprising that Neingo and Tholana (2016) state that the average grade of gold mined in South Africa has declined since 2005, as illustrated in Figure 2-21.

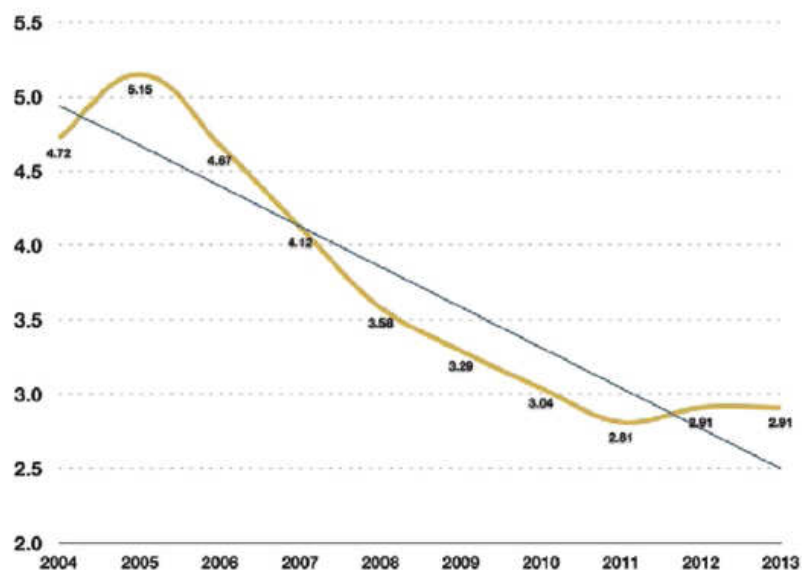


Figure 2-21: South African average gold grades from 2004–2013

Source: Neingo and Tholana (2016).

Fedderke and Pirouz (2002), however, argue that the decline in gold and uranium mining is likely to have been due to structural factors in the sector, rather than changes in the gold price. The structural changes relate to a dramatic change in the two factors of production employed, namely capital and labour. The gold and uranium mining sector experienced a strong upward trend in wage proportion since the mid-1980s that diminished net operating surplus to a small proportion of real output over the last three decades (Fedderke & Pirouz, 2002). The increased bargaining power of labour in this mining sector and the related real cost increases in labour should serve as an indicator of likely explanations in employment trends in the sector (Figure 2-13). This suggests that the South African gold mining sector has been subject to a strong change in the distribution of net value added between capital and labour that presents mining as a maturing sector in transition.

2.5 THE ROLE OF THE PLATINUM SECTOR WITHIN THE SOUTH AFRICAN ECONOMY

According to Johnson Matthey (2016a), the demand for platinum group metals is divided into four main categories, which include auto-catalyst, jewellery, industrial applications and investment. The average gross platinum demand for the last six years has been dominated by the autocatalytic convertors and the jewellery market, as illustrated in Figure 2-22.

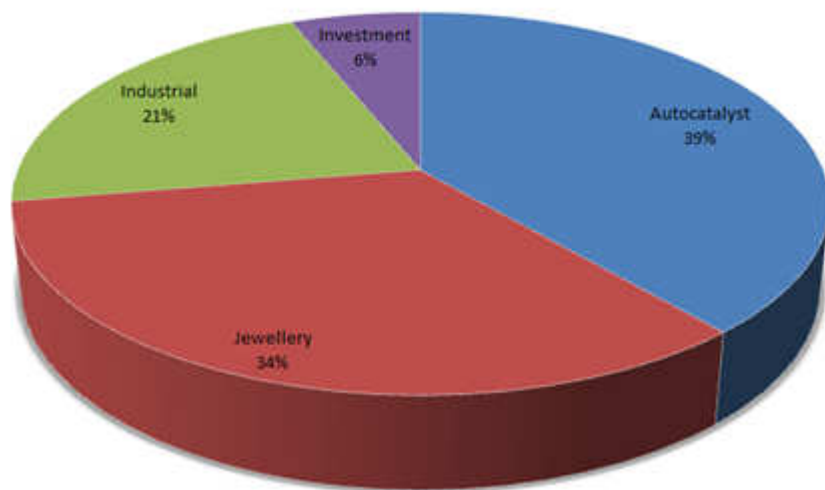


Figure 2-22: Total gross demand for platinum 2011–2016

Source: Author adapted from Johnson Matthey (2016a:42)

Each of the four sources of demand has regional contributors that dominate the individual market segments. European vehicle manufacturers and users of catalytic converters contribute to almost half of the world's demand in this segment, while the Chinese jewellery market makes up 66% of world's platinum jewellery market (Figure 2-23).

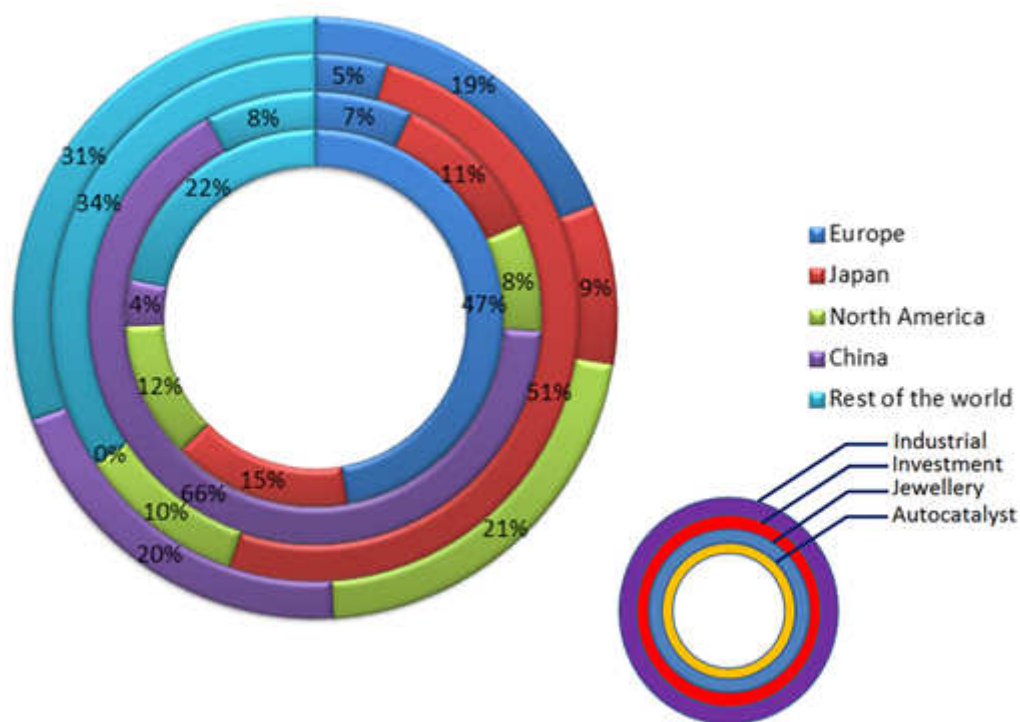


Figure 2-23: Total gross demand for platinum by region 2011–2016

Source: Author adapted from Johnson Matthey (2016a:45).

The investment opportunity in the purchasing of platinum bars is dominated by Japan, while the use of platinum in the chemical, electrical, glass, medical and biomedical as well as the petroleum industry is more evenly distributed. North America and China still contribute collectively to about 41% of the world's platinum demand in industrial applications.

The supply of platinum, according to Johnson Matthey (2016a), is driven by primary platinum producers. South Africa is by far the biggest contributor, producing 71% of the world's platinum and being a secondary supplier of platinum through recycling. Recycling is mainly within the autocatalyst industry and to a lesser extent within the jewellery and electrical industry, which contributes to about a quarter of the world's demand of this precious metal. Considering both primary and secondary suppliers of platinum, as illustrated in Figure 2-24, recycling as well as platinum mined within the borders of South Africa account for more than 80% of the world's supply.

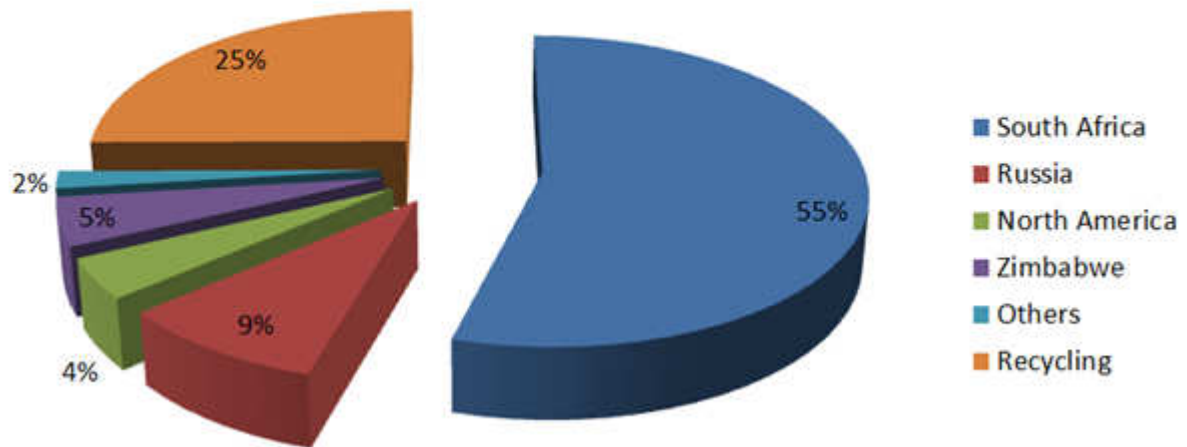


Figure 2-24: Total supply of platinum

Source: Author adapted from Johnson Matthey (2016a:44).

According to Steinitz (2008), a clear correlation exists between the size of the supply surplus or deficit and the price of the commodity for the last three decades up until 2008. This correlation, given in Figure 2-25, clearly illustrates that a cumulative deficit influences the platinum price positively.

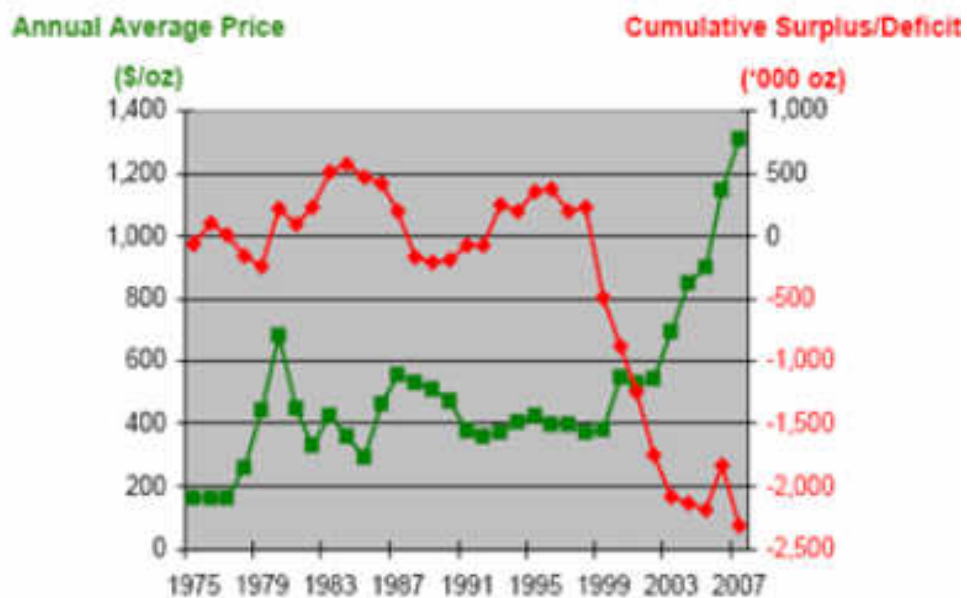


Figure 2-25: Platinum price correlation 1975 to 2008

Source: Steinitz (2008).

However, the supply/demand balance has become less dominating in the last decade, as illustrated in Figure 2-26. Within the period from 2010 to 2014, the correlation between the supply/demand balance and price was the exact opposite from the previous three decades, where the price decreased as a result of a supply deficit. The positive correlation between a cumulative deficit and price increase trend (similar to the period of 1975–2008) emerges again from 2015 but at a lower price base than in the 2006–2010 period.

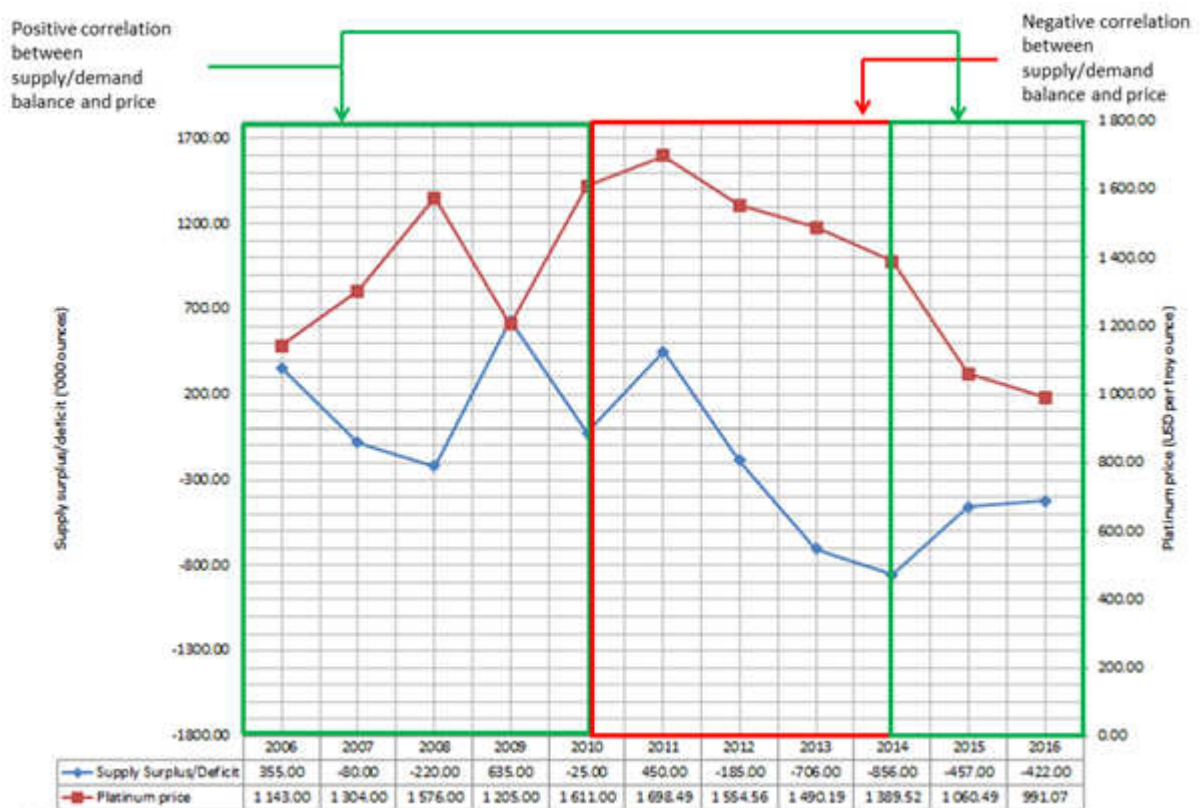


Figure 2-26: Platinum price correlation 2006–2016

Source: Author adapted from Jonson Matthey (2016a:1), Johnson Matthey (2012:56) and Johnson Matthey (2016b).

According to Harvey (2016), the platinum price decline over the last four years (2013–2016) was mainly due to an estimated above-ground stockpile of 4 million refined ounces that have subsequently been depleted to 2.18 million ounces in 2016. Harvey (2016) argues that the continued selling of these stocks is less likely to occur, as owners of these stocks have probably brought them closer to market value. The phenomenon of above-ground stockpiling of PGMs, according to StatsSA (2017b), is evident in the sales volume figures compared to the primary production figures of South African platinum mines given in Figure 2-27.

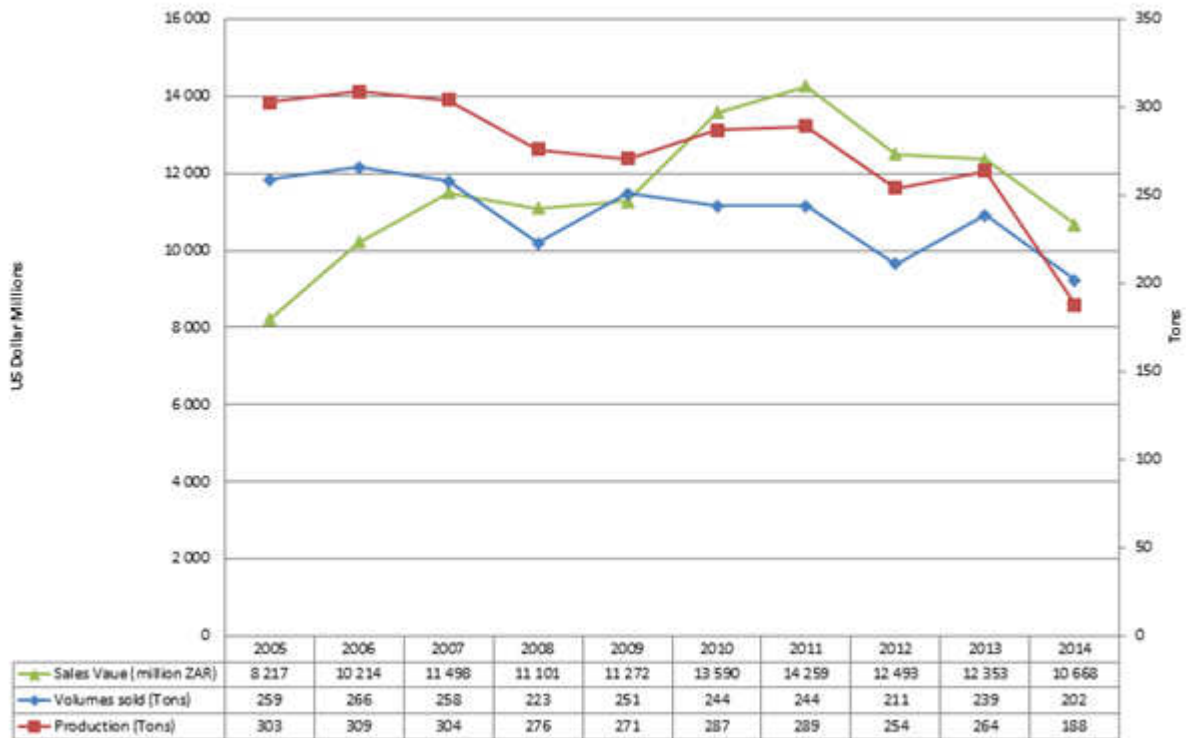


Figure 2-27: South African PGM production, sales and sales value 2005–2014

Source: Author adapted from StatsSA (2017b:20,22).

It is clear from the figures presented by StatsSA (2017b) that production of PGMs within South African mines, which is the world's biggest primary supplier of these precious metals, outperformed sales from 2005 to 2014. An estimated 365 tonnes (12,8 million ounces) of PGMs (not only platinum but all other precious metals found in the PGM basket) have been accumulated from 2005 to 2013.

It is only since 2014 that PGM sales outperformed production within South Africa. This revealed that the platinum industry has accumulated platinum stocks over a number of years, which has subsequently put downward pressure on the prices of these precious metals. The stockpiling of platinum, in particular, could have been as a result of a perception that the demand for this precious metal would increase at a far greater pace than what actually has been attained in the last decade. Contrary to this perception, Johnson Matthey (2016a) states that the demand for platinum has been relatively flat with an incremental increase during the last eleven years, as illustrated in Figure 2-28.

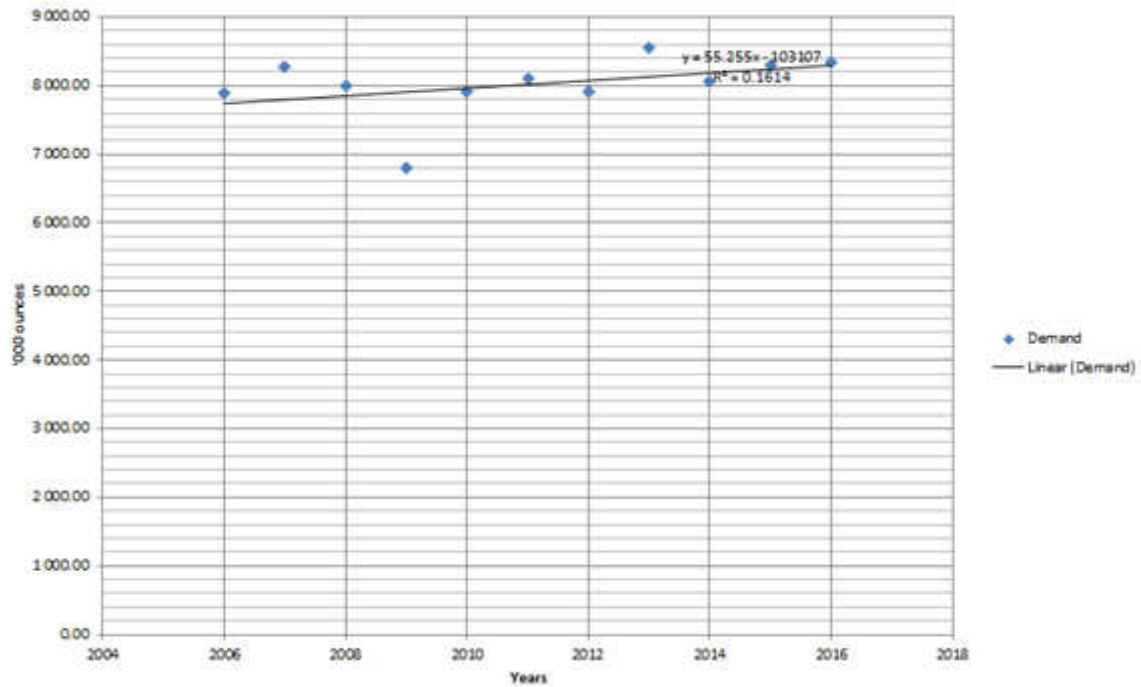


Figure 2-28: Total global platinum demand

Source: Author adapted from Johnson Matthey (2016a:40) and Johnson Matthey (2012:55).

2.6 THE COMPETITIVENESS OF THE SOUTH AFRICAN MINING INDUSTRY

According to Department of Research and Information (2016), the outlook for platinum and gold in the medium term is more positive. Expectations are that conditions will improve gradually over the next three years, as illustrated in Figure 2-29.

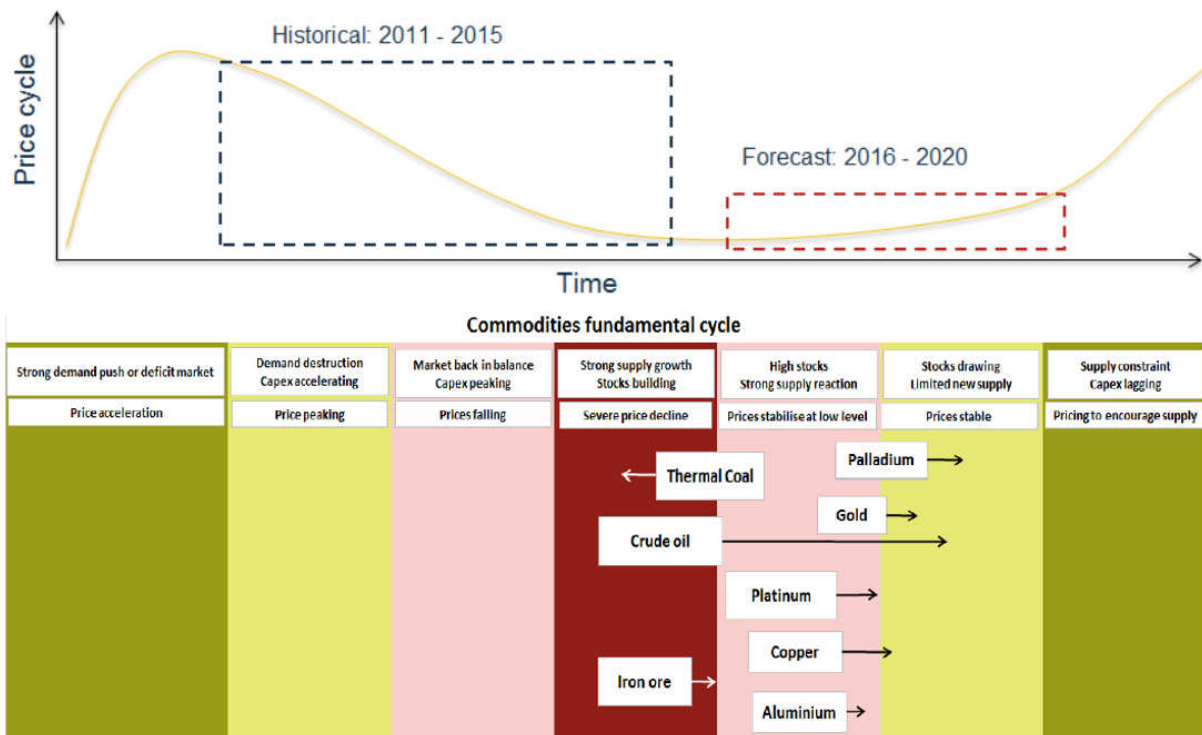


Figure 2-29: Long-term commodity cycle and current and expected positioning of various commodities

Source: Department of Research and Information (2016:5).

Despite that gold prices are expected to increase in the medium term (Figure 2.29), Fedderke and Pirouz (2002) argue that the associated decrease in the share of value-added produced attached to equity explains the declining propensity in the gold sector and the increased importance of efficiency improvements in the output growth of the mining sector. Time series (co-integration) data analysis confirms that employment losses in the mining sector are substantially attributable to rising real wage costs (Fedderke & Pirouz, 2002).

To understand why the competitiveness of the South African gold industry has declined over half a century, one needs to understand why South Africa had a competitive advantage in the first place. According to Malherbe (1950), the Witwatersrand mining industry has overshadowed all other mining activities in the country and the mining industry as a whole has been dominated by the production of gold in the 1950s. At the time (1950), the gold industry produced an exportable product with a fixed price. The major advantage was that mines were never faced with the fear of bankruptcy through the selling policy of a competitor. The removal of this risk, according to Malherbe (1950), goes a long way towards establishing a stable investment. This advantage coupled to relatively cheap labour and electricity cost as well as an abundance of high-grade ore

reserves provided the basis of one of the most reliable of all mining investments in the world in 1950 (Malherbe, 1950).

According to ICMM (2016), the industry recognises that a finite and depletable resource cannot deliver a sustainable long-term development on its own. However, the exploitation of that resource over several decades can provide various stimuli to processes that can deliver such development. This concept is echoed by Malherbe (1950), who states that despite secondary industries that are expanding, there is no doubt that their expansion is to a large extent due to the impetus given directly or indirectly to mining. The fundamental idea of the extractives sector which acts as a bridging activity to sustainable long-term development is questioned by Malherbe (1950), who asks whether secondary industries that were fostered by mining are strong enough to be self-supporting or even to expand to compensate for a decreasing mining output.

According to ICMM (2016), no reliable or comparable data are produced for all countries, but data exist that mining typically contributes only around 1 to 2% of total employment of a country. However, when indirect and induced employment is included, this can jump to 3–15%. This multiplier effect of the industry and in particular within the South African context is illustrated by Baxter (2015) in Figure 2-30.

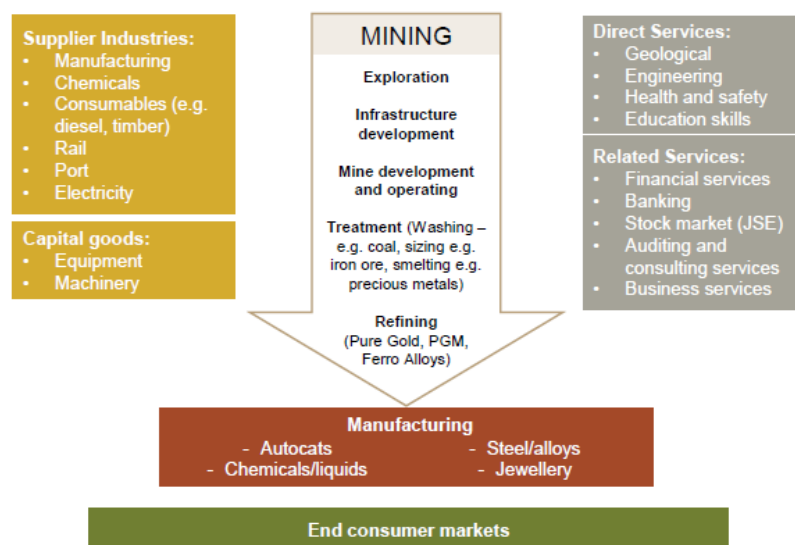


Figure 2-30: The indirect and induced employment opportunities that the South African mining industry creates

Source: Baxter (2015:29).

Figure 2-30 illustrates how the mining sector can assist its host country to reach higher and more sustainable levels of income and long-term development through the development and

stimulation of secondary industries. ICMM (2016) continues by stating that the specific properties of mineral in general continue to give them a central role in everyday life and economic life, as illustrated in Figure 2-31.

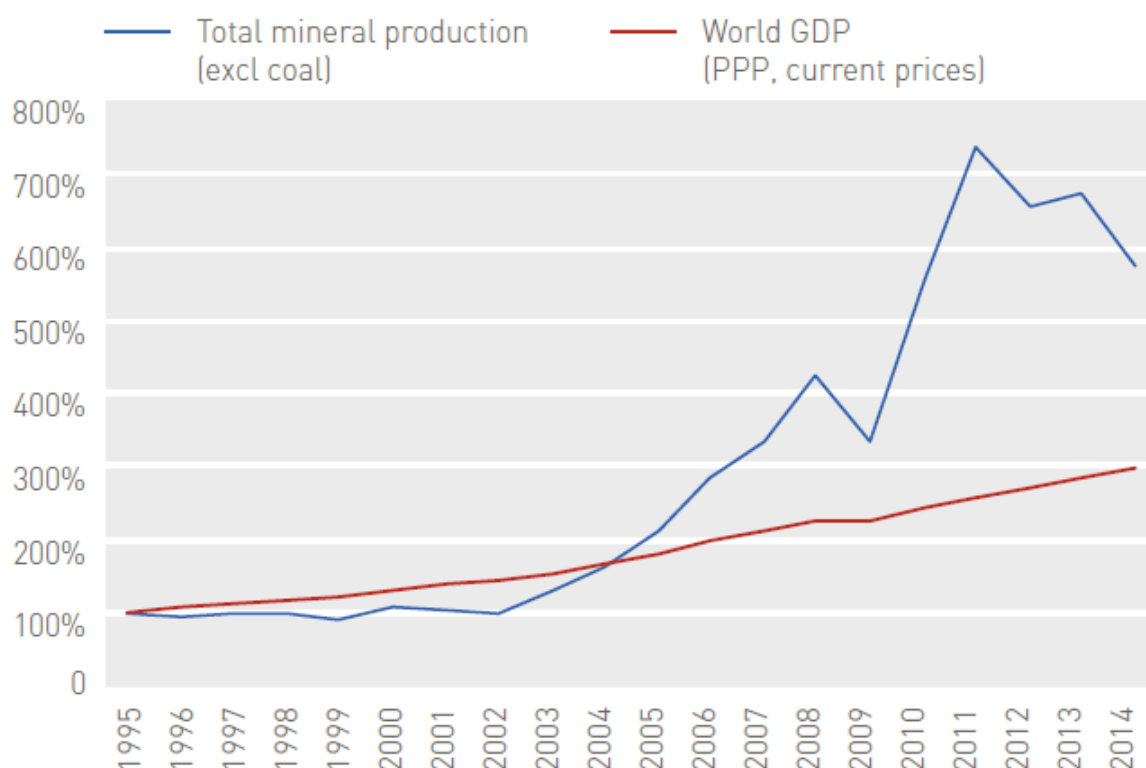


Figure 2-31: World GDP and total mineral production – 1995 to 2014 (1995=100)

Source: ICMM (2016:11).

According to ICMM (2016), studies have consistently demonstrated that when per capita income reaches 5 000 to 10 000 USD per year, metal demand increases particularly quickly. When populous countries such as China and India go through this development phase, the effects are dramatic. Additionally, any slacking of demand growth from China could possibly be taken up by more rapid growth of demand from India or other Asian and African economies approaching the critical per capita income level. ICMM (2016) argues that because mineral and metal usage remains very low for a large share of the world's total population, it is reasonable to assume that continued high rates of growth for a subset of the world's poorest countries could be an ongoing stimulus to sustain significant growth in mineral and metals demand for many years to come. The ICMM (2016) found that the macroeconomic contributions made by the mining sector form an inverted pyramid, as illustrated in Figure 2-32, in low- and middle-income countries.

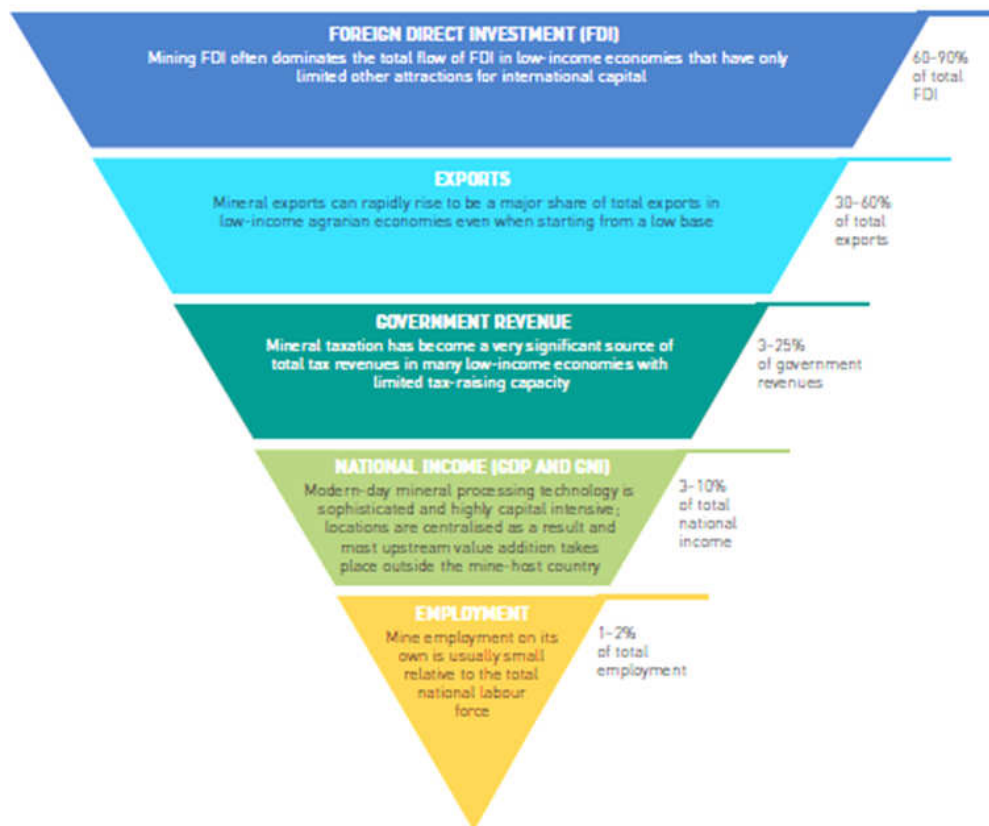


Figure 2-32: Macro-level contributions in low- and middle-income countries

Source: ICMM (2016:33).

Within this context, Baxter (2015) argues that South Africa's inverse pyramid is skewed (Figure 2-33). In considering the individual contributors, South Africa falls outside the average contributions when compared to its global peers. According to the author, two contributions are identified as possible challenges. These include the particularly low level of foreign direct investment when compared to other countries within this category as well as a relatively high level of direct employment.

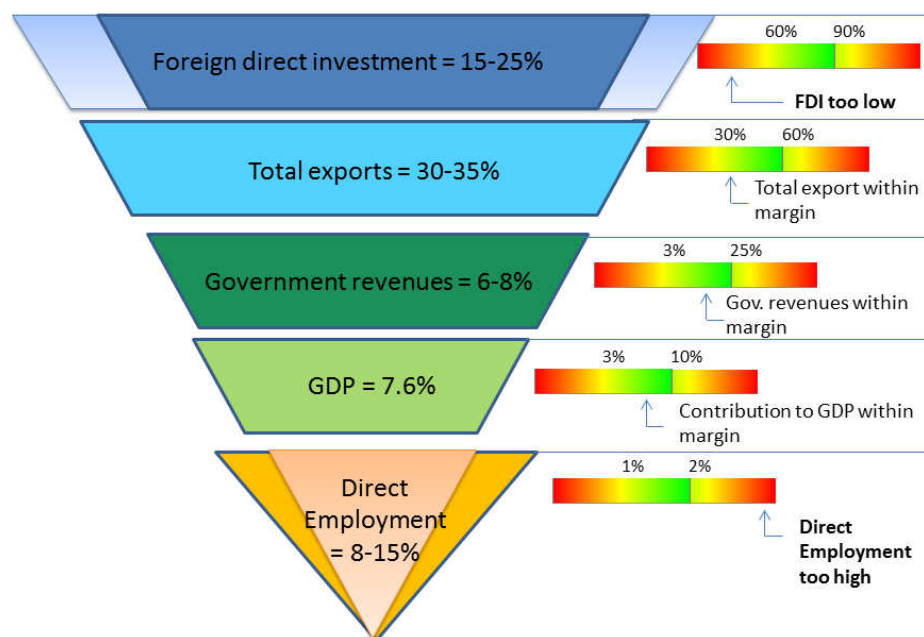


Figure 2-33: Macro-level contributions in South Africa for 2016

Source: Author adapted from Baxter (2015:18).

The overall cost-competitiveness of South African mines is under pressure, where CIMM (2016) indicates that compared to the average total cost of gold at around USD 670/oz in 2015, South African mines, according to Baxter (2015), falls within the third quartile on the cost curve (Figure 2-34).

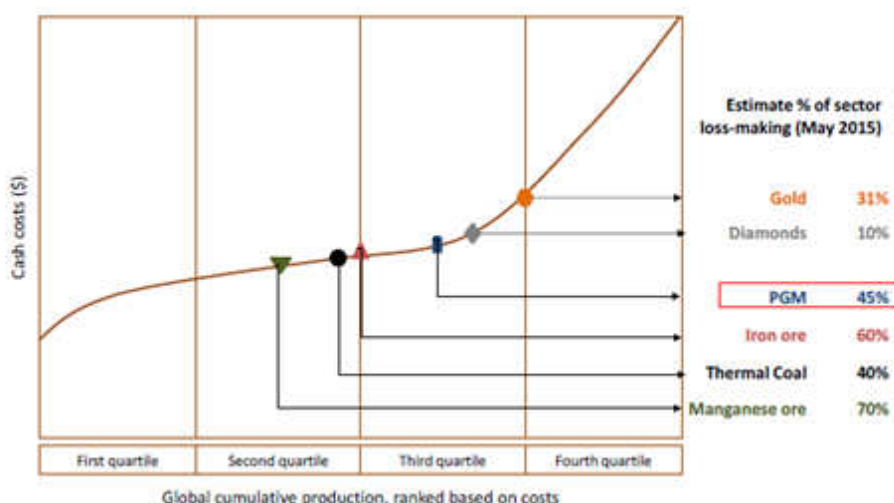


Figure 2-34: Illustrative SA commodity mining cost curve

Source: Baxter (2015:25).

Baxter (2015) also indicates that platinum mining falls within the same quartile, having only a marginal cost advantage over its gold mining partner. The major contributors that drive these excessively high total costs are comparatively high labour costs as well as above inflation increases in electricity costs, as seen in Figure 2-35.

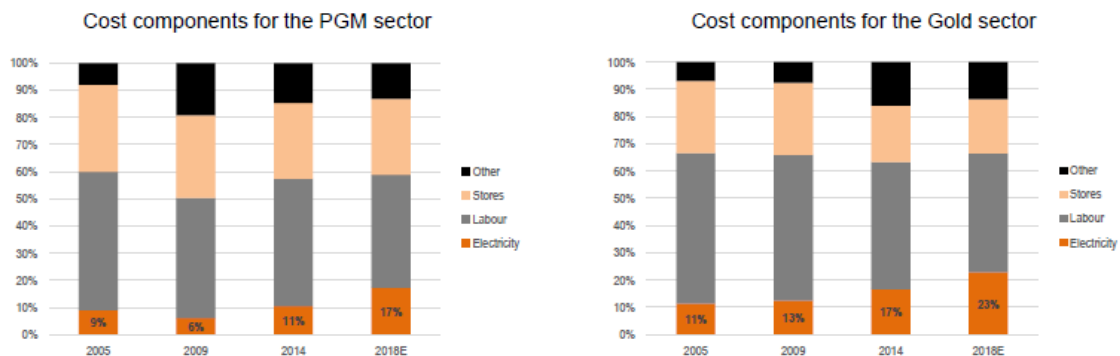


Figure 2-35: Cost components of the South African gold and PGM mining sector from 2005 to 2018

Source: Baxter (2015:24).

Due to South African gold and platinum producers' inability to transform its operations to more cost-effective operations, these operations are no longer seen as attractive investment opportunities. As a result, the country's ability to attract and retain foreign direct investment is negatively affected. Baxter (2016a) indicates that in a survey conducted on the South African mining industry, the overall operational effectiveness of the industry (net profit margin) has deteriorated since 2010, reaching negative returns in 2014 and 2015 (Figure 2-36).



Figure 2-36: RSA mining industry, loss-making in 2014/15

Source: Baxter (2016a:31).

As a consequence, major job losses within the mining sector were recorded within this period, presumably in an attempt to curb the decrease in operational activity effectiveness, as illustrated in Figure 2-36. The sectors most severely affected were the gold and platinum miners. This is illustrated in Figure 2-37.

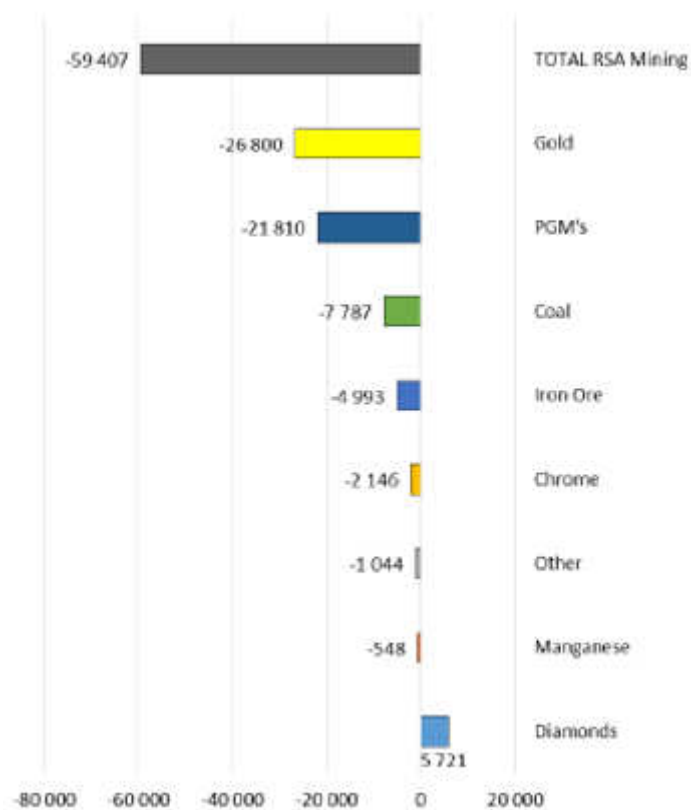


Figure 2-37: RSA job losses in mining from January 2012 to December 2015

Source: Baxter (2016b:32).

These job losses sparked a number of events, which included a wildcat strike by Lonmin mine workers over wages in the Marikana area. The resultant confrontation between miners and police led to the killing of at least 47 miners. According to Cavvadas and Mitchell (2012), the tragic events at Marikana attracted international attention in the media and in the investor community, with some suggesting that the incident was evidence of a South African mining industry in serious decline. To make matters worse, the immediate reactions to the strike have included suggestions of the need for mass retrenchments, closure of shafts and more mechanisation. Within the context of this study, a more in-depth look into mechanisation is pursued.

2.7 MECHANISATION AS A POSSIBLE SOLUTION TO THE DECLINING SA MINING INDUSTRY

According to Deloitte (2017), miners who are willing to seize the opportunity to transform themselves will have to make culture shifts to successfully execute a winning strategy in today's ever-changing market environment. This involves, amongst other things, understanding the drivers of shareholder value, unlocking productivity improvements, collaboration and unorthodox partnerships that will drive the industry forward, and moving from compliance to a potential source of competitive advantage. Regarding the gold and platinum mining environment, Baxter (2016b) states that South African miners need to make a paradigm shift from the current conventional mining methods to a modernised extraction strategy, as illustrated in Figure 2-38.

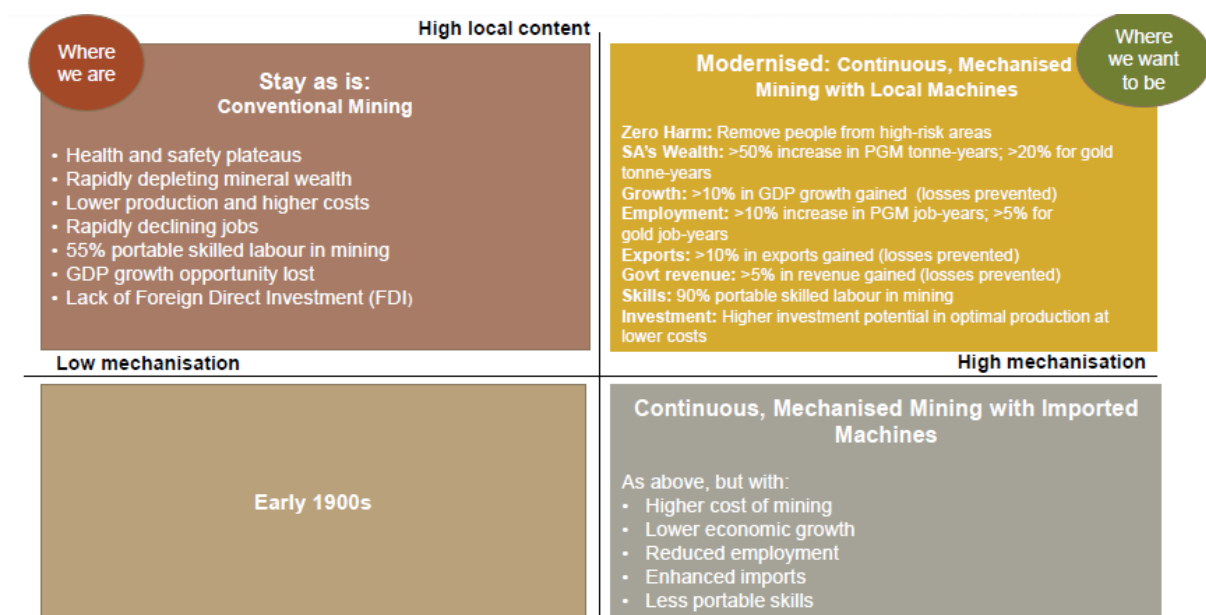


Figure 2-38: Modernisation – possible future scenarios in 20 years' time

Source: Baxter (2016b:46).

The current conventional mining extraction strategy is plagued with health and safety concerns, particularly within the gold and platinum industry. Due to the unique narrow tabular orebodies associated with these precious metals, South African miners adopted a mining extraction strategy that involves placing mine employees within the working areas, making use of labour-intensive mining practices to extract the ore within a geological, environmental and safety challenging environment. Due to the high reliance on manual labour associated with this mining method, safety and health concerns as well as productivity challenges remain high on the agenda. Baxter (2016b) believes that modernising these mines by implementing new technologies would not only remove employees from high risk areas but would also ensure optimal production at a lower cost,

thereby increasing investment opportunities in the nation's assets. Baxter (2016a) continues in claiming that South Africa holds some of the best mineral resources (gold and platinum deposits) in the world, as illustrated in Figure 2-39. Implementing technology in the form of mechanisation would ensure the profitable extraction of these resources.

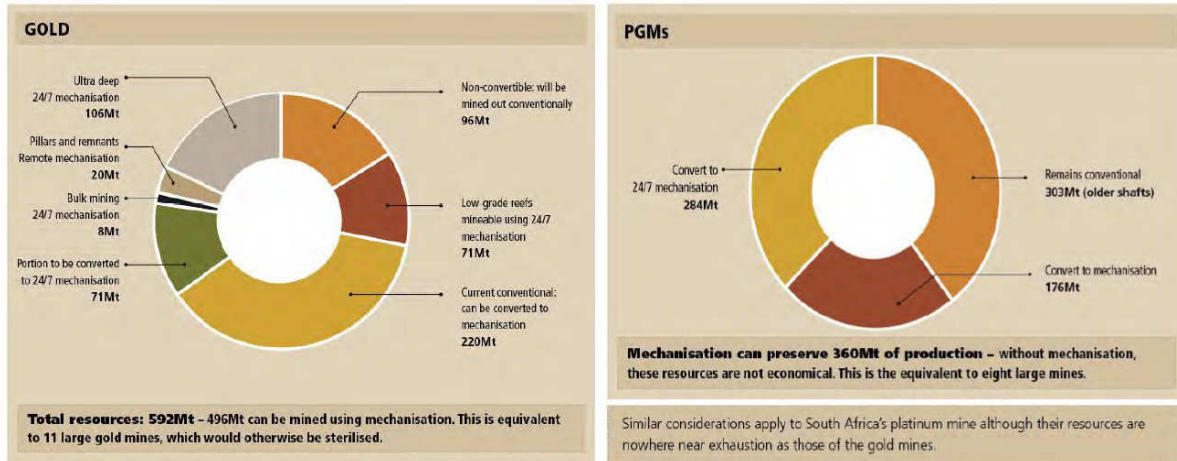


Figure 2-39: Mechanisation opportunities within the South African gold and platinum industry

Source: Baxter (2016a:17).

According to Baxter (2016a), more than 83% of the remaining 592 million tonnes of gold-bearing ore can be extracted by a more modernised ore extraction strategy that would have otherwise been sterilised. Almost half (47%) of the current 763 million tonnes of PGM bearing ore can be extracted by means of mechanisation that is currently uneconomical to be extracted by the conventional approach. Figure 2-40 gives key enablers of achieving the transformation of the current platinum and gold industry, according to Baxter (2016b).

Mineral	Opportunities	Key Enablers	Risks
1.PGM's	<ul style="list-style-type: none"> • Recovery in global market (EU, USA and China) • Rising emission and environmental standards • Rising investment and jewellery demand • Development and adoption of new technologies 	<ul style="list-style-type: none"> • Investment (capital) • Smart tape • Cost efficiency, improving productivity • Stable labour relations • Cost effective, efficient , reliable & available energy • Collaborative approach to market development 	<ul style="list-style-type: none"> • Market demand (global recovery) • Replacement technology • Policy and regulatory uncertainty • Labour instability (platinum belt) • RSA seen as an unreliable supplier to global market
1.1 PGM potential: Grow production to >322 tonnes by 2020 (2015: 275 tonnes) and stabilise employment at about 180 000 (2015: 180 000)			
2.Gold	<ul style="list-style-type: none"> • Remains key global reserve asset • Likely to be growth in fabrication demand after 10 years of decline • RSA still has significant reserves and resources 	<ul style="list-style-type: none"> • Investment (capital) • Smart tape • Cost efficiency, improving productivity • Stable labour relations • Cost effective energy • Team approach to resolving challenges • Progress on technology 	<ul style="list-style-type: none"> • Fall in gold price • High costs of domestic production • Depth of mining • Uncertainty • Labour instability
2.1 Gold potential, slow down rate of decline in production to a 2% decline per annum (from current 8% p.a.). Production declines to 127 tonnes (2015: 140 tonnes) and employment falls more moderately to 90 000 workers (2015: 115 000)			

Figure 2-40: Potential of precious metals

Source: Baxter (2016b:14).

According to Baxter (2016b), cost-efficiency and improving productivity remains one of the key enablers to slow down the decline in gold production to 2% per annum, as well as growing production within the PGM industry. These productivity and cost-efficiency improvements require a shift in focus, where mines become serial innovators (Deloitte, 2017) and where innovation is defined as the creation of a new, viable business offering. Baxter (2016a) argues that solutions to improving productivity and reducing costs reside within the mechanised realm of mining, as illustrated in Figure 2-41.

	PGMs	Gold
Mechanised mining system	Research is required to integrate tested equipment into a working system and to provide real-time monitoring and control. Thereafter, technology transfer is imperative.	A number of components (such as rock handling and support) need to be researched and developed. Certain learnings can be taken from PGMs.
Application	Allows safer, healthier and more productive mining of current reefs, which otherwise become economically sterilised.	
	PGMs	Gold
	Rock is extremely hard and the geology is complex.	Rock is even harder than PGM-bearing rock, and rock stress is very high, given depths of more than 4km.
24/7 mechanised mining system	Continuous mining machines that cost effectively cut the ore with reduced dilution have not been developed. Rock is extremely hard and the geology is complex. This requires globally leading R&D.	
Application	Allows the PGM industry to mine extensive, deeper orebodies in order to be more productive and thus help sustain the industry.	Allows exploitation of lower-grade reefs as well as deep high-grade reefs and high-grade pillar recovery.

Figure 2-41: Possible solutions to improve productivity and reduce cost within the gold and platinum sector

Source: Baxter (2016a:39).

A mechanised mining system allows for a safer, healthier and more productive mining method but due to the complexity of the orebodies, extensive research and development is required to realise the potential of this mining method (Baxter, 2016a). Continuous mining machines that cost-effectively cut the ore in a 24/7 mechanised mining system as opposed to making use of the current drill and blast methods would allow sustaining the PGM industry to mining extensively deeper orebodies. The same method could be employed to extract lower-grade gold deposits and deep high-grade reefs. The associated rock formation is, however, very hard and geology-complex (Baxter, 2016a), therefore requiring extensive research and development.

In seeking alternative innovative solutions, Baxter (2016b) states that a collaborative approach is required to not only stabilise labour relations within the industry but also to create a strategic framework for modernisation, as given in Figure 2-42.

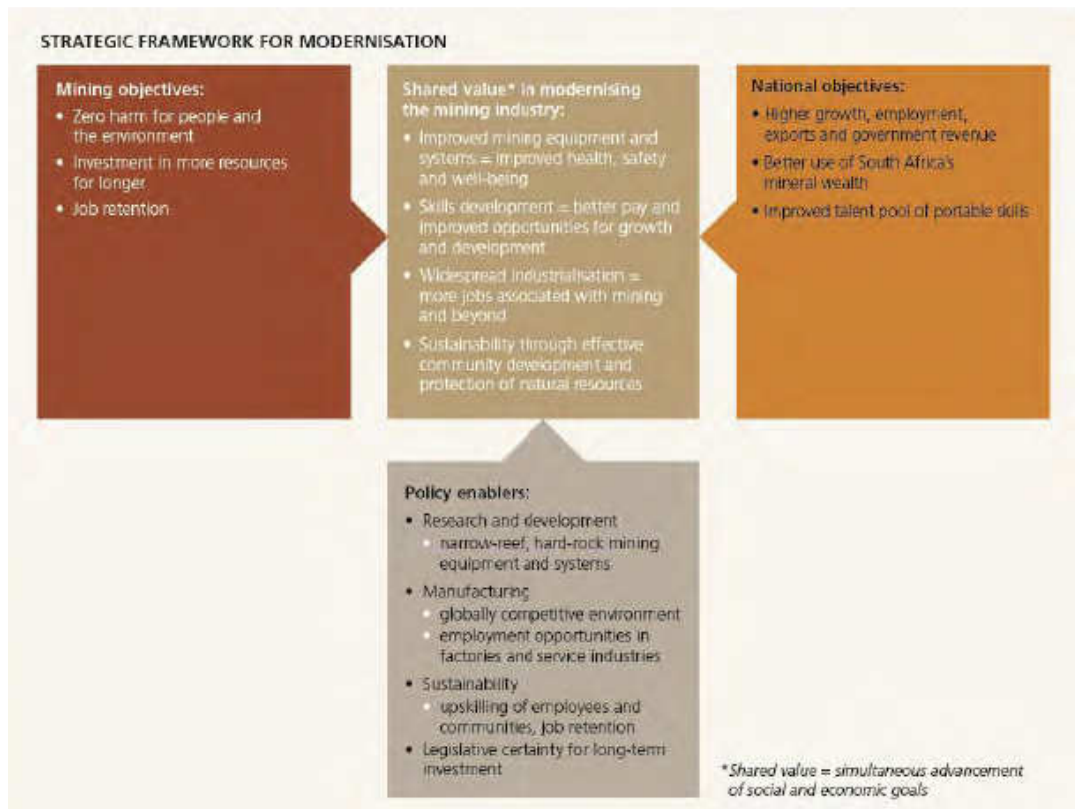


Figure 2-42: Strategic framework for modernisation

Source: Baxter (2016b:40).

The simultaneous advancement of social and economic goals includes improved mining equipment and systems, skills development, industrialisation and ultimately sustainability through community development. These shared values require constructive partnerships to essentially build on trust, as illustrated in Figure 2-43.

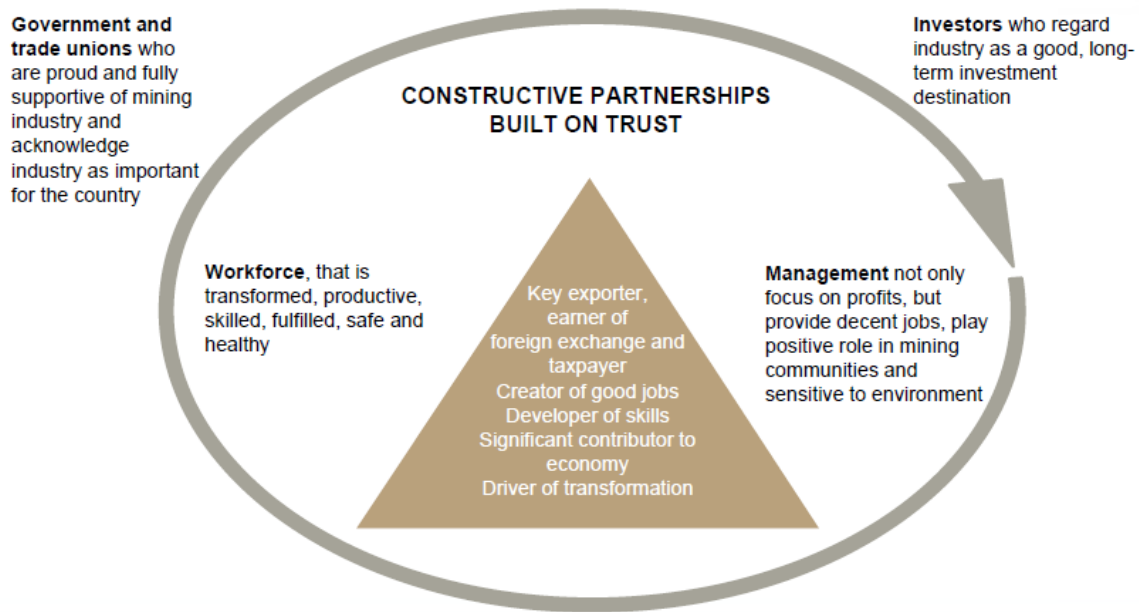


Figure 2-43: Vision for a competitive, vibrant and transformed South African mining industry

Source: Baxter (2016b:42).

Baxter (2016b) argues that in the event that mining constituents such as government, employees, employers and investors create a constructive partnership, the South African mining industry could remain a significant contributor to the economy by driving transformation and creating decent jobs through the development of skills. Within this context, this study aims to establish a framework in which the input of all mining constituents is collated in an appropriate framework to be used to implement change within the industry.

2.8 ALTERNATIVE STRATEGIES TO COMBAT POVERTY, INEQUALITY AND UNEMPLOYMENT THROUGH MINING

Morgan (2012) claims that South Africa possesses a remarkable \$1,5 trillion worth of non-energy minerals, yet the country struggles to stifle the decline in global mining exploration spent from 5% in 2004 to 1% in 2011. Du Venage (2013) argues that Africa received only one-fifth of the estimated \$1 trillion in global investment over the last ten years. Despite estimations that this share is expected to increase due to an increased demand for resources, investors are concerned about the growing tendency among the sub-Saharan mining countries, including South Africa, to want more without giving anything back. Even a moderate change in the current policies and macro environment will diminish the country's ability to compete for direct fixed investment or encourage reinvestment, states Du Venage (2013).

According to Morgan (2012), rhetoric around nationalisation as well as beneficiation has been some of the major focal points of the government's strategy to capture more value and increase employment. However, there remains anxiety in the mining industry in response to these proposals in terms of a severe lack in infrastructure, energy provision and regulatory clarity. Leon (2012) states that despite that South Africa has of the world's largest resources, the country struggles to exploit these mainly due to regulatory uncertainty. According to Canada's Frasier Institute, South Africa continues to slip down the policy potential index, ranking the attractiveness of mining destinations to investors, as reported by Leon (2012).

Morgon (2013) reports that the African Union's mining vision seeks to use mineral resources as a catalyst for the development of the wider economy, and stresses the importance of capturing more value upstream and downstream of the value chain. Morgon (2013) argues that the demand for populist rhetoric in the face of often ineffectual governance is a cheap way to curry favour with the considerable sector of the population, who felt let down by the failure to harness mineral wealth in the collective interest. Long-term planning required for mining investments include transparency and consistency in regulatory policy, according to Morgon (2013), who argues that inflammatory rhetoric rather than straightforward and open policy planning hampers investment.

Other more conservative initiatives include the development of the nation's infrastructure to stimulate export capacity as well as improve the educational sector to enable it to obtain the necessary skill to expand and create more jobs. McKay (2012) states that despite that the nationalisation of mines has been dispensed as unconstitutional and expensive, an adjustment to the mining industry's tax regime could be utilised as a new revenue model of government. Theunissen (2012) argues that while the thought of a mining super tax might not sit comfortably with South African business, the strategy certainly has merit and probably the potential to do more to reduce unemployment. Leon (2012) argues that a resource-rich, developing economy with ambitious transformation and development goals such as South Africa requires regulatory certainty and administrative efficiency for investors. This is essential especially for a high-risk, capital-intensive investment opportunity such as mining that requires significant capital layout before mining operations commence.

Leon (2012) argues that if key requirements of the mineral regulatory regime are vague, subjective and indeterminate, it is unsurprising that South Africa experiences an investment growth that is lower than any other significant mining jurisdiction. The intention behind both the original and the revised Mining Charter was to champion the government's Black Economic Empowerment (BEE) policy (Leon, 2012). This policy, which attempts to deracialise the economy and bring about meaningful economic participation, ironically became the catalyst for the populist support for the nationalisation of South Africa's mines. Leon (2012) states that it is because both

the original and revised Mining Charter promote a form of crony capitalism, resulting in the enrichment of the well-connected few as opposed to the economic empowerment of workers as well as the poor and marginalised black communities. Therefore, a flawed BEE policy will continue to fuel discontent among the historically underprivileged majority in South Africa and the demand for effective socio-economic transformation.

As a result of the revision of the Mining Charter early in June 2017, the Chamber of Mines represented 90% of mining companies in South Africa in applying for an urgent court interdict to stop the implementation of the new Mining Charter (Tandwa, 2017). The new Mining Charter requires a 30% black ownership of local mines as well as a ceding of 1% of annual turnover to empowering communities. Tandwa (2017) reported that the Chamber of Mines argues that the new Mining Charter was implemented without the necessary consultation with business. Groenewald (2017) states that markets reacted negatively towards the implementation of the new Mining Charter as investors became nervous due to regulatory uncertainty. The Chamber of Mines court interdict argues that the new Mining Charter undermines the very objectives it had set out to address as it inflicts financial and reputational harm on employers, employees and investors (Groenewald, 2017). In addition, Groenewald (2017) states that the Charter is contradictory in its core provisions as well as confusing in that the language used in the document fails to convey a clear message. According to Peyper (2017), regulatory uncertainty in the implementation of the new Mining Charter caused uncertainty in the markets and was widely criticised by business, labour and civil society.

The concept of nationalisation was initiated by the then president of the ANC Youth League, Julius Malema, in 2009. According to Malema (2009), the Freedom Charter unequivocally states that the mineral wealth of South Africa shall be transferred from monopoly industries and banks to the ownership of the people as a whole. Malema (2009) argues that big corporations brutally exploit labour and unsustainably exploit mineral wealth to make large profits. The call for nationalisation according to Malema (2009) envisages a paradigm in which the State will own the mineral wealth and mines as a custodian of the entire South African population. All South Africans should equitably benefit from the state-owned and -controlled mines and not only a few big businesses. Malema (2009) argues that racial oppression in South Africa is a direct consequence of colonialists' control of South African mineral resources. Malema (2009) states that beneficiation of the mineral resources and diversification of the economy will never happen if minerals and mines are still controlled by the big corporations that are confined to exporting South Africa's minerals to the bigger economies. Du Plessis (2013) disagrees with the concept of nationalisation; he believes the resource sector in South Africa is not subject to notable market failure, and that it is competitive and therefore a poor candidate for public ownership. Du Plessis (2013) adds that international evidence suggests that nationalised firms would be less efficient in these

circumstances. There is, however, a policy incentive to pursue nationalisation where long-term economic efficiency is sacrificed for short-term political benefits. Du Plessis (2013) states that the particularly high level of income inequality in South Africa in conjunction with a period of higher commodity prices creates an ideal platform for populist leaders to mobilise support to serve a majoritarian goal such as nationalisation. Du Plessis (2013) states that nationalising the resource will cost the government more than it receives as well as limit the scope for distributive policies on the national budgets. Furthermore, Du Plessis (2013) argues that the shareholders of South African mines include large public and private sector pension funds. Any nationalisation without compensation would pass the cost of nationalisation onto current and future pensioners in all sectors. The annual fiscal burden of this project would also raise government debt dramatically, according to Du Plessis (2013). It is also expected that investment will be curtailed across the board due to higher capital market interest rates and the balance of payments that will experience increased pressure.

Malema (2009) indicated that the threats of disinvestment are simply unjustified warnings because investors need South Africa's economic resources, labour and expanding market as much as South Africa needs investors. Du Plessis (2013), however, states that disinvestment would lead to lowering economic growth and the curtailment of employment growth within the country.

Turbeville (2014) has a different view in that he states that financialisation has been the root cause of inequality of income and wealth in the last 35 years. Financialisation is defined as the increase in the size and importance of a country's financial sector in comparison to its overall economy. According to Turbeville (2014), the financial sector has grown rapidly compared to the rest of the economy with non-financial sectors investment virtually stagnating. As a result, large amounts of capital have been allocated to financial investments that essentially reduce the shares of income and wealth enjoyed by 90% of the population. Turbeville (2014) justifies his findings on the basis that financialisation is driven by the market power to generate large economic rents that are extracted from the economy. Turbeville (2014) argues that because capital devoted to financialisation is structured around particularly high returns that include economic rents (profits in excess of value that would accrue from true competition) wealth inequality is fuelled. Turbeville (2014) makes mention of two possible remedies, which include public policies such as direct redistribution and focusing on the de-financialisation of the economy. Palley (2007) echoes this stance, stating that economic growth has been tepid, median wages have stagnated and income inequality has risen. The remedy according to Palley (2007) is a fundamental change of policy paradigm to reconfigure the balance of economic power and the dynamics behind the business cycle. This multifaceted approach includes, amongst other things, the restoration of policy control over financial markets, the challenging of the neoliberal economic policy paradigm that is

encouraged by financialisation and the reforming of the political process so as to diminish the influence of corporations and wealthy elites. Neoliberalism is considered a policy of social studies and economics that aims to transfer the control of economic factors to the private sector from the public sector. Mbasa (2016) argues that the emerging neoliberal macroeconomy diverts the ruling party (ANC) from its pre-1994 counter-radical approach as enshrined in the Freedom Charter and the National Democratic Revolution (NDR). According to Mbasa (2016) the ANC, however, contended that it was necessary for South Africa to adopt the neoliberal agenda in order to address the pre-1994 economic crisis and to correct the contradiction which emerged in the democratic breakthrough before pursuing its ideals of socialism. Mbasa (2016) states that the National Development Plan (NDP) contradicts the Freedom Charter and NDR and cannot bring about the socialist revolution. Mbasa (2016) adds that the NDP is long and vague in its position and pursues a neoliberalism framework that does not abide by the ideal of sharing the country's wealth beneath the soil.

Antin (2013) describes resource nationalism as a sovereign claim on resource assets by citizens of a mineral-rich country. This claim must deliver maximum benefit to citizens of the country. Claims of nationalisation that are considered a global cyclically reoccurring event by Antin (2013) did not embark from factual analysis, but were rooted in a re-occurring public perception. This populist rhetoric rekindled the debate and increased massive insecurity surrounding the future of the industries. Contrary to the perception of Malema (2009) that investors need South Africa and its mineral wealth, Antin (2013) argues that capital will always remain global and flee to where the grass is greener. Mutize and Gossel (2017) concur with this argument in stating that policies that limit the wealth-generation capabilities of the wealthy via market interference and higher taxes will stimulate capital flight and tax avoidance. Capital is therefore required to grow the economy by at least 6%, according to Mutize and Gossel (2017), in order to reduce high levels of unemployment. This capital has no colour or political affiliation, according to Mutize and Gossel (2017), and the argument of "white monopoly capital" is considered a political agenda rather than a fact. Duncan (2013) states that increasing competition and decreasing barriers to entry could seriously boost South Africa's growth potential without challenging key constituencies such as labour unions. In the absence of competition, companies do not have an incentive to innovate or find alternative ways to become more efficient. As a consequence, productivity, research and development stagnate, culminating in lower levels of economic growth (Duncan, 2013).

Smit (2013) puts this dilemma into context by stating that for nearly 150 years, mining has been the driving force behind South Africa's economy, which includes the country's socio-political and cultural development. Smit (2013) argues that within decades the economy was transformed from one based on agriculture and trade into a thriving economy based on the rich mineral reserves underground. Mining has contributed directly to the establishment of the Johannesburg Stock

Exchange, the development of infrastructure and has served as the catalyst for the development of other sectors (Smit, 2013). In addition, Smit (2013) states that mining and related industries not only employ over a million people but also continue to be the largest contributor to Black Economic Empowerment (BEE). More importantly, mining provides job opportunities for unskilled and semi-skilled people. Smit (2013) believes that just as South Africa shifted from a primary to a secondary economy with the discovery of gold mining and diamonds, the country is currently in a transition again. Smit (2013) argues that South Africa is making a transition to a tertiary economy where up to 65% of the GDP comes from this sector. Despite this transition, mining will continue to play an important role in the economy as a foreign exchange earner and employer of people. Smit (2013) believes that the mining industry will, however, have to make some serious changes to remain competitive, including:

- implementing sustainable mining methods that take into account the social and environmental impact on industry;
- adding value through beneficiation;
- achieving BEE targets; and
- promoting more equitable sharing in the country's resource base.

According to Crowley and Biesheuvel (2017), mining in South Africa is harder and costlier than ever before with a mix of shrinking reserves, rising labour costs, frequent stoppages and regulatory uncertainty. Crowley and Biesheuvel (2017) argue that the South African mining industry problems stem from its turbulent and oppressive past where many mines were largely built on the basis of cheap labour and electricity as well as minimal safety standards. To redress the inequality of apartheid, government implemented BEE policies with the aim to transform mining companies to be at least 26% owned by black investors (Crowley & Biesheuvel, 2017). Companies, however, argue that this will lead to a continued dilution.

Another aspect worth mentioning is above-inflation wage increases. Crowley and Biesheuvel (2017) state that labour cost, which makes up a third of the industry's overall expenses, almost tripled to R117 billion a year in 2016. Consequently, after more than a century of intensive mining, the industry made its first net loss since 2009. Thomas (2017) argues that the World Economic Forum ranks South Africa as the second most difficult economy to operate in when it comes to labour relations, which drives an ineluctable move towards mechanisation. Kaplan and Nattrass (2017), however, argue that higher minimum wages prompt employers to shed low-skilled jobs, thereby keeping only those with "decent work" (jobs with higher productivity and higher pay). This comes at the cost of destroying the last remaining jobs for SA's army of relatively unskilled,

unemployed people. Despite these different views, a number of authors, including Seccombe (2017), warn that failure to embrace mechanisation will result in a continued decline in the profitability of South Africa's mines. Both Seccombe (2017) and Lewis and Shabalala (2017) state that hundreds of thousands of jobs can be saved and the closure of mines could be delayed by mining deposits with smart new machines. Lewis and Shabalala (2017), however, indicate that limited progress has been made towards this transformation, but mining companies are being jolted into action by volatile commodity prices and the increased difficulty and danger of accessing the remaining reserves. Thomas (2017), however, warns that it is easier said than done as the South African gold and platinum mining industry in particular faces huge challenges with regard to mechanisation, which dictates minimal stope heights. Thomas (2017) reports that steep dipping ore seams present another big challenge in gold mines as it makes it impossible to use rubber tyre vehicles.

2.9 SA MINING INDUSTRY FINDS ITSELF AT A CROSS ROAD

Lewis and Shabalala (2017) state that while automation represents potential, it is regarded as a threat to jobs worldwide. It is particularly sensitive in an industry that employs hundreds of thousands of blue-collar workers in nations where mining contributed significantly toward the country's GDP. It is therefore not a surprise that in the case of South Africa, organised labour such as the National Union of Mine Workers (NUM) is not prepared to discuss mechanisation as they believe that it would lead to job losses (Lewis & Shabalala, 2017). It is on this premise that Antin (2013) believes that the South African mining industry finds itself at the crossroads where any erroneous decisions made will have an impact on the entire nation's economy. Antin (2013) argues that the current troubles facing the mining industry represent a major challenge to the economy and to popular aspirations for development. Antin (2013) believes that labour unrest and nationalisation of mines are not the solution, but argues that excessive wage demands, disruptive disputes between unions and escalating threats of mass protest action have negatively impacted on the productivity of the sector. James (2016) states that it is imperative that planned introduction of new mining technologies, such as mechanisation, should take the socio-economic conditions in South Africa into account. James (2016) argues that while mechanisation is a viable option, it is not the be-all and end-all for South African or African mining, as improved efficiency does not necessarily depend on mechanisation.

Adeleke (2017) states that a fundamental change in the structure is required because the way that mining is carried out has caused immeasurable socio-economic and environmental destruction. Adeleke (2017) offers two interventions to alter the trajectory of the South African mining industry by encouraging meaningful community participation as well as private sector accountability. According to Adeleke (2017), 40% of civil wars can be associated with natural

resources mainly because of a lack of equitable sharing of benefits and cost of extraction, lack of engagement with communities and the diversion of revenue to financing conflicts. South Africa is no exception to the phenomenon in that for more than a century the industry has produced obscene profits for a collective few whilst leaving a trail of socio-economic and environmental destruction across the country. Adeleke (2017) believes that a sustainable solution can be reached only through community engagement. This is symptomatic of the country's failure to give marginalised communities a meaningful voice. In addition, Adeleke (2017) argues that transparency is required in terms of financial disclosure and beneficiaries of a mining project. Adeleke (2017) states that a lack of knowledge about the ultimate beneficiaries of a global corporation means tax avoidance and illicit financial flow can thrive, which deprives countries of revenue to fund social welfare programmes.

Donovan (2013) argues that all these aspects must be looked at holistically. Issues such as economic downturn, major labour concerns and the enormous gap between both rich and poor and black and white have damaged the mining industry to a virtual breaking point. In addition, uncertainty about regulation has curbed future investments, bringing this issue to a crossroad (Donovan, 2013). These lingering challenges facing the mining industry, however, remain a balancing act. While more funds are flowing to the workers and the State would seem beneficial, Donovan (2013) warns that mining investors and speculators will be more inclined to take their business elsewhere. This has the potential to be catastrophic, especially in the gold and diamond industries where mining companies have alternatives. In the end, the government must create a balance between generating profits for the State and curbing mounting poverty. Donovan (2013) states that the mining industry is vital to at least maintain the status quo, as their departure would see already high unemployment numbers soaring even higher.

Montiea (2015) indicates that mechanisation offers a solution in that fewer people are exposed to risk, it increases productivity and potentially reduces cost. Therefore, there exists a possibility to exploit orebodies that would otherwise not have been economical to extract. Radebe (2015), however, explains that for decades generation upon generation of miners have toiled in the most inhospitable conditions to extract this precious ore. The growth within the industry has, however, come at a great cost to miners, their families and their communities. Therefore, Radebe (2015) argues that many view the mining sector as a symbol of global oppression under colonial and apartheid rule. The working and living conditions of miners remain harsh, explains Radebe (2015), stating that some of this is due to the nature of the job but the main cause is linked to the apartheid legacy. The so-called migrant labour system provided a flow of cheap labour that allowed the gold and platinum sectors to flourish, but has led to many social problems; it remains a source of bitterness, according to Radebe (2015). Zokwana (2014) concurs with this harsh reality, stating that the industry did not attempt to improve the welfare of these migrant workers by providing

training or adequate housing. Zokwana (2014) argues that NUM has fought against racism to improve the treatment of black workers under the apartheid system and campaigns against the class system. According to Zokwana (2014), mineworkers' wages are still determined by a job grading system based on the apartheid structure. According to this system, workers' wages are not dependent on the task they do or the corresponding risk to which they are exposed but on the amount of power they have over other employees. This structure has led to an economical struggle of mineworkers due to the inequalities of this system. It is within this perspective that Zokwana (2014) believes that mechanisation will not only reduce the number of jobs available to mineworkers as most do not have portable skills, but also that this is just another attempt by mining houses to maximise profits at the expense of mining communities. Dixon (2015) sums this situation up by stating that the mining industry has to create jobs on the one hand, but that it has to increase productivity on the other hand. Both these objectives require profitable mining operations and a growing economy, neither of which are apparent in South Africa right now.

According to Toll (2016), it is not all doom and gloom as he believes there are supply imbalances in certain minerals that culminate in a positive outlook and future for the mining industry. Toll (2016) does, however, indicate that the effect of the current economy forces marginal producers to evaluate their viability as the current low prices make some of the operation uneconomical. Therefore, the focus has changed from expansion to cost control where improving efficiencies are prioritised and potential closure of marginal operations become a reality. It is in this light that Lane and Beier (2014) believe that a step change in every respect of the business is required. Lane and Beier (2014) argue that the combination of stagnant or falling global commodity prices and rising input cost mainly as a result of above inflation energy and labour cost is forcing mining houses to make difficult decisions. According to Lane and Beier (2014), there is a real need to find ways to deal with labour as drivers are pushing towards upskilling and mechanisation in an effort to improve the working environment and reduce the dependence on large quantities of low-skilled labourers. Lane and Beier (2014) state that there is a need to increase the social dividend in an environment where mines employ fewer people. These social dividends include upskilling the existing labour force and creating more upstream employment opportunities.

In respect to energy supply in South Africa, Cutifani (2015) adds that the ability of South African industries to compete globally is influenced by the effectiveness of State Owned Enterprises (SOE), which include energy provider Escom. Cutifani (2015) argues that a government that supports uncompetitive SOEs while the burden is left to one group to carry and lead with competitive and efficient business practices is not sustainable. Cutifani (2015) states that all stakeholders must work together as partners to create a sustainable future. South Africa's long history of adversarial labour relations and in particular the trust deficit between labour, business and Government severely hinder the creation of a more efficient mining industry. According to

Cutifani (2015), the persistent focus on cost and returns is because the South African operating models and technologies are lagging those in other mining jurisdictions. For several years, the South African mining industry has been underperforming in comparison to its global peers and today South Africa falls outside the top 50 mining jurisdictions.

Cutifani (2015) believes that investment follows returns and not the other way around. This means that where investors do not see a worthwhile return, they simply will not invest. Within this investment climate, it is increasingly difficult to attract the long-term foreign direct investment flows needed for new mines and the financing of existing mines just to stay in business. Cutifani (2015) argues that even though the South African mining industry has been a great source of competitive advantage for the country, its viability is threatened if the industry cannot at least arrest its decline in productivity and reduction in input cost. Cutifani (2015) states that many of the underground mines are becoming unviable as mines expand to even greater depths and consequently increase in unproductive time to get to and from the working face. It is because of this that the mining industry today has to tackle an increasingly complex set of technical and societal challenges. Cutifani (2015) understands that the welfare and ongoing prosperity of the host communities is critical to returns over the long term as much as attracting investors and strong markets. The industry will therefore be successful only if it manages to secure an ongoing social licence to operate. Cutifani (2015) argues that without mining and without investment in new capacity, South Africa will not be able to support the delivery of a mining recovery and will not be in a position to support to provide jobs in support of the objectives of the National Development Plan. Cutifani (2015) states that the country needs an industry that operates in a facilitating environment that is conducive to making profits and where investment attracts further investment. But this requires a shift in mindset from all mining constituencies if the mining industry is to continue to be a crucial partner in the development of the country, a significant contributor to the fiscus, a major employer and a cornerstone for the ongoing livelihood of host communities.

Lane and Beier (2014) echo this view but state that mining companies also require a deep understanding of shifting community and government expectations. Therefore, it needs to commit to a high level of transparency and operational sustainability to address the demands of relevant stakeholder groups. Lane and Beier (2014) argue that incremental improvements are no longer enough to sustain the industry and believe that innovation is the new key to survival. However, innovation goes beyond technology and one should consider the whole system that includes the socio-economic system. Lane and Beier (2014) propose a new integrated system design illustrated in Figure 2-44, which will lead to new performance levels that are not possible on an incremental basis.

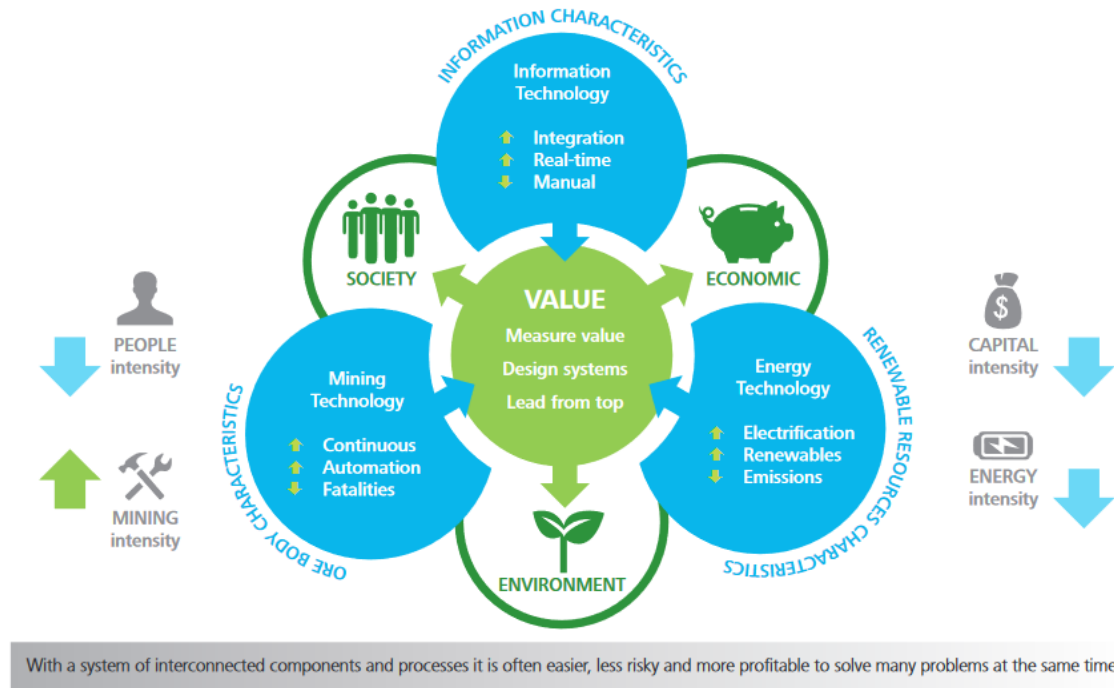


Figure 2-44: Integrated system design for the South African mining industry

Source: Lane and Beier (2014:2).

Lane and Beier (2014) believe that as mining companies begin to apply innovation to their full operational ecosystem, they stand to realise significant gains. Innovative thinking is required to influence the way the industry engages with workers, the government, community and all other stakeholders. Lane and Beier (2014) note that as companies increasingly rely on automation and mechanisation, for instance, they will likely require fewer mine workers, fundamentally altering industry realities where this innovation threatens the status quo. It is therefore imperative that mining companies need to be prepared for a divergent future scenario where collaboration is a key component. Cutifani (2015) concurs with these arguments and states that the mining industry must modernise technologies, operating models and management work practices.

According to Levknecht (2013), polarities such as mechanisation versus job creation within the South African mining industries are two seemingly opposing values. However, these paradoxes or dilemmas have the potential to complement each other if applied in a balanced way. Levknecht (2013) argues that in modern times, high performing organisations are successful partly because they have created systems and processes that assist them in managing polarities. Effective organisational leaders are therefore both clear and flexible with the emphasis on “both-and” thinking as a supplement to the traditional “either-or” problem-solving techniques. Levknecht (2013) also states that polarities are interdependent as they need each other, and neither is sufficient in isolation.

In order to visualise this “both-and” thinking, Levknecht (2013) recommends the use of a polarity map that has four quadrants, with each dilemma having an upside and downside. Billingham (2015) describes a dilemma as a problem that has distinct sides and where people become polarised. In addition, a dilemma is an ongoing problem where the solutions are interdependent. This means that in the event that you choose one solution, it negatively affects the other. Billingham (2015) states that polarity mapping is a great tool to understand and manage wider-reaching polarities, as it provides an opportunity to explore dilemmas at scale. The mapping process allows proponents for and proponents against a possible solution to name their highest value and deepest fears. According to Billingham (2015), fear drives polarised thinking that allows the team to reframe conflict into sustainable innovation and engagement. The key to polarities is to manage it rather than simply to solve the problem. Thus, the solution is to strike a balance between the two poles.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The decision of mechanisation within the mining sector is a strategic one because it is a determinant of the ore extraction strategy and mining cycle. Rosenzweig (2013) argues that decisions can generally be categorised within four fields that vary along two dimensions, namely control and performance. When facing a decision within the fourth field, such as the question of mechanisation, executives need to perform a careful dispassionate analysis as well as display a willingness to push existing boundaries.

According to Deloitte (2014), local mining companies have to manage unique South African operational complexities whilst operating in the context of global pressures. Mining executives subsequently face tough choices to ensure long-term sustainability, and require an analytical approach to determine the strategies that drive sustainable growth.

In considering both the local and international environment, as illustrated in Figure 3-1, it is evident that mining companies within South Africa face not only influences of global macro-economic developments but also unique local challenges.



Figure 3-1: Global and local influences in mining companies on South African operations

Source: Deloitte (2014).

Slow global recovery from the recession, unfavourable commodity prices and a global trend of resource nationalism to bolster slow economies and drive socio-economic development are but a few challenges faced by mining houses within the global arena. Despite these challenges, Africa with its vast mineral riches still offers an opportunity for mining companies to take advantage of this new frontier of expansion.

Deloitte (2014) adds that mining companies looking to operate on the African continent face socio-economic and political complexities that contribute to the perception of the continent as a risky destination for business. A lack of appropriate infrastructure is a further barrier, where African governments tend to turn to the mining companies themselves to accelerate infrastructure development. The South African mining industry in particular faces ever-increasing demands by trade unions and mine workers as well as rising demands by government and local community regarding the role that mines should play in society. The perception of inadequate progress in these key areas is often met with industrial action in the form of strikes and unrest, significantly impact on project development.

The overarching challenge is therefore to strike an equitable balance of interest. This by definition requires mining operations to be productive and profitable as well as fair to foreign investors, host states and affected local communities alike.

3.2 RESEARCH STRATEGY

This specific qualitative research made use of the case study method that focuses on developing an analysis of multiple cases to develop a theory. The study was a cross-sectional design to capture the required data at a specific point in time. The data were gathered from a pool of participants with varied characteristics to construct a model and new theories that do not require excessive financing and extended time frames. Timing of the study is believed to be representative as a number of participants within the study are currently confronted with this specific dilemma. Primary data gathered from semi-structured interviews were analysed by making use of a conventional content analysis technique. The aim of this study was not to determine cause and effect but merely to create an understanding of the field of interest.

3.3 PARTICIPANTS

In considering each stakeholder within the broader mining landscape, as illustrated in Figure 3-2, it is evident that each group has its own unique objectives that are often in contradiction with other stakeholders' objectives.



Figure 3-2: Overview of the stakeholder landscape

Source: Deloitte (2014).

In considering the unique characteristics of these mining constituents, it is clear that each group is challenged by aspects that hamper their specific desires and determine specific outcomes that are prevalent in the local mining landscape.

According to Deloitte (2014), the government's aim is to ensure that mining companies contribute to socio-economic and infrastructure development, while maximising revenue of the state. Historically, African government institutions have struggled to provide adequate services to the communities they serve and therefore often turn to private institutions such as mining houses to accelerate change. Disjointed government departments with inconsistent policy and populist rhetoric further distort the role of mining companies. This role calls for the distribution of the country's mineral wealth through the nationalisation of mines, which has become increasingly popular for politicians to garner favour with the impoverished majority. Even though these radical interventions are not expected to become a reality in the short term, mining stakeholders should bear in mind that policy in the form of taxes, royalties and adapting the mining charter may still have a significant impact on profitability and operational sustainability.

Similar perceptions by labour, organised labour and communities expect mining companies to play a more active role in socio-economic development. Mines are historically located in areas of poor service delivery and these communities are frequently on the receiving end of years of frustration due to a lack of tangible economic development that often results in social unrest. Despite corporate social responsibility investments, Deloitte (2014) state that there still exists a perception that these international mining companies hoard wealth and do not share it with the communities in which they operate.

The increasing requirement of mining companies to invest in broad service provision activities makes it challenging for executives to strike a balance between the responsibility towards their shareholders and the responsibility towards the community, according to Deloitte (2014). In the event that mines are willing to drive social change, they do not understand the community needs and often resort to fulfilling needs identified by the local municipality that fall short of meeting community requirements.

A sixth dimension that needs to be considered within the mining landscape is the provision of appropriate technology. Vogt (2016) states that roughly 30% of the current underground production comes from mechanised operations. Gold and platinum mines find it difficult to convert to a mechanised operation and, subsequently, this equipment has not yet been deployed widely in older mines that have been designed for hand-held drilling and conventional blasting techniques. This slow adaption of appropriate technology is as a result of the unique narrow tabular orebody typified by platinum and gold mining within South Africa.

The need for appropriate technology to effectively and efficiently extract these minerals creates a challenge in that tailor-made solutions are required that do not necessarily conform to other mechanised equipment suites across the globe. Within this context, it is therefore required to include the designers and manufacturers of underground equipment as well as other subject matter experts to create a holistic view of perceived challenges by all stakeholders.

The study population in this research study therefore included all stakeholders within the South African gold and platinum industry that represent the operating context. Figure 3-3 offers a consolidated view of all stakeholders within the South African gold and platinum industry. Thereafter, Figure 3-4 provides the location and geology of gold producers in South Africa.

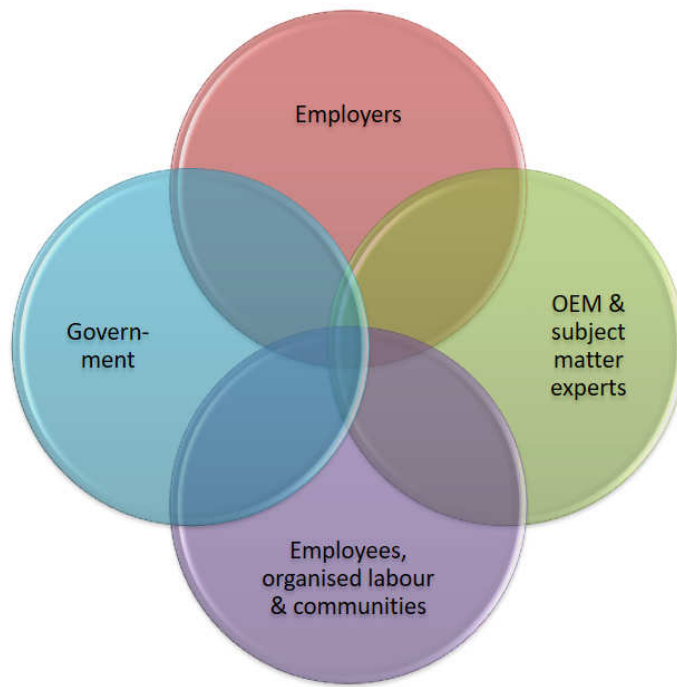


Figure 3-3: Consolidated view of mine constituencies

According to Chamber of Mines (2016), the major gold producers within South Africa include:

5. AngloGold Ashanti
6. Harmony
7. Sibanye Gold
8. Gold Fields
9. Village
10. Pan African resources

LOCATION AND GEOLOGY

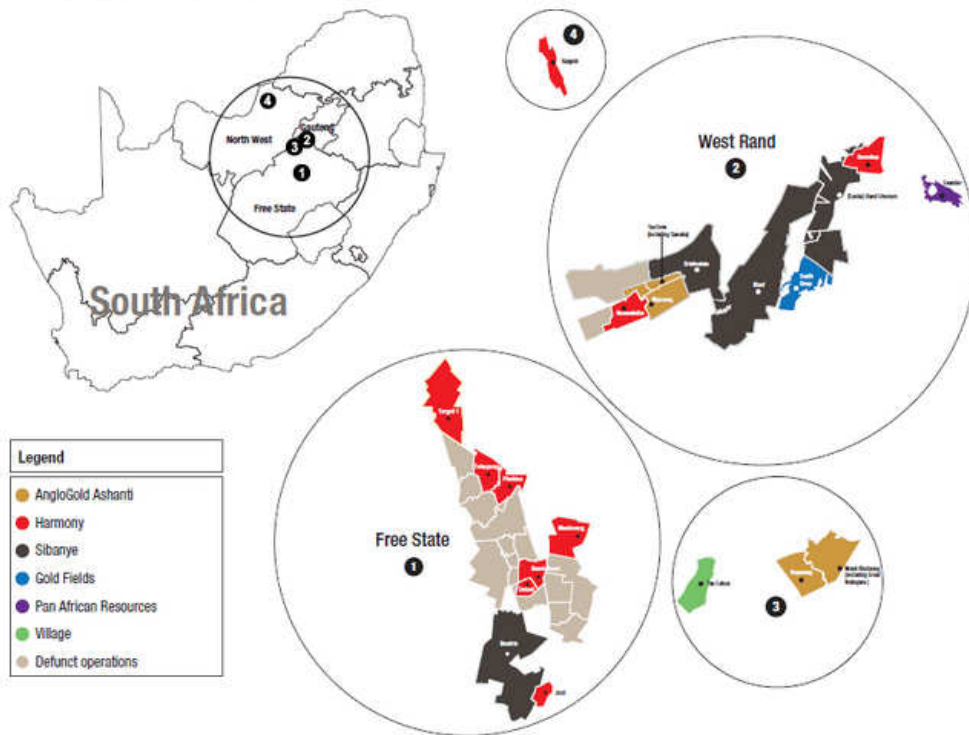


Figure 3-4: Location and geology of gold producers in South Africa

Source: Chamber of Mines (2016).

According to Bell (2015), the major platinum producers within South Africa include:

1. Anglo American Platinum (Angloplats)
2. Impala Platinum
3. Lonmin Platinum
4. Aquarius Platinum Limited
5. Royal Bafokeng Platinum Mines
6. Northam Platinum Limited
7. Glencore Xstrata

Bhorat, Naidoo and Yu (2014) state that even though South Africa has an average level of overall union membership compared to other OECD countries, the mining sector reported a union density of 80% in 2013, which marks the fact that this particular labour market is highly unionised, as illustrated in Figure 3-5. Bhorat, Naidoo and Yu (2014) highlight that the trade union movement

was not only a central agent in the struggle for democracy but that it also plays an influential role in the direction of transformation and economic restructuring of South Africa. From a human behaviour point of view, Pietersen (2005) indicates that both Western (*individualism*) and African humanism (*Ubuntu/collectivism*) need to be considered within the South African work organisation, where the bi-polar dynamic of the individual and society remains fundamental. African management writers such as Nzelibe (1986) argue the importance of group solidarity; the benefit of the individual enjoying the security of the group and conformity to group customs and norms are overriding forces in human life. It is for these reasons that considering trade unions as the voice of employees and the communities in which they operate would provide adequate representation within this research study.

According to This is Gold (2015), union representation at gold producers include:

- National Union of Mine Workers (NUM)
- Association of Mineworkers and Construction Union (AMCU)
- Solidarity
- United Association of South Africa (UASA)

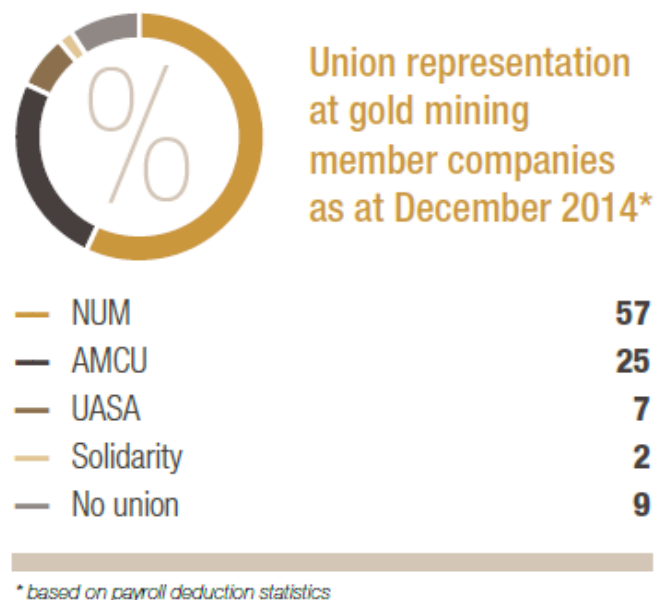


Figure 3-5: Union representation at gold mining member companies as at December 2014

Source: Chamber of Mines (2016).

Literature on the specific union membership within the platinum mining sector is not so forthcoming but it is believed that all the major role-players within the gold industry are also active within this particular sector, with the exception of Solidarity. The reason for finding it difficult to determine the role-players might be because, unlike the gold sector, there is no central bargaining process within the platinum industry. A second contributing factor is that union membership figures have been very volatile, recording major increases and declines in recent years. Chinguno (2013) states that trade union AMCU recorded a more than 500% increase in membership between the period of January 2012 and November 2012. According to AMCU's Secretary General, the majority of new members defected from NUM. Figure 3-6 provides the location and geology of platinum producers in South Africa.

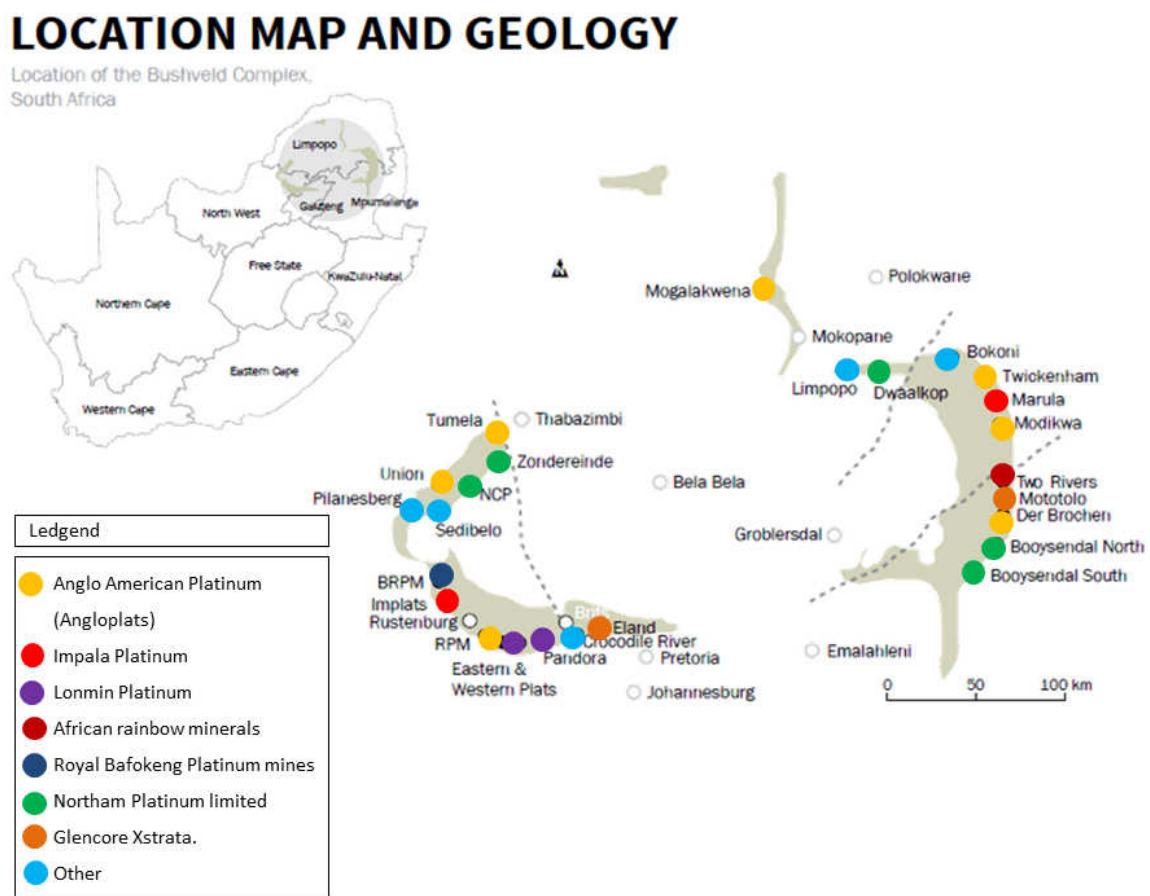


Figure 3-6: Location and geology of platinum producers in South Africa

Source: Chamber of Mines (2016).

In respect of government as a key stakeholder and mining constituency, the Department of Mineral and Energy as the regulatory authority within this sector has been selected as source of information and participant in the study.

Local and international original equipment manufacturers (OEM) in respect of low profile hard rock mining equipment include:

- Aard Mining Equipment (Pty) Ltd
- Fermel (Pty) Ltd
- Sandvik Mining Construction
- GHH
- Atlas Copco

In addition to OEM, a number of renowned subject matter experts and institutions have been identified to form part of the fourth and final stakeholder group. They are:

- Dr Paul Jourdan – Resource development strategist
- Centre of Mechanised Mining System (University of Witwatersrand)
- Chamber of Mines of South Africa

For this particular research question, it is impractical to collect data from the entire population, particularly due to time and budget constraints. It is therefore important to select a representative sample from the study population. The sample size is a representative sample of all the major mining constituents, with at least one of each of the identified stakeholders.

3.4 SAMPLING STRATEGY

According to Bickman and Rog (2008), most sampling in qualitative research falls within a strategy in which particular persons, settings or events are deliberately selected. This is termed purposeful sampling. The reason for this strategy of sampling is that it provides satisfactory representativeness or typicality by systematically selecting a small homogenous sample and it can be used to adequately capture the heterogeneity in the population. It allows for the examination of cases that are critical for the theories with which the study began and illuminates the reasons for differences between settings or individuals.

Saunders, Lewis and Thornhill (2009) indicate that purposive or judgemental sampling enables the researcher to select specific cases to answer the research question adequately and to meet the research objectives. This non-probability sample cannot be considered a statistical representative of the total sample, as indicated in Figure 3-7.

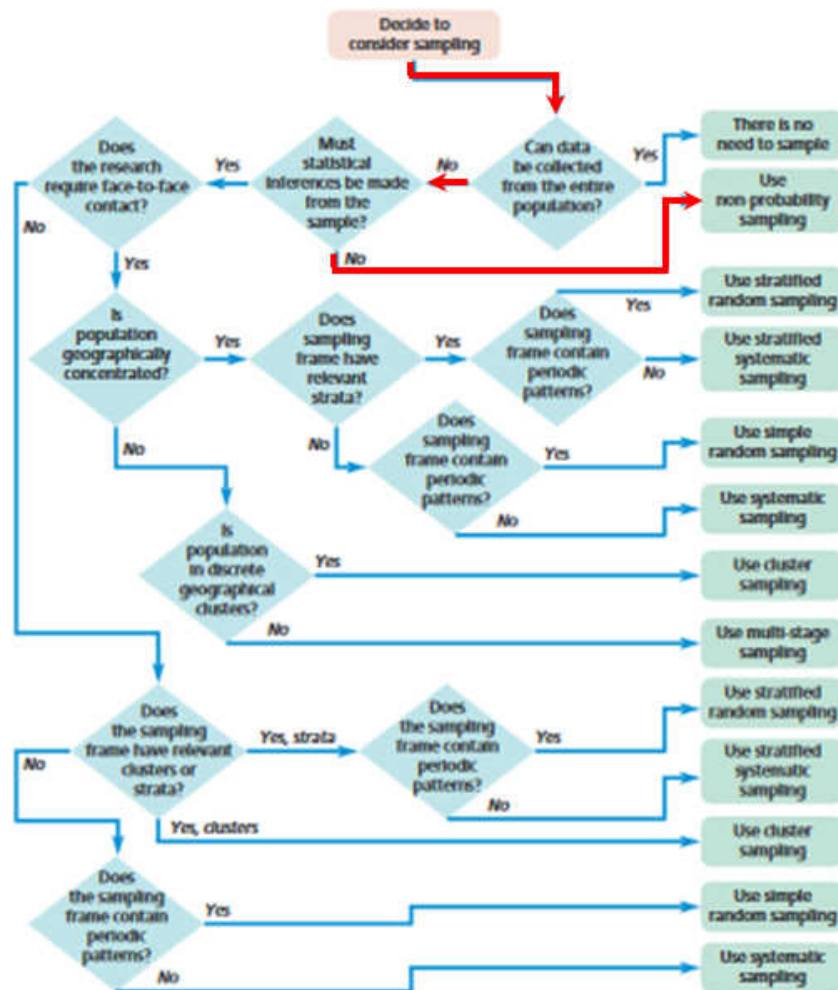


Figure 3-7: Flowchart in selecting a sampling method

Source: Saunders, Lewis and Thornhill (2009).

In the selection of the specific unit of analysis, heterogeneous or maximum variation sampling enables the researcher to collect data to describe and explain the key themes, as a small sample may contain cases completely different. Because the specific unit of analysis contains stakeholders that are for and against the mechanisation of South African mines, any patterns that do emerge are likely to be of particular value and represent the key themes.

Saunders, Lewis and Thornhill (2009) recommend that in order to ensure maximum variation within the sample, diverse characteristics sample selection criteria are identified prior to selecting the sample, as indicated in Table 3-1.

Table 3-1: Diverse characteristics sample selection criteria

Mining constituencies	Perceived key characteristics	Reference
Employees, organised labour and communities	In favour of conventional labour-intensive mining practices	Williams (2012) Sparks (2014)
Employers (mining houses)	In favour of mechanisation	Griffith (2015)
Government (Department of Mineral and Energy)	In favour of conventional labour-intensive mining practices	National Planning Commission (2011)
Subject matter experts and Original equipment manufacturers	In favour of mechanisation	Jourdan (2015) Vogt (2016) Solomons (2015)

The sample size was therefore selected, as indicated in Table 3-2, by including all the major stakeholders within the target population.

Table 3-2: Sample size

Mining Constituents	Organisation	Number of anticipated interviews
Employees, organised labour and communities	National Union of Mine Workers (NUM)	2 (one in gold division and one in platinum division)
	Association of Mineworkers and Construction Union (AMCU)	2 (one in gold division and one in platinum division)
	United Association of South Africa (UASA)	2 (one in gold division and one in platinum division)
Employers (mining houses)	Anglo American Platinum (Angloplats)	1
	Impala Platinum	1
	Royal Bafokeng Platinum mines	1
	Northam Platinum Limited	1
	AngloGold Ashanti	1
	Harmony	1
	Sibanye Gold	1
	Village	1
		(Representative must be involved with the strategic positioning of the mine/organisation)
Government	Department of Mineral and Energy	2 (Preferably a Chief Inspector of a particular mining region)

		representative of the target population)
Subject matter experts and original equipment manufacturers	Aard Mining Equipment (Pty) Ltd	1
	Fermel (Pty) Ltd	1
	Sandvik Mining Construction	1
	Atlas Copco	1
	Dr Paul Jourdan – Resource development strategist	1
	Centre of mechanised mining system (University of Witwatersrand)	1
	Chamber of Mines of South Africa	1
Total sample size		23

With a planned response rate of 40% or more, this sample size is believed to be adequate and representative of all mining constituencies and there exists the possibility of information saturation.

3.5 STRATEGY OF INQUIRY

Data were collected by performing individual interviews with individuals identified as part of the sample size. According to Hancock and Algozzine (2006), individual interviews may yield a significant amount of information but can be time-consuming. The option of making use of focus groups was also considered, however, given the current political and social climate within the mining industry, group interviews was not selected as a favourable strategy. The interview was structured in a semi-structured format by making use of six open-ended questions, which are included in Table 3-3.

Table 3-3: Open-ended questions

No	Question
1	Describe what mechanisation within SA mining context means to you and the organisation you represent.
2	What values exist in the current conventional mining extraction strategy employed within the SA platinum and gold industry?
3	What threatens the current conventional mining extraction strategy employed within the SA platinum and gold industry?
4	Are there any opportunities that exist in the implementation of a fully mechanised extraction strategy?
5	Are there challenges with the implementation of mechanisation within the broader SA platinum and gold industry?
6	Do you believe that a balance could be struck between these perceived paradoxes?

These questions were considered to be non-leading questions and were posed to each of the participants. Effective probing techniques were used to stimulate additional information without injecting the researcher into the interaction and therefore distorting the data. Because of the unique make-up of the sample size, proponents of mechanisation were believed to identify advantages of mechanisation as well as shortcomings with the current conventional mining strategy and vice versa. In addition, the same proponents assisted in generating action steps to realise the favourable paradox and identify yellow flags pertaining to the opposite paradox.

The use of a translator during these interviews was not considered essential, given the participants' education level and ability to express themselves in a universal language that is not necessarily their mother tongue.

The interviews were conducted in a natural, private and distraction-free setting. It was believed that making use of an interviewee's natural business environment enhances the probability to express themselves openly and freely. The researcher therefore requested that the interviews be conducted in the participants' office, which were subsequently executed as such.

Recordings of the interview data were conducted by means of handwritten notes and audio recordings. Permission to record the proceedings was obtained from the participants prior to the interview. These recordings were transcribed for closer scrutiny and comparison to data from other sources. Recordings were kept for a limited period and were destroyed directly after the submission of the dissertation.

Information obtained was anonymous and kept confidential, and the interviewee had the right to end the interview at any point in time. Participants were entitled to a full debriefing by the researcher after completion of the study.

3.6 DATA COLLECTION PROCEDURE

This qualitative research study made use of a semi-structured interview process to collect the data from the sample. The interview process included the following key aspects as stated by De Beer (2016):

- Explain the purpose of the study and timeframe.
- Compile field notes of observations, non-verbal behaviour and recordings.
- Prepare the setting.
- Pay attention to self-presentation.

- Create trust by creating a sense of rapport.
- Be sensitive to language and cultural differences.
- The questions were directed at participants' feelings, experiences, beliefs and convictions.
- No leading questions were posed to the participants.

The data collection process flow diagram for this research study is given in Figure 3-8.

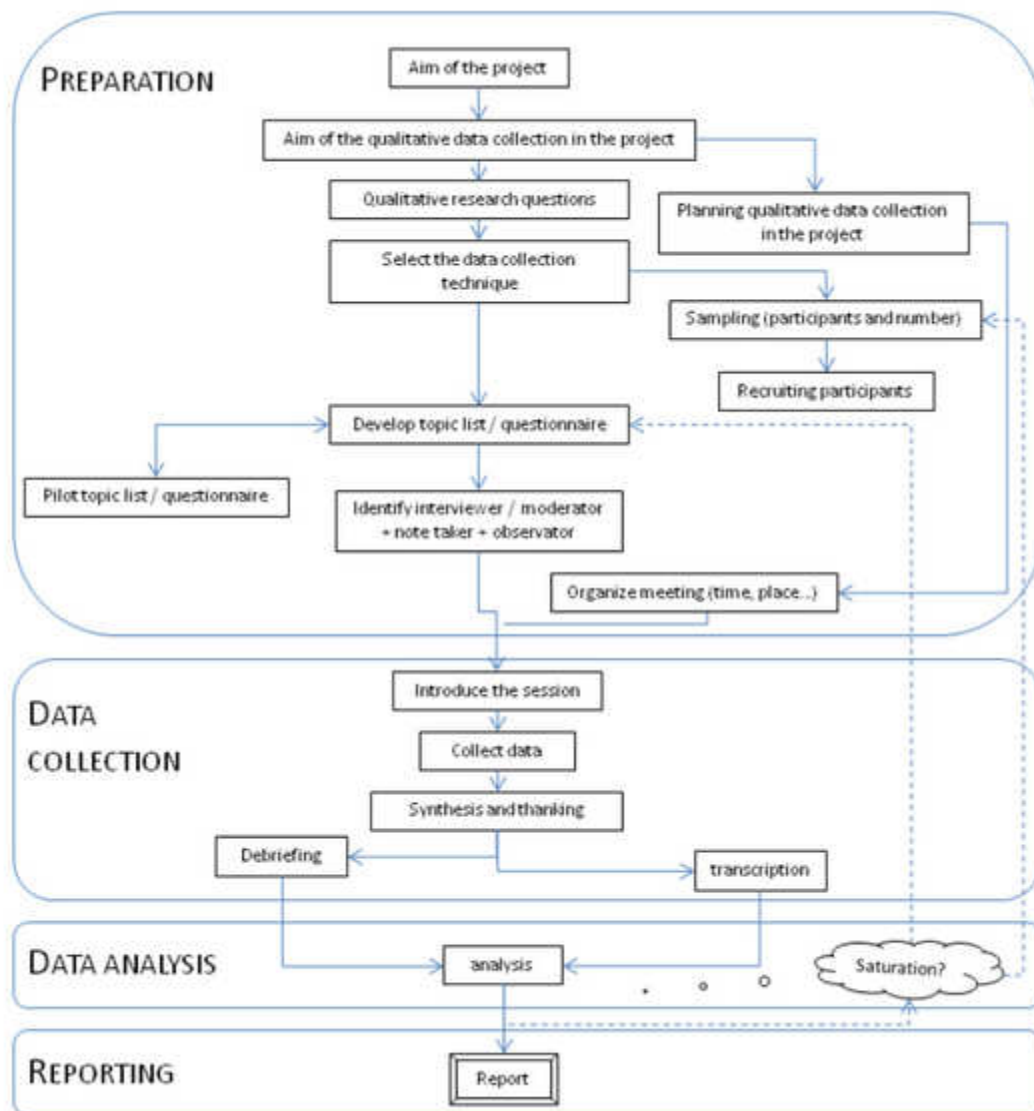


Figure 3-8: Process flow of interviewing people

Source: Kohn and Christiaens (2013).

The data collection phase includes the introduction of the session, the collection of the data by asking the open-ended questions given and using probing techniques to create more clarity if

required. The process concludes with synthesis and thanking the individuals for their participation. Transcription followed as well as a debriefing of the participants, prior to data analysis.

3.7 DATA ANALYSIS

According to Hsieh and Shannon (2005), the research design and analysis technique are a function of the research purpose. When it comes to qualitative research, the question of whether a study needs to use a conventional, directed or summative approach to content analysis can be adequately answered by matching the specific purpose and the state of science with the appropriate analysis.

Considering these aspects with the research problem and the fact that limited research has been conducted within the area of interest, the conventional content analysis technique was used. Hsieh and Shannon (2005) state that this technique is normally used with a study where the aim is to describe a phenomenon that results in concept development or model building.

The data were collected through semi-structured interviews where the individuals formed part of the sample. Subsequently, the interviews were transcribed. The method of transcription was in the form of rereading all the data to achieve immersion and to create a holistic picture. Codes were subsequently defined during the data analysis by highlighting the exact words from the text. Codes were sorted into categories based on how they relate and differ from one another. According to Hsieh and Shannon (2005), these emergent categories are used to organise and group codes into meaningful clusters. Depending on the relationship between the subcategories, the researcher planned to make use of a polarity map to organise the emerging concepts.

Because of the specific nature of mechanisation, it was believed that the mining methodology, compared to the conventional mining method as a current norm within the unit of analysis, essentially has two polarities. Beach and Joyce (2009) argue that many leaders find it difficult to distinguish between a polarity to manage and a problem to solve. A problem is defined as a concern that can be solved by only one unique right answer. In contrast, a polarity is a concern that can be managed by focusing on two interdependent, diametrically opposite right answers.

Beach and Joyce (2009) argue that polarities can never be solved but are managed by being vigilant to the proposition that both opposite resolving answers to the concern will receive appropriate attention. Too much emphasis placed on the one pole of a polarity while neglecting the opposite pole will always lead to failure. Polarity management is a theoretical framework for dealing with polarities to establish a long-term resolution to ongoing issues. The use of a simple rubric called a polarity map, as illustrated in Figure 3-9, can assist in charting out the dual nature

of a polarity and enable a deeper understanding of the benefits and pitfalls of the options considered.

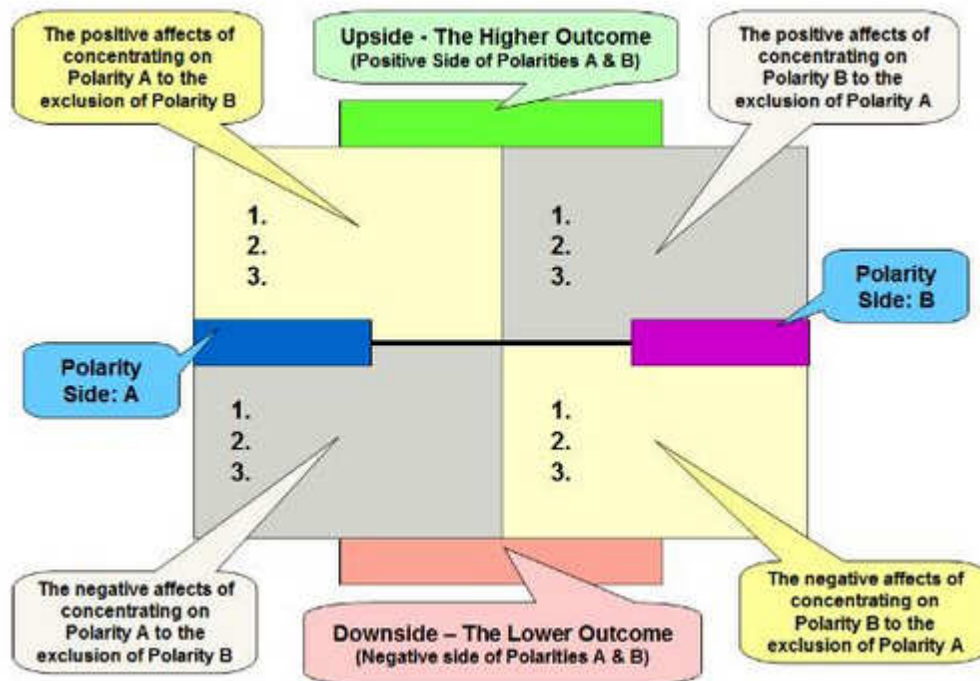


Figure 3-9: Polarity map

Source: Beach and Joyce (2009).

The information from the interview process was used to populate a polarity map between the mechanisation and labour-intensive mining practices. By using a qualitative conventional content analysis technique, text data from the interview process were analysed through a systematic classification process of coding and identifying themes or patterns to provide knowledge and understanding of the phenomenon being studied.

By creating definitions and identifying relationships between each category, subcategory and code, relevant theories and models can be created that, according to Hsieh and Shannon (2005), contribute to knowledge in the area of interest and suggestions for further research. The main advantage of the conventional approach to content analysis is gaining direct information from the study participants without imposing preconceived categories. Credibility was established through negative case analysis by searching for and discussing elements of the data that do not support or appear to contradict patterns that emerge from the data analysis, and mapping it on the polarity map.

According to Hamel (2009), the success of an organisation will hinge largely on the ability of its leaders to manage seemingly irreconcilable trade-offs or polarities. Traditional systems rely on

universal policies that favour certain specific goals at the expense of others. The future system must strike a balance between opposing objectives and enable employees to dynamically optimise key trade-offs. This will encourage organisations to combine the exploration and learning capabilities of decentralised networks with the decision-making efficiency and focus of hierarchies.

3.8 ETHICAL CONSIDERATIONS

Considering the study population to address the primary research question, the particular research site was within South Africa, and participants were representatives of the identified mining constituents. These individuals were therefore located at one of the divisions of the identified companies or institutions. It was, however, important to select participants at the appropriate level who have insight and control with regard to the strategic management of the organisation or industry. Because of the relative universal implementation of the Patterson job grading system across mining constituents within this research study, a participant in an organisation making use of this particular method must be at an E-band or higher.

Accessibility was achieved by making contact with the relevant mining constituents through multiple channels, which include:

- official organisational/company communication channels;
- networking and referrals communication; and
- social media (LinkedIn).

NHMRC (2014) states that the criteria for inclusion and exclusion of participants in qualitative research are often complex; therefore, researchers should state these criteria clearly and be able to justify them. Special care was taken to ensure that participants were not identifiable by the information they provided, unless they agreed to be identified. In addition, special care was taken to protect the identity of participants when disseminating information as well as in the storing of material.

It was considered important to respect the participants' view. It was therefore necessary that the accuracy or completeness of each interview transcript be verified by the relevant participant before analysis was completed. According to NHMRC (2014), the method of providing consent in qualitative research depends on various factors. In this particular context, the protection of vulnerable participants favours a formal, written process of consent and was subsequently executed as such.

CHAPTER 4: ANALYSIS OF DATA

4.1 INTRODUCTION

Elo and Kyngäs (2007) state that qualitative content analysis was first used as a method for analysing, amongst other things, media content and political speeches in the nineteenth century and has since then been used extensively in communication, journalism, sociology, psychology and business. Bengtsson (2016) argues that the purpose of content analysis is to organise and elicit meaning from the collected data in order to draw realistic conclusions from it. A number of processes were considered to draft the best possible study design for this research. External and internal resources were identified, and the researcher considered his experience of the phenomenon to be studied to minimise any bias of his own influence. Bengtsson (2016) states that by using inductive reasoning, the researcher analyses the text with an open mind in order to identify meaningful concepts that answer the research question. The aim of this study is to explore the values and fears of mechanisation within the gold and platinum mining industry of South Africa. This is considered an interesting and unexplored dilemma that is not too broad.

4.2 ORGANISATION OF DATA ANALYSIS

According to Zhang and Wildemuth (2009), qualitative content goes beyond objective content extracted from texts to examine meaning, themes and patterns that may manifest or be latent in the text. Zhang and Wildemuth (2009) argue that qualitative content analysis allows researchers to understand social reality in a subjective but scientific manner. Qualitative content analysis is a mainly inductive process, grounding the examination of topics and themes as well as the inferences drawn from them in the data. Zhang and Wildemuth (2009) state that this analysis focuses on the extraction of unique themes from the data, which illustrate a range of meanings of the phenomenon rather than the statistical significance of the occurrence of particular texts or concepts.

Conventional qualitative content analysis, according to Zhang and Wildemuth (2009), is used for grounded theory development in which coding categories are derived directly and inductively from the raw data. This inductive reasoning involves the researcher's careful examination and constant comparison to extract themes and categories from the data. To support valid and reliable inferences, qualitative content analysis involves a systematic and transparent procedure for processing data. Zhang and Wildemuth (2009) proposed an eight-step process that includes the following:

1. Prepare the data.

Data generally need to be transformed into written text prior to the analysis thereof. Qualitative content analysis is very often used to analyse interview transcripts that allow the researcher to reveal or model interviewees' information-related behaviours and thoughts.

2. Define the unit of analysis.

According to Zhang and Wildemuth (2009), the unit of analysis refers to the basic unit of text to be classified during content analysis. This is considered one of the most fundamental and important decisions. Zhang and Wildemuth (2009) state that messages have to be unitised before they can be coded as discrepancies in the unit definition can affect coding decisions and comparability of outcomes with similar studies.

3. Develop categories and a coding scheme.

Categories and coding schemes can be developed from various sources (Zhang & Wildemuth, 2009). Inductive content analysis is particularly appropriate for studies with the intention to develop a theory. When developing categories inductively from the data, Zhang and Wildemuth (2009) recommend that the researcher use the constant comparative method. This method would stimulate original insights and the ability to differentiate between categories. The essence of the constant comparative method includes:

- The systematic comparison of each text assigned to a category with each of those already assigned to that category. This process ensures that a full understanding of the category is developed.
- Integrating categories and their properties through the development of interpretive memos.

4. Test the coding scheme on a sample of text.

The most effective way to clarify and create consistency of category definitions is to code a sample of the data. After the sample has been coded, the coding consistency is verified through an assessment of inter-coder agreement. In the event that consistency is low, the coding rules need to be revised, following an iterative process until sufficient coding consistency is achieved.

5. Code all the text.

When sufficient consistency has been achieved, the coding rules may be applied to the entire corpus of the text.

6. Assess the coding consistency.

Subsequent to coding the entire data set, the researcher needs to verify the coding consistency for a second time.

7. Draw conclusions from the coded data.

Once all coding has been completed and consistency verified, the researcher has to make sense of the themes or categories identified. At this stage, the researcher will make inferences and present reconstructions of meanings derived from the data.

8. Report on methods and findings.

For the study to be replicated in qualitative content analysis, the researcher has to report on decisions and practices concerning the coding process as well as the methods used to establish the trustworthiness of the study. Qualitative content analysis will uncover patterns, themes and categories that are deemed important to a social reality.

Bengtsson (2016) mentions four distinct main stages, which include de-contextualisation, re-contextualisation, categorisation and compilation. In contrast to quantitative research methods, qualitative content analysis is not linked to any particular science and the process is not so rigid. Bengtsson (2016) states that it is important that through the entire process, the researcher needs to maintain a qualitative perspective where trustworthiness can to be achieved. An overview of the research process from planning and presentation can be seen in Figure 4-1.

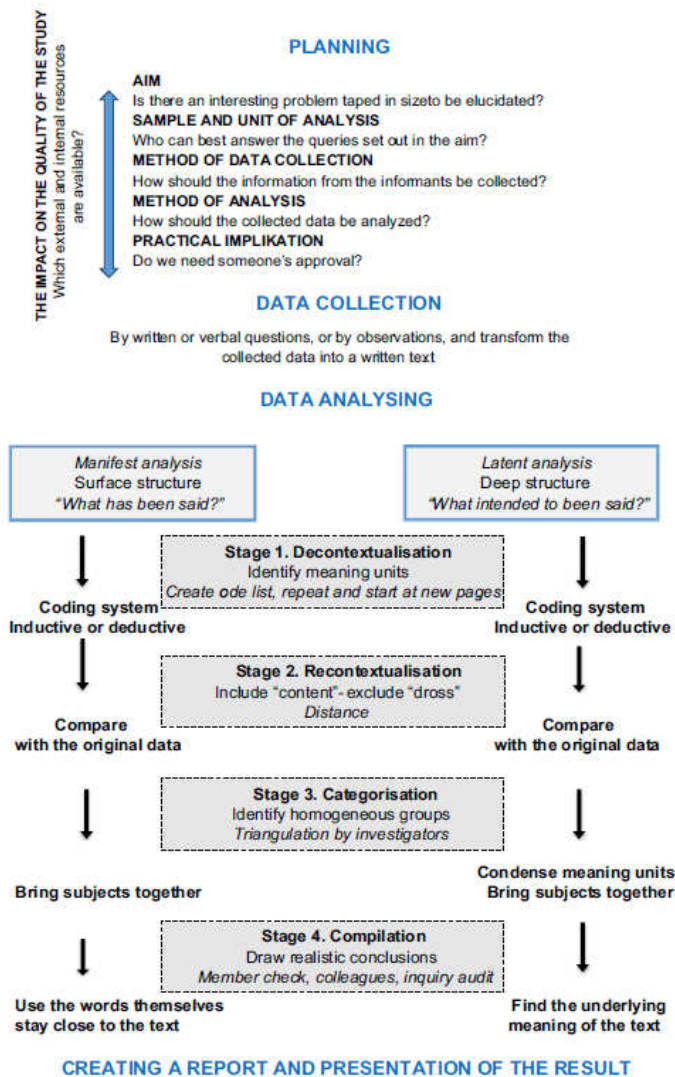


Figure 4-1: An overview of the process of a qualitative content analysis from planning to presentation

Source: Bengtsson (2016:9).

According to Elo and Kyngäs (2007), an inductive analysis process includes three main phases, namely the preparation, organisation and reporting phase. Similarities between these systematic processes and the eight-step process presented by Zhang and Wildemuth (2009) allowed the researcher to develop a formal inductive process, as illustrated in Figure 4-2.

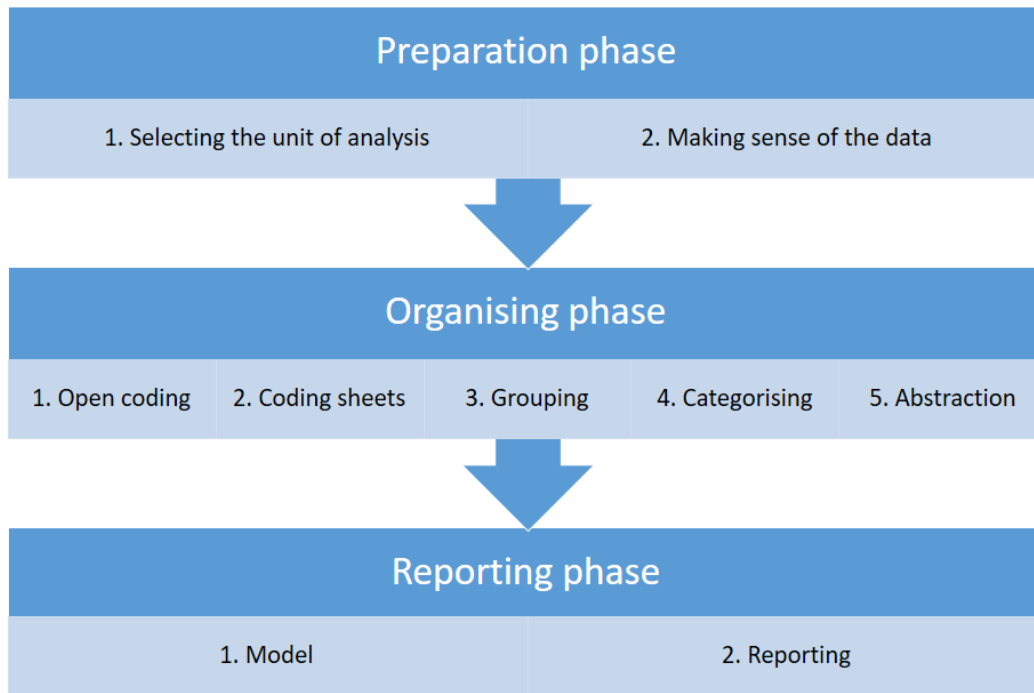


Figure 4-2: Inductive analysis process

Source: Author adopted from Elo and Kyngäs (2007).

Literature on qualitative content analysis presented different opinions on the use of concepts, procedures and interpretations. There are, however, similarities in the way the researchers explain the process. According to Bengtsson (2016), the difference often lies in the order in which the steps of analysis are taken, as well as in the way the researcher contemplates and consequently conceptualises the data. Based on these factors, the researcher decided that the data will be analysed by the process indicated in Figure 4-2.

4.3 CHARACTERISTICS OF RESPONDENTS

Bengtsson (2016) argues that in qualitative studies, it is common that data are based on one to thirty informants. The sample size was determined based on informational needs in order to adequately answer the research question. A summary of all the mining constituencies interviewed is listed in Table 4-1.

Table 4-1: Summary of all mining constituencies interviewed

Mining Constituents	Organisation	Number of interviews conducted
Employees, organised labour and communities	National Union of Mine Workers. (NUM)	1

	United Association of South Africa. (UASA)	1
Employers (mining houses)	Anglo American Platinum. Royal Bafokeng Platinum mines Northam Platinum limited AngloGold Ashanti Sibanye Stillwater Resources (Gold). Sibanye Stillwater Resources (Platinum). Village	1 1 1 1 1 1 1
Government	Department of Mineral and Energy.	1
Subject matter experts and original equipment manufacturers	Fermel (Pty) Ltd. Dr Paul Jourdan – Resource development strategist. Centre of Mechanised Mining System (University of Witwatersrand). Chamber of Mines of South Africa.	1 1 1 1
Total sample size		14

A total of 14 respondents were interviewed, each representing a particular cluster of mining stakeholders within the target population. A response rate of 60% was achieved from a planned interview target of 23 respondents. It was believed that this sample size is adequate and representative of all mining constituencies, and indications of information saturation were encountered during the content analysis process.

4.4 RESEARCH QUESTIONS

The research questions included six open-ended questions that were posed to all the respondents, as presented in Table 4-2. These questions were considered to be non-leading questions and were posed to each of the participants. Probing techniques were also used to stimulate additional information.

Table 4-2: Open-ended research questions posed to participants

No.	Question
1	Describe what mechanisation within the South African mining context means to you and the organisation you represent.
2	What values exist in the current conventional mining extraction strategy employed within the South African platinum and gold industry?
3	What threatens the current conventional mining extraction strategy employed within the South African platinum and gold industry?
4	Are there any opportunities that exist in the implementation of a fully mechanised extraction strategy?
5	Are there challenges with the implementation of mechanisation within the broader South African platinum and gold industry?
6	Do you believe that a balance could be struck between these perceived paradoxes?

The questions included enquiries related to the aim of the study that were utilised during content analysis. According to Bengtsson (2016), data collection methods such as interviews do not necessarily provide certainty in capturing the real context of the informants. Data collected during interviews were recorded and transcribed into a written form, which is an interpretive process.

4.5 ANALYSIS OF DATA

Preparation phase

According to Elo and Kyngäs (2007), the unit of analysis is the first step in the preparation phase and, depending on the research question, it may occur in several different forms, including a letter, word or sentence. Zhang and Wildemuth (2009) state that making use of a theme as a coding unit is aimed at primarily looking for an expression of an idea. Therefore, the researcher may assign a code to a portion of text of any size, provided that the portion of text represents a single theme. It is also important that this theme is of relevance to the research questions. In this research study, the unit of analysis decided on was categories that were extracted from different textual data, and the analysis included only the manifest content. Bengtsson (2016) argues that the key issue in making this decision is to decide what the researcher is seeking to elucidate as there are no established criteria for using content analysis. In this research study, the use of qualitative content analysis allowed the researcher to present data in categories, which made it possible to draw some interpretation of the results. Due to the manifest analysis conducted as part of the research study, the researcher described what the respondents actually said, making use of the words themselves as themes to describe the visible and obvious within the text.

The next step in the preparation phase is where the researcher strives to make sense of the data, according to Elo and Kyngäs (2007). The aim was to become immersed in the data by reading

through the material several times. Elo and Kyngäs (2007) argue that no theories can be developed from the data unless the researcher becomes completely familiar with the content.

Organising phase

The researcher chose an inductive content analysis process. According to Elo and Kyngäs (2007), this process is recommended if there is not enough former knowledge about the phenomenon or if the knowledge is fragmented. Open coding, where notes and headings are included in the text while it is being read, was the first step of the organising phase. The written material was read through and as many headings or themes as necessary were written down to describe all aspects of the content. The next step was to transpose the themes onto coding sheets where categories were freely generated. A table adopted from Bengtsson (2016:11) was used, where the researcher creates a transparent process from raw data to the conceptualisation of themes to ensure quality. This analysis schedule is included in the Annexures.

The meaning unit included in the analysis schedule is considered the smallest unit that contains some insight into what the researcher needs. It is a constellation of sentences or paragraphs containing related aspects in answering the question set out in the aim. Each identified meaning unit was labelled with a code that should be understood in relation to the context. This procedure is recognised as the “open coding process”, according to Bengtsson (2016).

Subsequent to the open coding, the lists of categories were grouped under higher order headings. The aim of grouping the data, according to Elo and Kyngäs (2007), is to reduce the number of categories by collapsing those that are similar or dissimilar into broader higher order categories. This process ensures that data are classified as “belonging” to a particular group with the purpose of providing a means of describing the phenomenon in order to increase understanding and to generate theories.

The final stage of the organising phase, according to Elo and Kyngäs (2007), includes abstraction. Abstraction includes the formulation of a general description of the research topic by generating categories. In this research study, abstraction included the generation of categories that are named using content-characteristic words. Sub-categories with similar characteristics were grouped together and main categories were generated from these generic categories. Table 4-3 presents an example of the coding sheet that includes the abstraction process of a particular theme.

Table 4-3: Example of the abstraction process used during the content analysis process

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
Improve their underground safety; secondly, potentially improve productivity; thirdly, also have a look at ways and means of how to become financially better acumen by implementing innovation technology into their operation such that they can reduce their cut-off grade, increase the life of mine and get a better internal investment that they may going forward.	It improves underground safety. Improvement of productivity. Reduced cut-off grades, increased life of mine and better internal investment.	Improved safety, improved productivity, reduced cut-off grades, increased life of mine, improved investment returns.	Improved safety, improved productivity, Reduced cut-off grades, increased life of mine, improved investment returns	Safety, productivity, ROI, sustainability, reduced cut-off grades.	Creates a safe environment where people are not exposed to danger. Improved productivity output. Alternative application of technology to create attractive investment opportunities. Sustainable mining method. Reduction in cut-off grades. Increased life of mine.

Table 4-2 represents the method used during the content analysis process where a total of 238 observations were coded, grouped, categorised and abstracted.

Reporting phase

According to Elo and Kyngäs (2007), the analysis process and the results should be described in sufficient detail to ensure a clear understanding of how the analysis was conducted as well as the associated strengths and limitations. Considering the six segments of the polarity map, coding sheets of each element were developed during the organising phase. A summary of the findings is presented in the subsequent sections of the reporting phase, identifying key categories that emerged from the content analysis process followed for each of the six segments.

4.5.1.1 Advantages of mechanisation

From the 238 observations made from the qualitative interviews conducted, 49 were classified as advantages of implementing a mechanised strategy within the mining industry. During the conventional qualitative content analysis, a total of 15 unique categories were extracted from the transcribed interviews by making use of an inductive process. These categories recurred throughout the data, as summarised in Table 4-4.

Table 4-4: Emergent categories classified as advantages of mechanisation

No.	Categories	Frequency
1	Creates a safe environment where people are not exposed to danger.	10
2	Improved productivity output.	7
3	Sustainable mining method.	7
4	Reduction in cut-off grades increases life of mine.	7
5	Alternative application of technology to create attractive investment opportunities.	6
6	Job displacement creates opportunities for the development of alternative niche markets.	5
7	Stimulate market growth in upstream industries.	4
8	Proven mining method with confirmed success rate.	3
9	Socially attractive skilled employment opportunities for younger generation.	3
10	Morally justified employment displacement imperative.	3
11	Regarded as an imperative to the survival of the industry.	3
12	Mechanisation offers a solution to technical and economic challenges.	2
13	Improved productivity prospects through 24/7 mining method.	2
14	Improve public image through the adoption of a more socially acceptable mining practice.	2
15	Possess in-house technical capability and skills.	2

From the content analysis, it is clear that the majority of respondents regard mechanisation as an alternative mining strategy that creates an environment for the safe and profitable extraction of minerals. It is regarded as a sustainable method of effectively reducing cut-off grades, creating attractive investment opportunities within the industry. Despite the fact that job displacement will occur, a number of observations suggest that respondents believe that alternative up- and

downstream industries could potentially experience growth as a result of adopting this alternative mining extraction strategy.

However, only a minority of the respondents believe that mechanisation is regarded as an imperative to the mining industry as it is a proven mining method that offers a solution to technical and economic challenges. A total of six observations suggested that job displacements as a result of mechanisation would appeal to the younger generation of South Africans joining the work force and these displacements are morally justified through the displacement of low-skilled, high-risk occupations for high-skilled, low-risk employment opportunities. Only four observations suggested that South Africa has the required expertise and skill set to establish and maintain a mechanised mining method and that the public image of mining houses would be improved through the adoption of more socially acceptable mining practices.

4.5.1.2 Disadvantages of mechanisation

A total of 67 observations were extracted from the data that were classified as disadvantages in adopting a mechanised mining method. Through indirect reasoning, the researcher extracted 13 categories from the data. These categories and the rate of reoccurrences that it appeared within the transcriptions are given in Table 4-5.

Table 4-5: Emergent categories classified as disadvantages of mechanisation

No.	Categories	Frequency
1	The current commercial mechanised solutions not suitable for SA orebodies that do not address the fundamental challenges.	27
2	New mining method reduces immediate direct job opportunities.	9
3	The lack of local research and development impaired our ability to develop tailor made solutions.	8
4	Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult.	7
5	There is no burning platform to initiate radical change within the industry yet.	7
6	There is a lack of trust and common purpose amongst mining constituencies.	6
7	Due to extended project pipelines and capital intensity of mining, the industry is not seen as an appealing investment destination.	5
8	People are not adequately empowered through training and education.	5

9	Current legislation is perceived as onerous and decreases competitiveness.	4
10	System optimisation is considered sufficient rather than a total transformation.	2
11	Foreign equipment procurement could lead to base erosion and profit shifting.	2
12	There exists a significant untransferable skills gap.	2
13	The sustainability of alternative job opportunities is questionable.	1

The fact that current mechanised extraction strategies do not effectively address the complexities associated with platinum and gold deposits within South Africa emerged from the text 27 times. This is the highest frequency of reoccurrence within the analysed data and emphasises the significance of this category within this qualitative study and to the subject matter in general. Other important challenges of implementing a mechanised solution are the fact that it reduces immediate direct job opportunities and the lack of local research and development to find a workable solution for the country's unique orebody. The incompatibility of existing infrastructure to a mechanised operation is very difficult and there is a belief that a burning platform is yet to be developed for such a radical transition to occur. The lack of trust amongst key stakeholders and extended project pipelines reduces investment appetite, and opportunities have also been identified as possible obstacles. A lack of employee empowerment through education and training and overly laborious legislation were also mentioned several times during the interviews.

System optimisation rather than transformation were mentioned only twice during the qualitative interviews, as well as the fear of profit shifting and base erosion from foreign equipment suppliers in adopting a fully mechanised mining method. Strategies of creating alternative job opportunities for displaced occupations as a result of mechanisation and the existence of a major untransferable skills gap remain an uncertainty amongst only a few of the respondents interviewed.

4.5.1.3 Action steps of mechanisation

Out of the 50 observations made, a total of 10 categories emerged from the data analysed. Through careful consideration and constant comparison, the researcher extracted these categories during the content analysis process. Table 4-6 includes these categories as well as the number of times these concepts emerged in the data.

Table 4-6: Emergent categories classified as action steps of mechanisation

No.	Categories	Frequency
1	Stakeholder involvement is curtailed to the success of implementing new technology.	7
2	The creation of manufacturing capability would create employee displacement opportunities.	7
3	Empowerment through education and training to change negative perceptions.	7
4	Consideration of mining infrastructure and system requirements.	5
5	The mining industry will experience a protracted evolution of the mining method over time.	5
6	Mineral beneficiation opportunities need to be exploited.	3
7	Cost-efficiency strategies need to be implemented to stimulate demand and curb the search for alternative investment opportunities.	3
8	Visionary leadership is required to save the industry from total collapse.	3
9	The entire business strategy of the mining industry needs to be re-evaluated.	2
10	Mining industry needs to re-invent themselves and develop transferable skills.	2

Critical actions required for a mechanised mining extraction strategy to be considered include stakeholder involvement, creation of displaced employment opportunities and empowerment initiatives to train and educate individuals. These three categories emerged frequently during the coding process as possible stimuli during the transition from a conventional mining method that relies on manual labour to a more mechanised approach. Mining infrastructure considerations and the focus on mineral beneficiation were also identified as possible action steps during a protracted evolutionary transition process rather than a rapid conversion of mining methods.

A call for visionary leadership to re-evaluate the entire business strategy of the mining industry in a quest to reinvent themselves was cited by a limited number of respondents. These overly broad statements were stated only five times during the interview process. More specific action steps were amongst the higher reoccurring categories in the coding scheme.

4.5.1.4 Advantages of conventional mining

A total of 18 observations were made that identified the inherent benefits of the current conventional mining extraction strategy. Seven categories were developed from the collected

data using inductive reasoning during the analysis of the text. Table 4-7 lists the seven categories in order of reoccurrence within the collected data.

Table 4-7: Emergent categories classified as advantages of conventional mining

No.	Categories	Frequency
1	Due to all the complexities involved in these orebodies, maintaining the status quo has its benefits.	5
2	Isolated technical improvement to the existing conventional mining methodology could lead to productivity and safety improvements.	4
3	Extraction strategy extensively utilises a localised commodity in the form of large amounts of labour without the need of high education levels.	2
4	South Africa has the largest platinum deposit in the world, which could create a monopolistic environment.	1
5	Conventional mining requires less capital to start-up and allows for flexibility in the process to handle low utilisation and geological discontinuities.	1
6	From a socio-economic perspective, employing more people with a lower salary is better than only a few people with high salaries.	1
7	Risk occupations create high remuneration opportunities without the need for higher education levels.	1

The primary benefit of the current method of extracting gold and platinum ore deposits in South Africa remains the versatility of the given methodology in dealing with the associated complexities of steep dipping, narrow tabular orebodies. There is also a belief that the modernisation and advancement of some of the technologies currently utilised could lead to productivity and safety improvements within the mining industry. The extraction strategy is fundamentally based on the utilisation of a large amount of manual labour where high education levels are not a prerequisite, which suits the current South African population profile. Moreover, it is believed that because South Africa is the holder of the world's largest deposit of platinum-bearing reef, it creates a scenario where the country may adopt a less efficient mining strategy that is mainly focused around the economic benefits that it holds for a country as a whole due to the monopolistic environment in which it finds itself. Similar to other industries, labour-intensive strategies typically require less start-up capital and allow for some flexibility from a financial and technical point of view. A reduced capital footprint results in a lower fixed cost that will be incurred at all levels of output and will affect the breakeven point of the operating unit. This cost benefit might be offset

by a higher variable cost due to the labour-intensive nature of the mining method, but allows for cost flexibility with the level of output.

The fact that high-risk occupations can artificially drive higher salaries without a need for comparatively high education levels is a principle most probably derived from the risk and return fundamentals found in the financial industry. In the financial market, investors expect a higher financial gain by accepting a higher measure of uncertainty of the return, termed the equity risk premium of such an investment. It is therefore not inconceivable that society would expect a higher return in the form of a salary for work being performed in an increasingly unsafe environment. This notion is, however, not conditional on the level of education that the particular individual has but rather on their propensity of taking on risk. From a socio-economic point of view, the adoption of more labour-intensive methods within the industry reduce unemployment and income disparity within the macroeconomy. These two categories were mentioned only once during the interview process.

4.5.1.5 Disadvantages of conventional mining

From the unitised observations extracted from the transcribed interviews, a total of 44 observations are considered as shortcomings of the current conventional mining extraction strategy. During the content analysis process, seven categories were identified, as listed in Table 4-8.

Table 4-8: Emergent categories classified as disadvantages of conventional mining

No.	Categories	Frequency
1	A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High cut-off grades sterilise the majority of the remaining ore reserves.	16
2	Due to the high health and safety risk to employees, the required rate of return on increases above a realistic achievable point; this makes it an unattractive investment opportunity.	9
3	Contrary to belief, flexibility within a conventional methodology is practically very limited.	9
4	Due to the nature of job occupations, the industry fails to attract new talent, which has dire consequences.	7
5	Above-inflationary wages have an adverse effect on financial viability of labour-intensive industries such as conventional mining.	4
6	Output efficiency reduces when manual labour is compared to mechanised processes.	3

7	Misaligned focus points deter collaboration amongst stakeholders in a paradigm where teamwork is paramount.	2
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An overwhelming number of observations were made regarding the specific conditions that need to prevail for a mining methodology solely reliant on the manual extraction of ore within the reef horizon, as it becomes increasingly more challenging to maintain these conditions going forward. Due to the absorbent costs associated with creating and maintaining these conditions for people to operate in, a significant amount of the existing ore reserves is being sterilised, as it is declared uneconomical to extract the minerals. From an investment perspective, the risk to employees within the reef horizon increases the risk premium dramatically. This in turn creates a disparity between the anticipated returns and associated risk, ultimately resulting in a decrease in the overall attractiveness of such an investment. Flexibility of the mining method is also considered to be limited in that a considerable amount of cost is incurred in creating favourable working conditions. The additional infrastructure requirements essentially strip the extraction strategy of its inherent flexibility. Another disadvantage is that making use of manual labour as a method of extracting minerals does not appeal to the younger generation of employees as they did with previous generations. This creates a skills and labour deficit particularly in occupations that form part of the mining crews directly involved in extracting the minerals manually.

Above-inflation labour increases are considered a challenge in that it directly affects the economic viability of the operation. Due to the reliance on manual labour, which forms part of conventional mining, an increase in the wage bill has a significant impact on the direct mining cost. In the absence of flexibility, the argument of lower efficiency rates compared to mechanised processes has been rehashed, maintaining that there is ultimately no real benefit in opting for a conventional mining layout at current depth. The lack of collaboration amongst the key stakeholders due to misaligned focus points was identified four times within the collected data as a challenge that the current mining method faces.

4.5.1.6 Action steps of conventional mining

Ten observations were classified as potential action steps, should a conventional mining methodology be opted for. During the content analysis, six categories were extracted from these observations and listed in Table 4-9.

Table 4-9: Emergent categories classified as action steps of conventional mining

No.	Categories	Frequency
1	During the modernisation of mines, priorities need to be established.	3

2	By creating a junior miner market, the introduction of entrepreneurial spirit within the existing market could be the differentiating factor.	2
3	During the transition period from old to new technologies, there will be a transition period where both mechanised as well as conventional methodologies will co-exist.	2
4	With the establishment of mechanisms such as a platinum trading company to regulate the price of platinum, South Africa can non-mechanise all platinum operations and establish themselves as a major employer.	1
5	Successful modernisation of conventional mines needs to be well documented so that other industry role-players can gain the knowledge of those successes.	1
6	The health and safety narrative is not necessarily a priority of all stakeholders but is rather seen as providing leverage to negotiate higher salaries without an education prerequisite.	1

Action steps for conventional mining include the implementation of isolated technologies that may systematically result in productivity and safety improvements. Therefore, mining operators should establish clear priorities that modernisation initiatives aim to achieve. The establishment of a junior miner market compared to the current mining landscape that is dominated by multinational mining giants was identified as another potential action step. It is believed that by establishing a junior miner market, entrepreneurial spirit associated with these players will create a differentiating factor in the industry. Due to the perception that the transition from the existing mining extraction strategy to a more mechanised approach is going to be a protracted process, a conducive environment needs to be created where the two mining methodologies can co-exist.

The establishment of a mechanism in the platinum industry regarding the fixing of prices, dividing up the market or otherwise restricting competition among the producers was another possible action step similar to what has been implemented in the diamond and crude oil industry. This form of overt collusion or cartel typically allows the industry, which clearly has the market power, to hold the price of platinum substantially above its marginal cost of production. The documentation of modernisation attempts in conventional mines and its successes have to be well documented. The same applies for misconstrued ideologies amongst constituencies in respect of the safety imperative of employees where possible action steps were mentioned on isolated occasions during the interview process.

4.6 CREDIBILITY, TRANSFERABILITY, DEPENDABILITY AND CONFORMITY

Zhang and Wildemuth (2009) argue that in evaluating interpretive research work, credibility, transferability, dependability and confirmability need to be ensured. Credibility refers to the adequate representation of the constructions of the social world under study (Zhang & Wildemuth, 2009). In order to improve the credibility of qualitative content analysis, researchers need to design data collection strategies that can solicit the representations as well as design transparent processes for coding and drawing conclusions from the data. To ensure adequate credibility, the researcher has provided precise coding definitions and clear coding procedures.

Transferability refers to the extent to which the researcher's working hypothesis can be applied to another context. It must be noted that qualitative content analysis does not require an index of transferability but rather the providing of data sets and descriptions that are rich enough so that other researchers are able to make judgements about the transferability of the findings to different settings and contexts. The researcher has ensured that there is adequate information available for other researchers to make an assessment on the transferability of the findings.

According to Zhang and Wildemuth (2009), dependability refers to the coherence of the internal process to changing conditions in the phenomena, whereas confirmability refers to the extent to which characteristics of the data can be confirmed by others who read or review the research results. Dependability and confirmability can be established through audits of the research process and findings. Dependability was established through the use of only one individual performing the content analysis process to ensure reasonable practicable internal coherence as far as possible. Confirmability was established through reviews conducted by the respondents on the respective coding.

4.7 SUMMARY

In following the three basic building blocks of the content analysis process, namely preparing, organising and reporting, a number of key categories emerged from the data collected that were grouped in the six segments of a polarity map. A polarity map is considered a theoretical framework for dealing with polarities to establish a long-term resolution to ongoing issues. The qualitative conventional content analysis process included, amongst other things, the analysis of text data from the interview procedure through a systematic classification method of coding and identifying themes or patterns in order to provide knowledge and understanding of the phenomenon being studied. A total of 238 observations were classified into 62 categories grouped into the six segments of the polarity map. Chapter 5 presents the findings of the study in the form of a polarity map with the associated action steps of each dilemma.

CHAPTER 5: FINDINGS, CONCLUSIONS AND IMPLICATIONS

5.1 INTRODUCTION

Chapter 5 comprises an overview of the entire study; it includes the restatement of the research question and a summary of the literature reviewed. A review of the findings from the qualitative content analysis is presented factually and in an organised narrative. The findings are followed by a conclusion fundamentally based on the research question stated in Chapter 1 as well as an analysis, synthesis and evaluation of what was found in the research, bringing the research paper to a full circle completion. Practical suggestions for addressing issues that were raised are offered, which not only include what should be done but also how it can be done. Some thought was given in respect to possible further studies in the area of the research conducted. The chapter concludes with a brief statement of the purpose of the research, followed by an overview of the findings and a conclusion.

5.2 SUMMARY OF THE STUDY

Mechanisation within the South African gold and platinum industry is a mining methodology that sparks diverse reactions whenever it is considered. Reasons for these mixed sentiments are as diverse as the belief in achieving success through the implementation of such a mining strategy. This research study explored the values and fears of mechanisation within a South African setting in an attempt to clarify why the sector has achieved inconsistent mechanisation implementation results as well as to create an understanding of what key success factors are required to circumvent the challenges associated with the implementation thereof. This research provides insight to decision-makers and other stakeholders in attempting to create holistic representation of the advantages and the disadvantages of mechanisation within a pre-defined population group. Fundamentally, the entire study aimed to provide an answer to the challenges of mechanisation within the South African gold and platinum industry.

The literature study commenced with an overview of South Africa's economy and how its performance is measured. Considering South Africa's economic growth over the past century and the main drivers that created the growth crafts a construct of an economy built on mainly mining activities, taking the advantage of limited competition and unsustainable social structures. In light of the political climate and associated economic development within the country, South Africa's history is characterised as highly unstable, with isolated temporary periods of economic prosperity since 1970. The economy has, however, slowly moved from a labour- and capital-intensive market prior to 1994 to a paradigm where technology advancements contribute more than half of the recorded growth currently. Due to the labour-intensive nature of South Africa's mining

industry, mining intensity within the country has revealed a similar trend over the last four decades. From a giant industry, playing a significant role in the economy in the 1970s to 1980s, the mining industry has diminished in importance to a position where it contributes less than 10% of the country's GDP in 2017. With the platinum and gold industry still accounting for more than 60% of the mining industry in South Africa, these two industries drive the declining trends. Where market applications of these two precious metals are the complete opposite of each other, driving its associated commodity prices, both industries experience the same difficulty in struggling to maintain competitiveness compared to other sovereign nations. This, even though South Africa still possesses the largest gold- and platinum-bearing deposits in the world. One of the major contributors to the demise of platinum and gold mines within South Africa is due to its high above-inflationary wage increases. The inability of the mining industry to transform its operations to more cost-effective operations subsequently deters investors, resulting in a further decline in foreign direct investment. Mechanisation of mining operations is seen as one of the possible solutions to the challenge faced by the South African gold and platinum industry. However, this transition raises a number of concerns because the adoption of a mechanised solution is riddled with technical and social complications. It is on this basis that an exploratory study aimed at capturing all the values and fears of both the existing mining extraction strategy and the mechanised alternative was conducted. The review of the literature also formed the basis for the development of the strategies of inquiry. As a consequence, an interview process was formulated in a semi-structured format that made use of six open-ended questions.

The study population in this qualitative research study included all stakeholders within the South African gold and platinum industry that represent the operating context. The identified mining constituencies included:

- Employees, organised labour and communities
- Employers (mining houses)
- Government (Department of Mineral and Energy)
- Original equipment manufacturers
- Subject matter experts

A total number of 23 respondents were identified as the sample size that were invited to take part in the research study. A response rate of 60% was achieved, where 14 individual interviews were conducted with at least one of the interviewees representing each of the identified key stakeholders.

5.3 FINDINGS

During the analysis of the data collected from the interview process, a total of 238 observations were made that were grouped into a theoretical framework for dealing with polarities. Thereafter, a long-term resolution to ongoing issues termed a polarity map could be established. Through an inductive qualitative content analysis process, these observations were de-contextualised, re-contextualised and categorised.

During the organising phase of the content analysis process, categories were extracted for the data collected. This was done by labelling each identified meaning unit with a code which should be understood in relation to the context, forming part of the open-coding process. The abstraction process in this research study included the generation of categories which are named using content-characteristic words. Higher order categories for each of the six segments of the polarity map were identified during the content analysis process.

5.3.1.1 Advantages of mechanisation

From the 49 observations made, a total of 15 categories were extracted from the meaning units. The majority of respondents regard mechanisation as an alternative mining strategy, which creates a cost-effective environment for the safe and efficient extraction of minerals. Reducing cut-off grades creates a favourable setting for creating attractive investment opportunities within the mining industry. Despite that job displacement will occur, a number of observations suggest that respondents believe that alternative up- and downstream industries could potentially experience growth as a result of adopting this alternative mining extraction strategy. These results of the study correspond to a statement by Taylor (2013) that mine mechanisation will assist in addressing safety, cost and productivity challenges. Taylor (2013) reported that innovative thinking will be required to address these economic, safety and health issues to establish a sustainable mining industry.

5.3.1.2 Disadvantages of mechanisation

From the data, a total of 67 observations were extracted that were classified as disadvantages of adopting a mechanised mining method. The 13 categories extracted from these observations indicated that the current mechanised extraction strategies were considered as ineffective in addressing the complexities associated with platinum and gold deposits in South Africa. Other challenges in implementing a mechanised solution lie in the fact that it would reduce immediate direct job opportunities and the lack of local research and development to find a workable solution for the country's unique orebody. CNBCAfrica (2013) regard mechanisation as a double-edge sword, stating that despite mechanised mining solutions creating a steady revenue stream and

the potential for significant cost reduction, job losses as a result of mechanisation could have an adverse impact on the nation's unemployment rate that could spark renewed labour sector disputes. The incompatibility of existing infrastructure with a mechanised operation is considered a challenge and there is a belief that a burning platform is yet to be developed for such a radical transition to occur. The lack of trust amongst key stakeholders and the extended project pipelines, which reduce investment appetite and opportunities, have also been identified as possible obstacles. A lack of employee empowerment through education and training and overly laborious legislation were also mentioned several times during the interviews.

5.3.1.3 Action steps of mechanisation

Ten categories emerged from the 50 observations grouped as possible action steps towards the implementation of mechanisation as an alternative mining extraction methodology. The higher ranked categories included stakeholder involvement, creation of displaced employment opportunities and empowerment initiatives to train and educate individuals. These three categories emerged repeatedly during the coding process and act as possible stimuli during the transition from a conventional mining method to a more mechanised approach. According to CNBCAfrica (2013), the South African mining industry needs to be more technology orientated in the future and should focus on reducing labour numbers at the reef horizon, which is exposed to life-threatening situations. Mechanisation not only offers the opportunity to remove people from eminent danger but also offers a platform to develop new skills, according to CNBCAfrica (2013). Mining infrastructure considerations and the focus on mineral beneficiation were identified as possible action steps during a protracted evolutionary transition process rather than a rapid conversion of mining methods.

5.3.1.4 Advantages of conventional mining

Seven out of the 18 observations grouped as values or advantages of the current conventional mining method referred to the versatility of the given methodology in dealing with the associated complexities of steep dipping, narrow tabular orebodies. There is also a strong belief that the modernisation and advancement of isolated technologies within the existing mining method could lead to productivity and safety. Conventional mining is primarily based on the utilisation of a large amount of manual labour where high education levels are not a prerequisite. Because South Africa currently possesses a relatively large low-skilled workforce, this mining methodology provides direct employment opportunities for a major portion of the predominantly rural population. Moreover, it is believed that because South Africa is the holder of the world's largest deposit of platinum-bearing reef, the country may adopt a less efficient mining strategy due to the monopolistic environment in which it finds itself. Similar to other industries, labour-intensive

strategies typically require less start-up capital and allow for some flexibility within from a financial and technical point of view. A reduced capital footprint results in a lower fixed cost that will be incurred at all levels of output and that will affect the breakeven point of the operating unit. This cost benefit might be offset by a higher variable cost due to the labour-intensive nature of the mining method, but allows for cost flexibility with the level of output and the reduction of capital intensity. Taylor (2013) argues that one of the reasons for the implementation of a relatively large workforce within South African mines was due to the abundance of this resource that has been low-cost for years. Reuters (2013) states that the South African mining industry and in particular the platinum sector favours labour-intensive mining practices due to the geology associated with the orebody. Because of the geological structure of the platinum seams, the rock is still drilled, blasted and cleared by men.

5.3.1.5 Disadvantages of conventional mining

A total of 44 observations were regarded as challenges related to the current mining extraction strategy. Seven categories emerged from the meaning units identified, which included the increased difficulty to ensure the required health, safety and environmental conditions within the reef horizon. Due to the absorbent amount of cost associated with creating and maintaining these conditions for people to operate in, a significant amount of the existing ore reserves are being sterilised as it is declared uneconomical to extract the minerals. From an investment perspective, the risk to employees within the reef horizon increases the risk premium dramatically. This in turn creates a disparity between the anticipated returns and associated risk, ultimately resulting in a decrease in the overall attractiveness of such an investment. Flexibility of the mining method is also considered to be limited in that a considerable amount of cost is incurred in creating favourable working conditions. The additional infrastructure requirements essentially strip the extraction strategy of its inherent flexibility. Another disadvantage is making use of manual labour as a method of extracting minerals does not appeal to the younger generation of employees as it did with previous generations. This creates a skills and labour deficit particularly in occupations that form part of the mining crews directly involved in extracting the minerals manually. According to Reuters (2013), modernising the traditional drill and blast process with a more mechanised approach will improve safety, reduce cut-off grades and resolve some of the socio-economic problems associated with labour-intensive mining practices.

5.3.1.6 Action steps of conventional mining

Ten observations were grouped as potential action steps of the current labour-intensive mining extraction strategy. From these observations, six categories were extracted from the meaning units. The highest-ranking categories included the systematic implementation of isolated

technologies in modernising the strategy rather than transforming it, which could result in productivity and safety improvements. However, this emerging theme is inconsistent to statements made by Deloitte (2017) that true innovation cannot be achieved by implementing isolated technology solutions. Therefore, organisations are required to approach innovation as an enterprise-wide differentiator, according to Deloitte (2017). The need for mining operators to establish clear priorities that modernisation initiatives need to achieve was emphasised. Another potential initiative involved the establishment of a junior miner market compared to the current mining landscape dominated by multinational mining giants. It is believed that by establishing a junior miner market, entrepreneurial spirit associated with these players will create a differentiating factor in the industry. Due to the perception that the transition from the existing mining extraction strategy to a more mechanised approach is going to be a protracted process, a conducive environment needs to be created where the two mining methodologies can co-exist.

5.4 CONCLUSION

In an attempt to answer the primary research question of exploring the challenges of mechanisation within the South African gold and platinum industry, it became clear that the implementation thereof is a complex dilemma that can not be solved by one unique answer. This subject matter is therefore believed to be a polarity or concern that can be managed only by effectively focusing on two interdependent, diametrically opposite right answers rather than seeking for one single solution. Evidence of placing too much emphasis on the one pole of a polarity while neglecting the opposite pole, ultimately leading to failure, was found throughout the research study. In considering the current understanding of mechanisation as well as certain socio-economical and technical complexities associated with the South African gold and platinum mining industry, this research paper proposes the use of a polarity map to navigate leaders through the process of managing a polarity. Using this simple rubric assists in charting out the dual nature of a polarity and in enabling a deeper understanding of the benefits and pitfalls of the options considered. Considering mechanisation and the current conventional mining method as opposite polarities rather than considering a single solution to the challenges related to the South African mining industry allows leaders to develop an opportunity of co-existence instead of limiting alternatives to one single solution.

According to Johnson (1998), polarities can be defined as ongoing chronic issues that are unsolvable, making traditional problem-solving skills of finding the “right answer” obsolete. Polarity management therefore simplifies this complexity without being simplistic and capitalises on diversity without alienating groups. Johnson (1998) states that polarity management could also convert resistance to change to a resource for sustainable, ongoing changeability. Levknecht (2013) argues that through polarity management, two seemingly opposing values can

complement each other when applied in a balanced way. This modern “both-and” thinking could create an ideology where we see mechanisation and conventional mining as two interdependent methods where one is incomplete without the other. This thinking supplements our traditional “either-or” problem-solving thinking and acting, according to Levknecht (2013).

To visualise “both-and” thinking, Johnson (1998) created a polarity map divided into four quadrants, each portraying the values and fears of each of the dilemma. The higher purpose contains the answer to the question, “Why invest in managing this polarity?” (Johnson, 1998). In this research study, the higher purpose is to secure South Africa as the mining giant of the world. The deepest fear is that not managing this polarity would ultimately lead to the demise of the South African mining industry. The dynamics of managing a polarity include a natural flow from the disadvantage of one pole to the advantage of another (Johnson, 1998). However, after moving into the upside of the opposite pole, the system will in the course of time reach its limits and move towards the downside of that pole. This creates a natural pressure to self-correct by moving to the upside of the original pole. Johnson (1998) states that there are two forces that contribute to the shift from one pole to the next, which include the increased pressure from the disadvantage of the one pole as well as the increased attractiveness of the advantages of the opposite pole. In this research study, it is evident that moving from conventional mining to a more mechanised approach is fuelled by the disadvantage of the current labour-intensive mining method as well as the increased attractiveness of mechanising some activities. However, it is also true that over the course of time this strategic direction could potentially adjust itself to a more labour-intensive industry once again. The findings of the analysis conducted in this research study are summarised in the form of a polarity map illustrated in Figure 5-1.

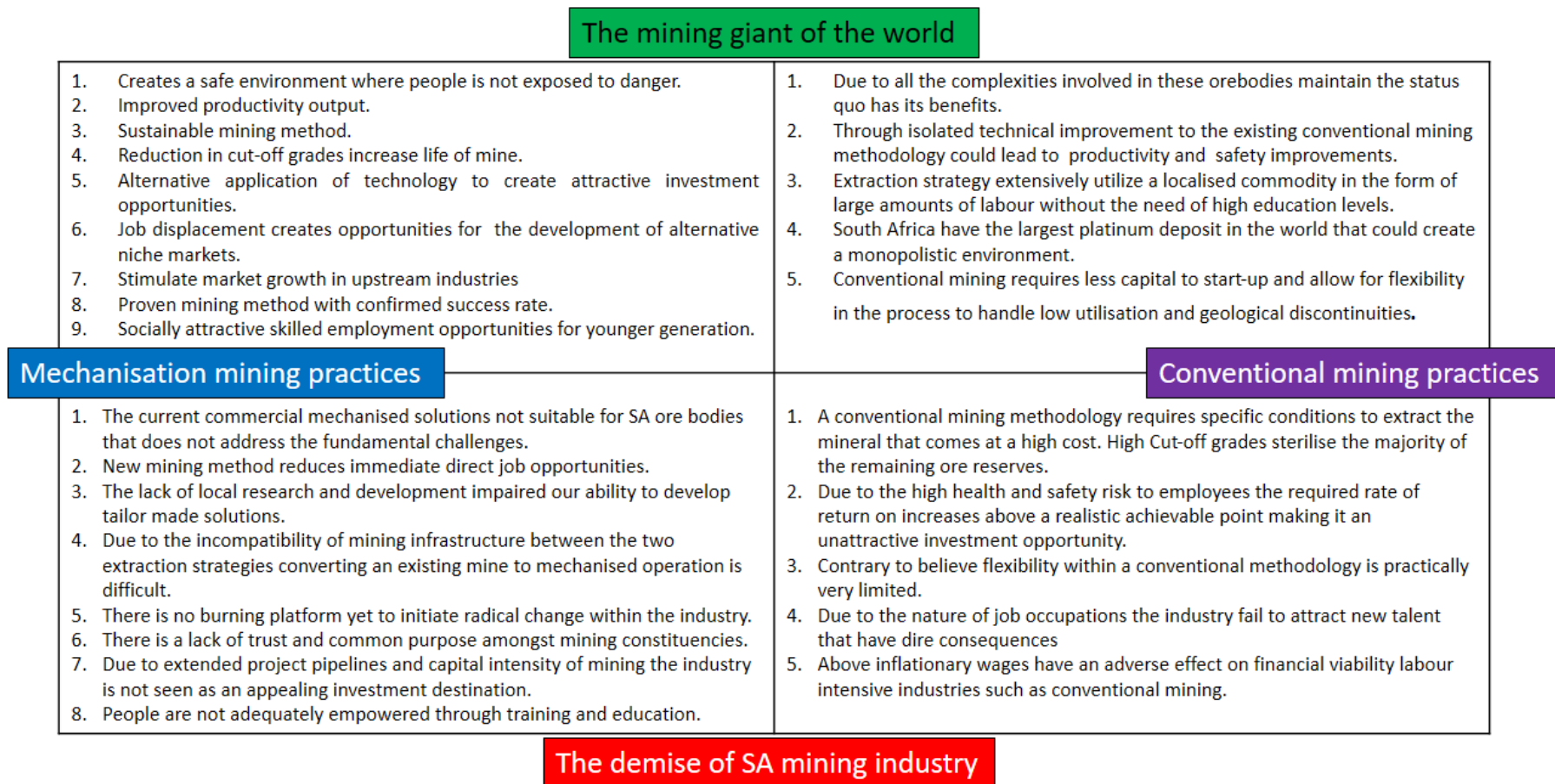


Figure 5-1: Polarity map of Mechanisation and Conventional mining practices

According to Johnson (1998), a well-managed polarity is one in which an industry or organisation capitalises on the inherent tensions between the two poles. Attaining the benefits of both upsides and the synergies between them will result in the fulfilment of the higher purpose. According to Johnson (1998), a polarity is managed poorly when an industry or organisation puts too much emphasis on the one pole to the neglect of the other. This often happens as a result of traditional problem-solving methodologies.

To manage the polarity, Johnson (1998) believes that an industry or organisation needs to identify structures, policies or practices that will ensure that the positive results in each upside quadrant are maintained. The action steps forming part of the polarity map are developed to guide leaders in maintaining the positive results from both conventional mining and mechanised practices within the South African gold and platinum mining industry, as illustrated in Table 5.1.

Table 5-1: Action steps of both mechanisation and conventional mining practices

<p>Action steps for mechanisation.</p> <ol style="list-style-type: none"> 1. Stakeholder involvement is curtail to the success of implementing new technology. 2. The creation of manufacturing capability would create employee displacement opportunities. 3. Empowerment through education and training to change negative perceptions. 4. Consideration of mining infrastructure and system requirements. 5. The mining industry will experience a protracted evolution of the mining method over time. 6. Mineral beneficiation opportunities need to be exploited. 	<p>Action steps for conventional mining practices.</p> <ol style="list-style-type: none"> 1. During the modernisation of mines priorities need to be established. 2. By creating a junior miner market the introduction of entrepreneurial spirit within the existing market could be the differentiating factor. 3. During the transition period from old to new technologies there will be a transition period where both mechanised as well as conventional methodologies will co-exist. 4. With the establishment of mechanism such as a Platinum trading company to regulate the price of platinum, South Africa can non-mechanise all platinum operations and establish themselves as a major employer.
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These action steps emerging from the qualitative research study state clear actions and decisions that will maintain a paradigm of conventional and mechanised co-existence within the South African gold and platinum mining industry. Early warnings termed red flags are measurable indicators that alert the user of the polarity map moving into the downside of a particular pole. These measurable indicators for both mechanised methods as well as conventional mining are included in Table 5.2.

Table 5-2: Red flags of both mechanisation and conventional mining practices

<p>Red flags for mechanisation.</p> <ol style="list-style-type: none"> 1. Mechanised solutions operational competence fall short of addressing the fundamental challenges of narrow tabular ore bodies. 2. Increased levels of unemployment due to no alternative job opportunities for displaced skills . 3. Insufficient execution of local research and development to develop tailor made solutions. 4. Continued mining infrastructure incompatibility challenges with mechanised solution. 5. High resistance to change as no burning platform exist. 6. Lack of trust amongst stakeholders. 7. High levels of capital intensity creates unattractive investment opportunities. 8. Inadequate empowered through training and education. 	<p>Red flags for conventional mining practices.</p> <ol style="list-style-type: none"> 1. Extremely high cut-off grades that sterilise the majority of the remaining ore reserves. 2. High health and safety risk to employees. 3. Limited flexibility within a mineral extraction methodology. 4. Inability of the industry to attract new talent. 5. High wages demands that negatively effect the financial viability of a large portion of the mining industry.
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Red flags were extracted from the disadvantages of both the mechanised mining strategy as well as the conventional mining method. Red flags will caution the user of the polarity map that persistent venturing along this strategic path will result in the realisation of the anticipated fears of the particular pole. According to Johnson (1998), these red flags will sensitise the user that a natural flow from the downside of one pole to the upside of the other is required, forming an infinite loop over time as polarities are ongoing. Johnson (1998) stresses that to “solve” polarities is to learn how to manage them.

5.5 IMPLICATIONS

A practical suggestion for addressing the issues that were raised in the research include the use of polarity management within the South African mining industry. This qualitative research study forms the basis of recognising the pole preference of mining constituencies and that these values and fears are in conflict with each other. The polarity map therefore provides a visual representation of the proponents for and proponents against mechanisation, the natural predisposition to move towards their preferred values and away from their perceived fears. It is the researcher’s belief that the South African gold and mining industry is currently trapped from the normal flow of a labour-intensive mining industry towards a more mechanised methodology because the system is holding onto the values of conventional mining and avoiding the fears associated with mechanisation. In order to get unstuck, it is necessary for the industry and the nation to recognise that this is a polarity to manage and not a problem to solve. Once that is understood, the development of a polarity map as presented in this research study is required to capture the conflicting values and fears of both sides of the poles to combine them for the higher purpose. It is important to note that with a polarity to manage, the focus on either pole in isolation is not sustainable. Any effort to move from the downside of one pole to the upside of the other,

assuming this is the “right answer”, will generate resistance that will result in the loss of a competitive advantage and in a costly struggle without sustainable positive results. The utilisation of a polarity map is therefore suggested as a tool to anticipate the learning curve and to gain support in advance. According to Johnson (1998), getting unstuck includes the following steps on how this polarity could be managed:

1. Affirming the upside values of the present pole (conventional mining methods).
2. Recognising the potential downside towards which the industry intends to move (mechanisation).
3. Seeking support in pursuing the upside of the pole towards which the industry intends to move (mechanisation).
4. Offering support to hold onto the upside of the present pole (conventional mining methods).
5. Gaining agreement regarding the higher purpose (the prosperity of the South African mining industry).

It is suggested that following these steps will ensure that all stakeholders anticipate the learning curve that forms the key to sustainability. Johnson (1998) states that with any polarity, the exclusive focus on either pole will generate its own resistance and is not sustainable.

5.6 FUTURE RESEARCH

The application of “both-and” thinking within the South African mining industry that supplements rather than replaces the traditional problem-solving techniques is necessary because we need both approaches. Further research is therefore required to explore the further use of polarity management within the industry and to investigate the existence of unsolvable problems. In respect of mechanisation, further exploratory research is required by making use of focus groups. This will not only supplement the research findings of this qualitative research study but will also provide a platform for creating a deeper understanding of the existence of polarities and the management thereof amongst all stakeholders. The rationale behind the necessity of additional research in polarity management and in particular mechanisation is due to the success of high-performing industries and organisations in achieving their higher purpose. In part, they have created systems and processes that assist them to adequately manage polarities.

5.7 SUMMARY

The objective of the research study was to investigate the factors that contribute to the challenges of mechanisation within the South African mining context and to provide insight into the reasons

for hindrances to the implementation thereof. Due to diverse opinions regarding mechanisation as a possible solution within the South African mining industry that is in crisis, the researcher believes that there is a definite need for conducting a study with the specific aim of identifying and quantifying the challenges to modernise South African mines.

The content analysis process of this qualitative research study included a preparation, organising and reporting phase. Through inductive reasoning, a number of key categories emerged from the data collected, which were grouped according to the six segments of a polarity map. A polarity map is considered a theoretical framework for dealing with polarities to establish a long-term resolution to ongoing issues. The qualitative conventional content analysis process included the analysis of text data from the individual interviews conducted on a sample of the target population. Through a systematic classification process of coding and identifying themes or patterns, valuable knowledge and understanding of this phenomenon being studied was gained. A total of 238 observations were classified into 62 categories and subsequently grouped into the six segments of the polarity map.

The use of polarity management in respect of this subject matter is based on the researcher's personal conviction that the South African gold and platinum mining industry is faced with a polarity rather than a solvable problem in respect to whether to mechanise or not to mechanise. The implementation of polarity thinking could be complicated, as Johnson (1998) believes that when we experience a challenge, a natural tendency exists to automatically go to past experiences and, more specifically, problems we were asked to solve throughout our education. Virtually all of these problems were "either-or" with one single solution. The second reason why individuals are likely to use "either-or" thinking for a polarity is that a dilemma appears to be very similar to a problem in that an "either-or" problem is often 50% of a polarity to manage. Johnson (1998) argues that applying traditional problem-solving techniques to a polarity creates an incomplete picture that results in significant resistance to a seemingly obvious solution as well as the introduction of a new set of challenges.

Johnson (1998) argues that pole preference is a combination of values and fears. Therefore, a person or group prefers one pole over another because they value the advantage of their preferred pole or they fear the downside of the opposite pole. It is important to recognise that there are conflicting values and fears as both proponents of the paradox are inclined to move toward their preferred values and away from their fears. From a polarity management perspective, these tensions are an important resource because they provide two essential pieces of the polarity map to manage this polarity by capitalising on the inherent tension between the two poles. According to Johnson (1998), polarity management provides a set of principles to formalise and enhance the skill with unsolvable problems. Industries and nations that develop the ability to not

only distinguish between solvable problems and unsolvable polarities but also to have the ability to respond effectively to each will create a sustainable competitive advantage. It is the belief of the researcher that challenges related to mechanisation within the South African gold and platinum industry need to be managed rather than addressed with a singular solution.

5.8 PERSONAL REFLECTION

I benefitted from this research study in that it completely altered my perception of this subject matter. Due to my technical background and engineering profession, my tendency was always to resort to conventional problem-solving techniques as almost all challenges are considered as solvable problems. It was on this basis that I believed the challenges related to mechanisation within the mining industry were no exception in that there exists only one defined solution to this problem. This research study has allowed me to consider this new concept of managing a dilemma by applying “both-and” thinking. It allowed me to remain open to alternative suggestions that at face value are the complete opposite to my personal convictions. I firmly believe that this research study and the application of polarity management could act as a catalyst to stimulate constructive dialogue amongst all stakeholders in a time where the sector is in desperate need of a turnaround strategy. Following a similar path and further research that involve the consideration of both conflicting and supporting views of mechanisation as well as the visualisation of such opinions in the form of a polarity map has the potential to establish a clear strategic direction for the industry. The use of polarity management could possibly be the answer to the stalemate position in which the industry finds itself.

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ANNEXURES

INFORMED CONSENT

Background

Mr. C.D. Conradie (Student number 11961023) is conducting this study in partial fulfilment of the MBA degree. This research project is designed to explore and describe the values and fears of mechanisation in the South African gold and platinum industry. Information obtained from the research project will be used for research purposes only.

Explanation of procedures

No intentional risks or harm are anticipated as a result of your participation. It will take approximately 20-30 minutes of your time to complete the interview. The information gathered during this project will at all times remain confidential. The following will be ensured by the researcher:

- The researcher will put it clearly to all participants that participation (including assent) in any research study is absolutely voluntary and that no pressure, of whatever nature, will be placed on any potential participant to take part;
- The researcher will put it clearly to all participants that any participant may withdraw from the study at any time and may ask that his/her data no longer be used in the study, without stating reasons and without fear of any form of prejudice;
- every participant who takes part in the study will receive the indicated form for informed consent and it will be ensured that every participant understands the information (including the process and risks) fully;
- every participant will provide informed consent before the study commences, or a witness will stand in on behalf of the participant when the participant cannot provide permission, but agrees to it;
- any foreseeable risk is restricted to the minimum, any permanent damage is avoided as far as possible and appropriate precautions and safety measures are in place;
- confidentiality of all the information of all participants will be respected and ensured;

Agreement

This agreement states that you have read and received a copy of this informed consent. Your signature below indicates that you understand the parameters of your participation and agree to take part in this research study.

Signature of Participant

Date

30 - 3 - 17

Participant's Name

Date

30 - 3 - 17

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This agreement states that you have read and received a copy of this informed consent. Your signature below indicates that you understand the parameters of your participation and agree to take part in this research study.

Signature of Participant



Date

16/5/17

Participant's Name

Navin Sinan

Date

16/3/17

Interview questions

No.	Question
1	Describe what mechanisation within SA mining context means to you and the organisation you represent.
2	What values exist in the current conventional mining extraction strategy employed within the SA platinum and gold industry?
3	What threatens the current conventional mining extraction strategy employed within the SA platinum and gold industry?
4	Are there any opportunities that exist in the implementation of a fully mechanised extraction strategy?
5	Are there challenges with the implementation of mechanisation within the broader SA platinum and gold industry?
6	Do you believe that a balance could be struck between these perceived paradoxes?

Quest 1: Sunset industry.

Mechanisation a solution to tech. challenges
Conventional becoming more inefficient with depth.

Quest 2: Mechanisation allow for 24/7 operation

Current status:

- Extremely deep
- Shift duration short.
- Do away with blasting.
- Remove people from danger.
- Socially more acceptable.

Quest 3: Build on a legacy of migrant labour.
Electricity cheap.

new generation fastly different. → not interested in manual labour.

Quest 5:

- Unemployment rate, high.
- Big Challenge → how we impliment mech.
- without the tag. (job losses)
- Beneficiation; dev our own equipment.
- Alternative jobs

Question 6:

- Mechanisation the ONLY solution
- Need to find feasible implimentation
- Need to be globally competitive
- We are a niche market
- Do not have cheap labour anymore.

Add ques: What tech exist for gold? What is the obstacles

- 1) Need to have a burning platform
- 2) Tech is available. → not off the shelf.

↓
will have to be adapted.

3) As long as labour = cheap & good margin → status quo prevails.

4) When mechanise, no alternative job opp.

Add ques: Sunset industry → Gold.

- 1) It is true.
- 2) Marginal mines; long project pipelines.
- 3) Tripartite issue.

Transcription of Respondent no3.

Interviewer: So thank you Respondent for allowing me this opportunity. I am going to start right with the first question and it reads: Describe what mechanisation within the South African mining context means to you and the organisation you represent?

Respondent: Mechanisation in the South African mining context is for me, really is that we're not going to have a South African mining industry if we are not able to harness mechanisation in general. And this is also view held by my organisation that we have to find a way of introducing mechanisation, specifically to be able to handle technical challenges associated with our future ore reserves and where they are. And then secondly from a productivity point of view, as we go deeper in variably our currently conventional labour force we become more inefficient and therefore makes a lot of our ore reserves obsolete. So in short, for me mechanisation really is a tool to secure the future for South Africa and specifically gold mining industry which is the industry that I represent.

Interviewer: Thank you very much. And explain to me Respondent, what do you guys regard as advantages that is currently within a conventional type of mining extractions strategy? And what I mean by that is, despite the fact that you indicate that we need to go to mechanisation. Is there stuff that we can retain from this sort of mining extractions strategy?

Respondent: I think the advantages of going mechanisation introducing it is that what's happening is, core bodies are involved, South African gold mines are extremely deep and progressively deeper which makes our day, our working day so much shorter. So the percentage of time that we spend travelling to the working place, and our employees travelling to the working place, is quite extensive meaning that the productive hours that's available, is quite limited. Now by way of how we actually mine currently by in conventional with re-entry periods with blasting etc, means that we hardly ever using all the time that's available. So what mechanisation opportunity that it does represent, is that it represents an opportunity to actually have a 24/7 operation. It's in particular if we can do mechanisation and do away with blasting practices. For that there is a number of opportunities that do exist but in short it's a case of saying that we can mine 24/7 instead of 8 hours a day. So that really from a various of propositions that I would say, it's ready to be able to utilise 24 hours a day which is really what we're going have to do if we are going to curb the cost challenges that do exist. Moreover I think, what mechanisation does do, is that safety remains one of our biggest challenges and our current conventional mining methods are obviously extremely labour intensive and brings the human life quite close to the rock face. So if we were able to mechanise, I mean we would be able to actually remove our people from the most hazardous environment, so actually we would be able to curb a lot of the accidents and incidents as which we have. In total it also helps the company in terms of its public image that's carried as well as obviously from a socially more acceptable because in South Africa, I mean in our mining industry you seen that it actually exposes our employees and instead of utilising been there for superior value

for everybody.

Interviewer: So you actually now just indicated obviously what the threats are that you as a company currently experience within this paradigm. The opportunities besides productivity and the safety, is there any other sort of opportunities that do exist by implementing mechanisation?

Respondent: Maybe just to elaborate a little bit more on the threat side of things, I think what we must understand is that, the South African, specifically the gold mining industry is built on a legacy in which we really had migrant labour which was an untapped resource of labour that was available in the early days of gold mining for quite a marginal cost. As well as electricity and water was fairly inexpensive, if you had to compare to world standards. So one of our biggest threats is that, you know as South Africa is a country that is developing, unfortunately or fortunately, our labour cost is on an annual basis increasing at least by 6 or 7%. So work and jobs that we were able to do historically with hand labour, now all of a sudden becomes actually more advantageous to look at mechanisation to sort of offset this ever increasing cost that is associated with labour. I think the other side of it also is that, obviously the threat that we do find ourselves is that the dynamic or the source of migrant labour that we had in history, is changing because we need to understand that we have young people that get educated and go to school and now are not very interested in actually doing hard labour. And the consequence and despite this proven technology that hasn't changed in hundred years, we actually are not going to have people to do it in the near future. Which is a significant threat. So apart from the cost of the labour, actually the interest from the labour to do the job is also not really there and that's becoming an increasing and bigger challenge. In terms of the opportunities that it does present, I do think that what we are sitting with is that we need to find sort of a world in which the mining industry actually keeps abreast of the development in terms of people and trends that we've had with young people as an example. So I mean what technology presents, is actually an easier way of doing the work. So by this I'm saying, I think if we had to compare the chances of technology, not really technology but mechanisation specifically, mechanisation being successful now relative to twenty years ago, I think the appetite with time is becoming more bigger. Both from people that want to utilise it as well as companies that are willing to try it for the reasons I've explained previously.

Interviewer: And anything in particular, and now specifically relating to the gold industry Respondent, what remains the biggest challenge of physically just going and saying, "Today we lay down the rock drill and we bring in the machine"? What are the things in your mind that plays a vital role and that remains a challenge to just simply implement?

Respondent: You have to start big circle and so from an outer circle point of view, saying what is our South African economy in very much to a large extent as a percentage of our GDP. It does have a marginal contribution now, but it still has a definite contribution, not potentially in GDP but in terms of employment. So as a country currently, we are sitting with 25% unemployment, I think that is the number,

so from a Government point of view, the interests from Government would be to actually seek industries and stimulate growth in industries that's going to employ people. Hence the reason why our current Government is the biggest employer as it currently stands. I think one of the major challenges that does exist, is that how do we introduce mechanisation without the "tag" that goes with it. Because invariably when you speak to any mining person about mechanisation, in the same breath they would say mechanisation equals job losses. So I think one of the major key challenges that we sort of have to be able to manage, is how do we bridge that? How do we do boast mechanisation and at the same time understand what do we do in the employment now? Now to this extent I think the major obstacle is that there's not anything feasible right now on the table to take over. That core of employment role that mining plays at the moment. And as largely because we are a net exporter of everything that we mine. As a collective and as a country, one of our biggest challenges has to be we need to understand how do we do beneficiation. How do we actually use and actually do our own equipment development and building thereof? And therefore be able to find another avenue of employing people in a higher skill. Because at the moment, if we look at our current conventional mining methods, it's hand labour, it's hard labour. It doesn't require any form of education and hence, I mean the ease that we are able to source labour. I think the issue is that these people have to work somewhere. When we go to the mechanisation process and I should think that from a social point of view, as Government and industry we need to understand how do we go about doing so, how do we locally beneficiate? Because I don't think I believe that if we don't do that, the chances of mechanisation being successful, technically it might work but socially it won't be acceptable.

Interviewer: And finally Respondent, how do you from an individual point of view, and then obviously also in line with your company aspirations, how do you actually see it? We had to look in a mirror ball. How do you see this industry, and particular the gold industry, panning out in years to come?

Respondent: I think from what I've shared in terms of the previous points, I should think that it's very clear that there isn't going to be a really a future for too long for the South African gold mining industry if we do not find a feasible way of introducing mechanisation. It's one of those where it's by hook or by crook, if we don't find a way of implementing mechanisation, invariably the industry have to come to a sudden closure. In truth what it really needs, is that we're delaying the inevitable, so the current workforce we have, over time will base to be unemployed. So it's now in our interest as well as Government's interest actually to find a way of doing exactly that. Introducing mechanisation so we can pull on the life of our ore bodies, because apart from the social economics side of things. Technically, there's only a, from a techno economic valuation point of view. We can't ventilate some of the places where our ore bodies extend to. We cannot secure seismic release in places where a lot of our ore bodies are. Although to a large extent the grade of our gold ore bodies has been protecting us to a large extent in tough times, I do think that going forward you know, even if our grade as it stands, won't be able to afford us the opportunity to be globally competitive. So I think as a South African industry we've got a huge challenge given that as South African mines we are narrow tabular, and by its definition "narrow

tabular”, means that it’s not open cast and akin to anything we do globally. I think we’re a niche market and what has made us successful, has been cheap labour, cheap water, cheap electricity and high grades. And I think as we start ticking them off, we don’t have cheap labour anymore, electricity has become increasingly expensive, and therefore the stars are certainly not aligning long term for us and we need to be able to mechanise to be able to secure a future. Specifically being as gold producers globally competitive. Because from a global point of view, South Africa’s gold mining in history, is every year, it is a sunset, very much viewed as a sunset industry. Every year we unfortunately produce less and that’s off the back of a lot of our ore reserves being sterilised and they’ve being sterilised because either we don’t have a technical way of mining them, where mechanisation would be able to give us say, an answer or a way, or secondly just because from a cost point of view, we can’t handle it. And very specifically on a lot of our marginal gold deposits which we have across South Africa.

Interviewer: And then just one thing that we talked about prior to this interview. Respondent can you elaborate a little bit with regards to technology? First of all, indicating obviously we’ve got a very unique ore body, particularly in the gold industry. You’re talking about steep tipping inclines of more than about 10 degrees so even rubber tyred vehicles opposes a significant challenge in terms of that. Do you honestly believe in, and being the head of the technical department as well, do you believe that no. 1, technology exists and is there anything that you regard as being a challenge in terms of implementing this sort of technology if that does exist?

Respondent: I think the best example of this would be to say, if we look at our method of breaking our rock, we to this day, use the SECO S215 rock drill. That rock drill is as old as the mining industry. It might have gone through some alterations right in the beginning, but to a large extent it stayed the same. And the reason why it stayed the same, is purely by virtually the fact that we didn’t have a need to change. There’s no need in burning a platform. The only time that technology really comes to the fore, technology/mechanisation are used then interchangeably because to a large extent they are, is when there’s a burning platform, when there is no future to do anything but to introduce technology or mechanise. By way of example, the way that we would historically a surveyor in South Africa would conduct his work underground, would be a surveyor with the necessary equipment, you would go underground with historically four helpers; one to carry a ladder, one to carry a theodolite, one to carry the lunch bag and one to carry the books and the surveyor himself carried nothing. So that was very much a mind-set that it was inculcated in our South African mining industry. And every year the helpers become less to the surveyor to the extend where we possibly won’t even have surveyors going forward. So that’s unfortunately what has to happen for us to survive. To answer the question in terms of do I think that there is a technology available; I do think there is. Maybe not off the shelf, definitely not off the shelf technology and mechanisation that can be taken and introduce at the whim. I think there are a lot of challenges, but if we go and look at the amount of time that senior executives in gold mining companies spend and how much money they spend towards technology and mechanisation, I think we’ll understand that it’s not a burning platform yet. So I think there is technology available, but not in its current format. It will have to be adapted and it will have to be changed and we would have to deal with

the changes that it does present and actually introduce them. But as long as, you know labour is relatively cheap, and we have relatively good margins, we probably won't introduce it. Specifically if you're sitting in an environment where from a regulatory point of view it's not been rewarded or incentivised to actually mechanise or introduce technology which is very much the current South African landscape where employment is a real, real challenge. So the closure of the mine that employs 4 500 people. Sadly we failed in terms of, as industry and Government, in terms of social and labour plans as to where the take up of these individuals should be. Whether we close the operation or whether we mechanise, because whether we like it or not, actually mechanisation does mean reduction in labour requirement. I think our inability to give an alternative to this labour, is what is a major obstacle in terms of introduction in both technology and mechanisation. I think as long as we don't understand what the social impact and social compact would require in what we need to do, to actually forward employment or other opportunities for this labour, that's how long it will take for us to successfully introduce mechanisation.

Interviewer: And then last but not least, the one question or discussion that came up in previous interviews, and I just would like your take on, especially with reference to gold mining. One of the comments that was made was the burning platform was already here. Meaning that, I think there was a comment being made "by 2025, if we don't mechanise now, we will virtually shut all of our gold operations" (no 1) and the second thing that I would like to just know, is basically to understand from your point of view; the gold mining in itself, from the 1970's where we've been the world's largest producer of gold, we virtually went to supplying about less than 10% in terms of gold production. From a resource point of view, or reserve point of view, do we have enough reserves and obviously you're looking at by mechanising or implementing technology, the lower the cut of grades so inevitably you actually unsterilize, if I can refer to some of these gold deposits again because you make it economical to mine again? Do you believe that we will reach that sort of levels again, or is it days gone by and we will never reach it?

Respondent: I think all the points that you're making are quite valid in terms of the ability of mechanisation to address a lot of the techno economic challenges. I think the answer is so, is it true that without mechanisation 2025 is probably the end of life? Well, yes. Also in part because we need to acknowledge that as a destination for capital. South Africa is a country, it's not a dripping roast at the moment and people are not too keen to invest serious amounts of capital in terms of long lead time projects which invariably, any gold mine is. From start of the sinking of a shaft to its first ounces is anything from 10 to 12 years and there are very few people or investors in the current climate that's prepared to take that risk. I think the challenge that we have, is that with the introduction of mechanisation, and using the point of saying if you don't mechanise, we die. I think it's quite true because from existing infrastructure, we have multiple secondary reefs, in specifically gold that are lower grade but can be economically extracted if we would be mechanised. I think what we have to acknowledge is that this is a three tier; this is a tripartite issue. It's an issue in terms of employers, us as business, it's an issue in terms of Government and it's an issue in terms of labour. And unfortunately what we find ourselves in at the moment,

is that as business we're saying that 2025 is the final time. The cliff is fast approaching but our challenge is that from a Government and from a labour point of view, somehow that urgency is not shared. And that is why we typically having, sad examples of Blyvoor as a gold mine with a huge secondary reef opportunities now virtually sterilised on the back of we've exciting that we need to work using conventional methods going forward. I think probably that's one of the museum pieces that we lurks and shows us what the future is going to be. I think as business we understand that, as Government, I think it understands that although its challenges is so what does it say to the constituents, or the electorates when they do not have any work anymore. And the same is also true, unfortunately for our labour. So I think as long as our tripartite are aligned in terms of the goals that we have, we won't get there. Now again I believe that business needs to take the lead in this. And this is why I've said, although I would like to repeat what I've said earlier which to say, if we as business do not give viable opportunities, or off set points or alternatives for that matter, for Government and for labour to see what they will do with the big challenge, which is the fact that there is not going to be any employment if you do go mechanisation. Unfortunately if we don't take lead in that, it's not going to arrive by itself and so I really do think that beneficiation is a huge challenge for us to have work. I think the bigger issue here is from a global point of view, we also need to acknowledge that our Labour Law as it currently stands in South Africa, is unfortunately not geared towards as being competitive from a beneficiation point of view. If we had to compare us to China as an example, there is no comparison purely because the Labour Law is so cumbersome in South Africa. In fact to employ somebody here and unemploy somebody is virtually impossible. And that again was born from our history. Our history was predicated on people who were exposed in the early days of mining industry and as time has gone by and by the way of the political change in our country, we need to understand that invariably labour and Government was a seamless line. It was one feed stock. A lot of our laws are sort of overly in favour of labour and definitely not in favour of having a sustainable business going forward. I think ultimately the magic here is going to be that we need to get tripartite alliance and see if the light is a combine. Because if we don't, unfortunately as business alignment won't be able to make it work and the future will then be on the one hand, if that's the case. The future will very much be capital starvation, harvest strategies being employed by all major companies and then shutting down gold mines one after the other after the other. And over time basically we re-introducing these people back into society without a viable future. Because unfortunately once you've been a rock drill operator underground, you can't go and work in a Checkers. The gap in terms of remuneration is too big. A rock drill operator at least earns R13 500 - R14 000 where as a person that works in a Checkers as an example works for R6 000. The divide is too great. That's the one side of it, so it will be very much, 2025 might be too an optimistic view in terms of the future. Maybe only the mega mines ie South Deep which digs endlessly and is mechanised, will be the longest and the last man standing. Purely because they will be able to manage the social expectation and it's a limited work force to deal with. I think the other side of it is that, if we were able to as a Government, business and labour get together and they have a common understanding in of terms of how we will resolve beneficiation and embrace mechanisation, it will be successful. But I believe that unless we do that with a

sustainable approach, probably the first will be the future which is a very much no gold mining in our deep level ore bodies beyond 2025.

Interviewer: Thank you very much.

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
Improve their underground safety, secondly potentially improve productivity and thirdly also have a look at ways and means of how to become financially more better financial acumen by implementing innovation technology into their operation such that they can maybe reduce their cut-off grade, Increase their life of mine and get a better internal investment that they may going forward	It improve underground safety. Improvement of productivity. Reduce cut-off grades, increase life of mine and get a better internal investment	Improve safety, Improved productivity, Reduce cut-off grades, increase life of mine, improved investment returns	Improve safety, Improved productivity, Reduce cut-off grades, increase life of mine, improved investment returns	Safety, Productivity, ROI, sustainability, Reduce cut-off grades.	Creates a safe environment where people is not exposed to danger. Improved productivity output. Alternative application of technology to create attractive investment opportunities. Sustainable mining method. Reduction in cut-off grades increase life of mine.
I mean mechanisation is a common trend in the global context which we have a look at the degrees of mechanisation that exists in mines across the globe and especially in developed countries like Australia, Europe, places like South America as well and vast degrees of mechanisation for the vary reasons mentioned previously.	Mechanisation is a common trend in the global context	Common trend in a global context.	Common trend in a global context.	Proven method.	Proven mining method with confirmed success rate
From a safety aspect, I think that paramount that machines do allow mining to be done more safely because of the fact that you remove the people from the dangerous environment. There is obviously issues surrounding the safety with man machine interfaces, but that can be managed as well.	Remove people from the dangerous environment, that improve mining safety.	Remove people from the dangerous environment, that improve mining safety.	Remove people from the dangerous environment, that improve mining safety.	Safety	Creates a safe environment where people is not exposed to danger.
Secondly, I think from a productivity point of view, if you look at how mining was done in the early days in the coal mines in the UK, I mean there they still used donkeys and sleds and if you have a look at the ratio of tons per man per month to what it is now a days, you take a continues miner for example. A continues miner probably cuts a quarter of a million tons worth of coal in a month for you, whereas hand cut methods they will maybe doing 100 of 200 tons per man per month. So there are reasons why we need to move along the mechanisation route, but I think it is important that from a South African context that people understand that mechanisation does not mean that you have to dump a whole lot of machines underground.	From a productivity point of view there are reasons South Africa needs to move along the mechanisation route.	Improved productivity.	Improved productivity.	Productivity.	Improved productivity outputs.
There is obviously some machines that are required, but if you look at the whole value chain from where the mine starts, the shaft infrastructure, the mining method itself, once the rock has been broken and transported to surface, the ability to manage that process in the mid field situation as well, it needs to be a seamless routing right away through where the fit for purpose mechanisation needs to be fitted into that process to improve safety and get better return on investment made.	The mining method need to be a seamless routing right away through where fit for purpose mechanisation need to be fitted into that process to improve safety and get a better return on investment made.	Improve safety, improved investment returns.	Improve safety, improved investment returns.	Safety.ROI.	Creates a safe environment where people is not exposed to danger. Attractive investment opportunity.
It is not always about the mining context. I mean, if you take gold mining for example, a deep level gold mining with a narrow vain ore bodies that we have, we are so quick to try and bring those into reserve, where maybe they should stay in resource status. They are not economical mineable now a days if you start to expose people to that hazard. But unfortunately greed plays a big role in corporate companies.	It is not always about the mining context. Some resources in South Africa such as gold mining typified by narrow vein ore bodies is not economically mineable if you start to expose people to that hazard.	Remove people from the dangerous environment, that improve mining safety.	Remove people from the dangerous environment, that improve mining safety.	Safety	Creates a safe environment where people is not exposed to danger.
So I think there is a balance that needs to happen and if we are already serious about not injuring anybody ever again, then the only way to do it is if a rock falls on a piece of machinery, yes, you have lost the money but you haven't killed anybody in the process.	There needs to be a balance and if the mining industry is already serious about not injuring anybody ever again, then the only way to do it is if a rock falls on a piece of machinery.	Remove people from the dangerous environment, that improve mining safety.	Remove people from the dangerous environment, that improve mining safety.	Safety	Creates a safe environment where people is not exposed to danger.
Of course it is a competitive advantage for ourselves being a local manufacturer. I mean there are certain benefits that mining companies get by buying the mechanised solutions from us as a local manufacturer and I think those maybe are not enforced as hard what they should be	It is a competitive advantage being a local manufacturer. There are certain benefits that the mining companies get by buying the mechanised solutions from us as a local manufacturer. It is not enforced as hard as it should be.	Possible emerging market creation within the manufacturing environment for tailor made mechanised solutions	Possible emerging market creation within the manufacturing environment for tailor made mechanised solutions	Alternative industries	Stimulate market growth in upstream industries.
I think that mechanisation is definitely part of the solution going forward. I think mining is not as sexy as what it used to be 40 years ago? I think that young people, or young incumbents are far wiser now because of things like the internet. They know that there's other opportunities out there for them and if you have to track the age of rock drill operators that exists in mines now, if you have a look at how that age has migrated over a period of time, you probably will find that the average age of a rock drill operator now is probably 40 years plus.	Mechanisation is definitely part of the solution going forward. I think that young people are more technologically orientated and mining is not as attractive as what it used to be 40 years ago. The average age of a rock drill operator is now probably +40 years.	More appealing employment opportunity to the younger generation	More appealing employment opportunity to the younger generation	Socially acceptable.	Socially attractive skilled employment opportunities for younger generation.

I mean being a jackling operator in mining Australia, the guys earn decent cash. That's quite a sought after career. Being a trolley operator for example in mining Australia, I mean those guys are earning as much if not more than the GM of the mine. Because of the value that the individual brings	Creation of highly skill employment opportunities that justifies higher earnings	More appealing skilled employment opportunities	More appealing skilled employment opportunities	Socially acceptable.	Socially attractive skilled employment opportunities for younger generation.
I mean converting resources into reserves you need to do a couple of things. You either need to apply a different type of technology or you need to drop the overall cost of bringing those ounces up from underground so that they go from unpaid to pay. You can do that in a number of ways and I think if there is a bigger focus on how we can convert resources into reserves, I think we can start coming up with one or two values or methodologies in terms of how we can do that. And it's not always just by reducing your overheads, not always by making less people or cutting management salaries or something like that. We need to look for a more deep seated opportunities that exist to try and make that conversion.	When converting resources into reserves you can either apply a different type of technology or you need to drop the overall cost of bringing those ounces up from underground in a economical manner. It's not always just a matter of cutting cost. We need to look for a more deep seated opportunities that exist to try and make that conversion.	Applying a different technology to unlock investment opportunities.	Applying a different technology to unlock investment opportunities.	Investment opportunities.	Alternative application of technology to create attractive investment opportunities.
There are definitely isolated examples of good success. The Two Rivers of the world, The Black Rocks of the world. I mean, fully mechanised. They do marvellous scaling, scaling is a bit of a challenge, but never the less so, they are a fully mechanised underground mine. So it can be done. It can definitely be done. They don't have the autonomous trucks, they don't have the autonomous loaders and I'm not sure that it will ever be part of the long term strategy but from a mechanisation point of view, can mechanisation work in an underground mine in South Africa? Yes it can.	There are definitely isolated examples of success where operations within South Africa are fully mechanised underground mines. So it can be done. I doubt if automation of trackless equipment is ever going to be part of the long term strategy but from a mechanisation point of view it can work in South Africa.	Proven mining method with high success rate.	Proven mining method with high success rate.	Proven method.	Proven mining method with confirmed success rate
If you think about where the real unsafe practice are putting people into a stope, this is when people walk between the last line of support and the unsupported face itself.....We need to understand that maybe mechanisation is not just a removal of everybody, but maybe we just dose the stuff on mechanisation or we water jet the stuff or we do something. I think it's not that necessarily that you have zero people, because I don't think that's an idealised state because you still have to able to provide employment for people. But maybe that just don't work in those identified endangered situations, that we try and mechanise those first as a way to getting the whole mechanisation concept understood. That it's not a forced situation to try and replace people.	Mechanisation is not necessarily that you have zero people, because I do not think that's an idealised state because you still have to be able to provide employment for people. But maybe that just don't work in those identified endangered situations. We must try and mechanise that functions first rather than getting the entire mechanisations concept understood. I believe this is not a forced situation to try and replace people.	Employment displacement is required to remove people from a hazardous areas.	Employment displacement is required to remove people from a hazardous areas.	Morally justified employment displacement	Morally justified employment displacement imperative.
Gold, we are price taker, therefore if half of our mines are making a loss, they are in their second and third quarter as of the Global cost and that's a problem and we need to mechanise to keep them open. We need them to mine more, mine longer and the open a new mine..... we need to find solutions.....we still have massive gold resources that we can't tackle. We need mechanised solutions and also safety at those depths. We will most probably need mechanised automated solutions to keep people away.	In the gold industry we are a price taker and because half of the operations within SA is their second and third quarter of the global cost we need to mechanise them to keep them open, mine more, mine longer and open new mines. We need to find mechanised solutions to mine sustainably as SA still have massive gold reserves that will otherwise be sterilised. We probably need mechanised automated solutions to keep to keep people out of danger.	Mechanisation keep mines open, mine more, mine longer and open new mines	Mechanisation creates a sustainability	Sustainable.	Sustainable mining method.
If we muck together, we could use this as a fantastic opportunity to build mining supplies sector. Also the multipliers are massive. I've written on it, I've even coined the term lateral migration where I showed how mining supply companies in countries that were now mined out like Germany, had all re-invented themselves. Because they engineer intensive, they can make other things.....once you create those agile knowledge intensive industries, they go to weird and wonderful places.	If we all work together mechanisation could be a fantastic opportunity to build a mining supplies sector with massive multipliers (lateral migration). Germany have literally migrated when their ore reserves were depleted and reinvented themselves. Because they are engineering intensive they had the opportunity to make other things.	Mechanisation could lead to the development of alternative industries	Mechanisation could lead to the development of alternative industries	Alternative industries	Job displacement creates opportunities for the development of alternative niche markets.
If we crack deep mining, it would be exportable and we'll be the lead suppliers for all their equipment needed. I mean that's best case scenario. So there are other so called values which are about injuries, full house and safety. There are fatality rates, injury rates and so on that could be, ideally we would like a mining borrow remote control. Kill machines, don't kill people.	In the event that we crack deep level mechanisation we could potentially become the lead supplier of these equipment needed. Mechanisation also reduce the risk of injury to people where machines rather than people are entering these dangerous areas.	Potential of creating new upstream industries. Mechanisation is also seen as a safety imperative to remove people from a hazardous area.	Creation of upstream industries. Safety improvement where people is not exposed to dangerous areas.	Safety. Alternative industries.	Creates a safe environment where people is not exposed to danger. Stimulate market growth in upstream industries.

Mechanisation in the South African mining context is for me, really is that we're not going to have a South African mining industry if we are not able to harness mechanisation in general...So in short, for me mechanisation really is a tool to secure the future for South Africa and specifically gold mining industry	Mechanisation is regarded as imperative to the survival of the South African industry. Mechanisation is regarded as a tool to secure the future for South Africa, specifically the gold industry.	Mechanisation is regarded as an industry imperative	Mechanisation is regarded as an industry imperative	Survival imperative.	Regarded as an imperative to the survival of the industry.
introducing mechanisation, specifically to be able to handle technical challenges associated with our future ore reserves and where they are.	By introducing mechanisation will enable the industry to handle technical challenges.	By introducing mechanisation will enable the industry to handle technical challenges.	By introducing mechanisation will enable the industry to handle technical challenges.	Solution to techno economical challenges.	Mechanisation offer a solution to technical and economical challenges
So what mechanisation opportunity that it does represent, is that it represents an opportunity to actually have a 24/7 operation. It's in particular if we can do mechanisation and do away with blasting practices...For that there is a number of opportunities that do exist but in short it's a case of saying that we can mine 24/7 instead of 8 hours a day. So that really from a various of propositions that I would say, it's ready to be able to utilise 24 hours a day which is really what we're going have to do if we are going to curb the cost challenges that do exist.	Through a 24/7 mechanised operation you do away with current blasting practices. By mining 24/7 instead of 8 hours a day the current cost challenge could be curbed by increasing productivity exponentially.	Through mechanised mining you are able to produce 24/7 that dramatically increase productivity.	Through mechanised mining you are able to produce 24/7 that dramatically increase productivity.	Increased face time	Improved productivity prospects through 24/7 mining method.
safety remains one of our biggest challenges and our current conventional mining methods are obviously extremely labour intensive and brings the human life quite close to the rock face. So if we were able to mechanise, I mean we would be able to actually remove our people from the most hazardous environment, so actually we would be able to curb a lot of the accidents and incidents as which we have.	Safety remains one of the industries biggest challenges. Conventional mining methods are extremely labour intensive and bring human life very close to the most hazardous environment.	Conventional mining methods are extremely labour intensive and high risk occupations	Conventional mining methods are extremely labour intensive and high risk occupations	Safety	Creates a safe environment where people is not exposed to danger.
In total it also helps the company in terms of its public image that's carried as well as obviously from a socially more acceptable. In South Africa, I mean in our mining industry you seen that it actually exposes our employees and instead of utilising machines for superior value for everybody.	By mechanising the public image of mining houses could improve with the adoption of more socially acceptable mining practices that does not expose people to harm and utilising machines instead.	Public image of mining houses could improved with the adoption of a more socially acceptable mining practices	Public image of mining houses could improved with the adoption of a more socially acceptable mining practices	Public image	Improve public image through the adoption of a more socially acceptable mining practice.
I do think that what we are sitting with is that we need to find sort of a world in which the mining industry actually keeps abreast of the development in terms of people and trends that we've had with young people as an example. So I mean what technology presents, is actually an easier way of doing the work. So by this I'm saying, I think if we had to compare the chances of technology, not really technology but mechanisation specifically, mechanisation being successful now relative to twenty years ago, I think the appetite with time is becoming more bigger. Both from people that want to utilise it as well as companies that are willing to try it for the reasons I've explained previously.	We need to find a world in which the mining industry actually keeps abreast with the development of people and trends of the youth. What technology presents is actually an easier way of doing the work. The appetite for mechanisation with time is becoming bigger from both the people that wants to utilise it as well as companies that is willing to try it.	Mining industry need keep abreast with the development of people and trend of the youth. The appetite for mechanisation is increasing for both employees and employers.	Mining industry need keep abreast with the development of people and trend of the youth. The appetite for mechanisation is increasing for both employees and employers.	Socially acceptable.	Socially attractive skilled employment opportunities for younger generation.
I should think that it's very clear that there isn't going to be a really a future for too long for the South African gold mining industry if we do not find a feasible way of introducing mechanisation. . It's one of those where it's by hook or by crook, if we don't find a way of implementing mechanisation, invariably the industry have to come to a sudden closure. In truth what it really needs, is that we're delaying the inevitable, so the current workforce we have, over time will base to be unemployed.	I think it is very clear that there is no real future for the South African Gold mining industry if we do not find a feasible way of introducing mechanisation. If we don't find a way of implementing mechanisation invariably the industry will come to a sudden closure. We are delaying the inevitable. The current workforce that we have, over time will be become unemployed.	Need to find a feasible way of introducing mechanisation as it is a business imperative.	Need to find a feasible way of introducing mechanisation as it is a business imperative.	Regarded as an imperative to the survival of the industry.	Regarded as an imperative to the survival of the industry.
The only time that technology really comes to the fore, technology/mechanisation are used then interchangeably because to a large extent they are, is when there's a burning platform, when there is no future to do anything but to introduce technology or mechanise....I think all the points that you're making are quite valid in terms of the ability of mechanisation to address a lot of the techno economic challenges. I think the answer is so, is it true that without mechanisation 2025 is probably the end of life?	Mechanisation address a lot of the techno economical challenges. Without mechanisation 2025 will probably be the end of life for the majority of gold mines in South Africa. The only time that technology really comes to the fore is when there is a burning platform.	Mechanisation address a lot of techno economical challenges in the mining industry.	Mechanisation address a lot of techno economical challenges in the mining industry.	Survival imperative.	Mechanisation offer a solution to technical and economical challenges

...if you don't mechanise, we die. I think it's quite true because from existing infrastructure, we have multiple secondary reefs, in specifically gold that are lower grade but can be economically extracted if we would be mechanised.	Mechanisation has the potential to excess multiple secondary reef, especially in gold that are lower grade but can be economically extracted if we would mechanise	Mechanisation has the ability to access lower grade that can not otherwise be extracted economically	By reducing the cut off grades through mechanisation you increase the life of mine	Reduce cut-off grades.	Reduction in cut-off grades increase life of mine
And the motivation for me to mechanise that, is predominantly to do away with all those things and turn it into a skilled occupation which in turn would be high pay because skilled people are paid a lot more than low skilled people. Take the high PT out of it, take the labour out of it, and keep the people safe. So act in a protected environment. It's more of a morality for me...It's more of a morality for me. To you as an individual, support a paradigm where you have low skills, low pay, people doing hard manual labour in a dangerous environment, or do you want a paradigm where you have high skilled people being high paid without having to work hard manually and work in a safe environment?	With mechanisation you do away with all the disadvantages of conventional mining and turn it into a skilled occupation which in turn would be a higher pay. If you take the PT out of the work you can take the people out of the dangerous areas where you keep them safe in a protected environment that is morally justified. You can not support a paradigm where you have low skills, low pay, people doing hard manual labour in a dangerous environment. It is a moral imperative to rather support a paradigm where you have highly skilled people being highly paid without having to work hard manually and not exposed to environmental risks.	It is a moral imperative to rather support a paradigm where you have highly skilled people being highly paid without having to work hard manually and not exposed to environmental risks.	It is a moral imperative to rather support a paradigm where you have highly skilled people being highly paid without having to work hard manually and not exposed to environmental risks.	Morally justified employment displacement	Morally justified employment displacement imperative.
The point that you raised about gold. Up to about 100 years, we were the major supplier of gold in the world. South Africa produced more gold than anybody else in the world for well over a 100 years. And it's only this last 20 odd years, that we've lost that premier position. And it's not because we have no more ore reserves. We have plenty of ore reserves. But the economics of extracting them has stopped us from mining.	For well over 100 year South Africa was the top gold producer in the world. It is only the last 20 years that we've lost our premier position. This is not because we do not have any ore reserves left. We have plenty of ore reserves. It is the economics of extracting it that has stopped us from mining them.	South Africa has sufficient ore reserves to be mined. The current cut-off grades however sterilise a lot of these ore reserves as it is uneconomical.	South Africa has sufficient ore reserves to be mined. The current cut-off grades however sterilise a lot of these ore reserves as it is uneconomical.	Reduce cut-off grades.	Reduction in cut-off grades increase life of mine
Well we are not struggling, we are very good at producing and introducing mechanisation. Just look at the coal mines. The coal mines went from virtually hand on operations to fully mechanised operations, continuous miner sections in a period of about 10 years and totally transformed. We hold the number of records for production from continuous miners. So, given the tools, given the applications, we can be very, very successful in what we do	South Africa has a history of introducing mechanisation quite successfully. The coal mines went from virtually hands on operations to fully mechanised operations with continuous miners in a period of 10 years. So given the tools, given the applications we can be very successful.	Mechanisation in South Africa was quite successful in the past.	Mechanisation in South Africa was quite successful in the past.	Proven method.	Proven mining method with confirmed success rate
...they use to have those little belts that they put on the stoke and they tried to reduce the amount of development when they did it. It used to take them nearly 3 months to advance those conveyors. What do you do about production in that time? You haven't got any. What do you do as an alternative then? You make more face available, you invest more capital in opening up more face, which is not productive. These are the two capitals we are talking about. We are talking about the mine capital, cost of the mine, the cost of opening up face and we are talking about the equipment capital. And people don't see these as two separate things. They don't talk about them together. And yet the cost capital to open up the mine is substantially more than the cost of the equipment which is doing the mining.	The capital cost of opening up more ground is substantially more than the cost of equipment which is doing the mining. The infrastructure to support mechanised mining need to be considered holistically and need to be a prerequisite as the alternative might be more capital intensive than ensuring that the system is maintained.	The capital cost of opening up more ground is more than the cost of equipment doing the mining.	The capital cost of opening up more ground is more than the cost of equipment doing the mining.	Productivity improvement associated with mechanisation warrant the capital intensity thereof.	Productivity improvement associated with mechanisation warrant the capital intensity thereof.
Now mechanisation is absolutely critical to get us to a point where we become more efficient than what we are doing currently. Using technologies that will allow us to mine at a narrower excavation height because of the issues of safety. So, a large amount of the reserves that we have left in gold, is locked up in pillars. Now to put somebody into a shaft pillar area or to extract these pillars that have been left behind as remnants, is a significant risk. We already have such a poor record in terms of health and safety. Yes, we have improved, and I'm not taking that away from the industry, from the '80's when there was 700/800 people being killed to now sub 100 of the actual fatalities, is a good improvement, but there's a lot more to do to get the target by 2020 zero fatalities in the mining sector. So how exactly do we do that? Mechanisation creates an opportunity where the worker can stand away from the area of high risk and you put a piece of equipment in there.	Mechanisation is absolutely critical to get the South African gold and platinum industry to a point where they become more efficient and safer. By making use of technology a large amount of reserves can be mined efficiently and safely that are locked up in pillars that has been left behind as remnants that can not be extracted successfully making use of conventional extraction strategies.	Mechanisation is critical to the survival of South African gold and platinum industry. Ore reserves that is currently uneconomical to be mined can be mined safely and successfully by making use of more cost effective extraction strategies.	Mechanisation is critical to the survival of South African gold and platinum industry. Ore reserves that is currently uneconomical to be mined can be mined safely and successfully by making use of more cost effective extraction strategies.	Survival imperative. Reduce cut-off grades.	Regarded as an imperative to the survival of the industry. Reduction in cut-off grades increase life of mine.

<p>When you talk about what does mechanisation or what does modernisation in the South African mining context means, it creates the opportunity of extending the life of mining. Of South Africa? Extending job opportunities, looking at more investments in the country....If I want to change the mining method where there is no risk, maybe I want to invest in it. So, that creates an opportunity for foreign direct investment. It means if you can mine more core from this ground here, there is more money coming into the country. We have the largest gold reserves in the world. But in terms of production worldwide, we're sitting at no 7. China is ahead of us, India is ahead of us. How is that possible? Because they have different ore bodies and they don't have to do this type of stuff that we are doing. Ours is flat and narrow and continuous or relatively compared to the stuff in Australia which is close to surface, massive mining, they can open (30??) with large piece of equipment and we can't do that. So mechanisation in the modern context and modernisation as a better example means continuity of the sector and continuity of the sector means all those knock-on things I've said in that process.</p>	<p>Mechanisation creates an opportunity to extend the LOM that by default sustain job opportunities and will make South Africa a more appealing investment destination. The investing community will be more inclined to invest in an opportunity with lower risk. Mechanisation and modernisation therefore means continuity of the mining sector with all the knock-on effects associated with a sustainable and thriving industry.</p>	<p>Mechanisation creates an opportunity to extend the LOM. sustain job opportunities and will make South Africa a more appealing investment destination.</p>	<p>Increase LOM. Sustainable mining method and make the country a more appealing investment destination.</p>	<p>Reduce cut-off grades. Sustainable method. Investment opportunities.</p>	<p>Reduction in cut-off grades increase life of mine. Sustainable mining method. Alternative application of technology to create attractive investment opportunities.</p>
<p>But the other part of mechanisation that often gets lost, is it's seen as a job displacement. It is a job displacement. You can't get away from that. But it is also an opportunity to create new jobs. Because we have to, as you would know from the outside, we have to employ people to create the manufacturing capability. So, we create new jobs in the manufactured space because you get a larger order book...The trade-off is, we may lose jobs here, you will gain jobs in the other spaces. It's not one for one. So, the person who loses his job here, may not be employed in the other space. But you create a different job here with a different skill that's sort of a better numeration for that. The net gain, or the net effect is a zero gain, so everything balances out.</p>	<p>Mechanisation is a job displacement initiative but is also an opportunity to create new jobs. The displacement of mining jobs could be in part be the creation of new manufacturing capability within South Africa.</p>	<p>Mechanisation could displace mining jobs into the creation of new manufacturing capability within SA.</p>	<p>Mechanisation could displace mining jobs into the creation of new manufacturing capability within SA.</p>	<p>Alternative industries</p>	<p>Job displacement creates opportunities for the development of alternative niche markets.</p>
<p>But we also need to deal with this person who will not be taken and absorbed in the other spaces. And that's a critical concept. So mechanisation creates new opportunities and the other opportunity which we discussed is, it creates an export potential. So why does Canada, America, Australia and the rest of the world don't need narrow reef mining? It's not because they don't have the narrow reef stuff. It's just that they don't need to access it because they have such vast reserves available at easily accessible. We had that in South Africa. We were mining quick and easy when it was shallow and as it got deeper and deeper it became more challenging and the costs associated went up. If we master that capability now, when the other countries are in the position to start their narrow reef mining. We are the experts. So, they turn to us. We export all our equipment. That's the opportunity that provides for us. So, that's what mechanisation talks to from my perspective.</p>	<p>Mechanisation within the South African context could allow us an opportunity to create critical skills within the manufacturing environment that we can master and creates export potential in years to come. Narrow orebodies is not unique to South Africa but could be found all over the world. Due to the intensive mining activity within the country all the other easily extractable ore bodies have been already mined out. Other countries will follow the same path but by the time they have no other alternative but to mine these narrow reefs South Africa will be considered the experts.</p>	<p>Opportunity to create critical skills within the manufacturing environment that we can master and creates export potential in years to come.</p>	<p>Opportunity to create critical skills within the manufacturing environment that we can master and creates export potential in years to come.</p>	<p>Alternative industries. Upstream market growth.</p>	<p>Job displacement creates opportunities for the development of alternative niche markets. Stimulate market growth in upstream industries.</p>
<p>that a gold mine currently sitting at 3 000 metres below surface, it will move to 4 000 metres below surface. The rock stresses go up automatically. So, that means even before you start mining, the rock is already fractured. It will be more difficult to keep that rock supported, so that you can allow people to go in. The risk of injuries and fatalities go up automatically as a result of that. How do you access it? You bring in your piece of equipment, let the person stand in a remote spot, whether that be 50 metres away or on surface but something that we will still develop in the process. But it means that should something happen at the face, there's zero risk to the individual. And perception that mining is a dangerous environment, can change.</p>	<p>Within a gold mine that is currently at a depth of 3000m below surface will eventually move to 4000 m below surface. At these depths the rock is already fractured and will become increasingly more difficult to support the hanging. The risk therefore increases exponentially with conventional mining methods as you mine deeper. However with mechanised operations you are sending a machine in these areas that significantly reduce the safety risk. This in turn will change the perception that mining is a dangerous environment.</p>	<p>The risk therefore increases exponentially with conventional mining methods as you mine deeper. However with mechanised operations you are sending a machine in these areas that significantly reduce the safety risk. This in turn will change the perception that mining is a dangerous environment.</p>	<p>The risk therefore increases exponentially with conventional mining methods as you mine deeper. However with mechanised operations you are sending a machine in these areas that significantly reduce the safety risk. This in turn will change the perception that mining is a dangerous environment.</p>	<p>Safety. Public image</p>	<p>Creates a safe environment where people is not exposed to danger. Improve public image through the adoption of a more socially acceptable mining practice.</p>

...we have the skills, we have the capabilities. Let me give you an example of that. So, we were mining the deepest of all the mining countries in the world. We were having issues of seismicity, having issues of cooling the workers from 70 degrees to 28 degrees. We developed that skills here in South Africa. We now can mine at depths of 3,5 km's because we can cool it, we can keep the rocks supported. We did not call on external expertise to do that. What happened is when we developed those skills, those skills were then exported. People came and took all our skill and put into that.	We have the skills and capabilities to provide in-house solutions for the challenges that we are currently faced within the gold and platinum mines. Historically the mining fraternity within SA was faced with a number of unique challenges that was successfully addressed such as seismicity without the assistance of external expertise.	We have the skills and capabilities to provide in-house solutions for the challenges that we are currently faced.	We have the skills and capabilities to provide in-house solutions for the challenges that we are currently faced.	In-house capability and skills.	Possess in-house technical capability and skills.
We also demonstrated that our stuff is reliable. OEM's that are currently being used in South Africa mining industry have won over that battle where we perceive to be of poor quality.	Manufacturers of equipment have also demonstrated that our product offerings is as reliable as their multi national counterparts.	Manufacturers demonstrated that local equipment are equally reliable compared to foreign offerings.	Manufacturers demonstrated that local equipment are equally reliable compared to foreign offerings.	In-house capability and skills.	Possess in-house technical capability and skills.
The potential for mechanised mining creates many other opportunities that we haven't fully articulated in the process. That will overcome some of these burdens that the country suddenly faces.	Mechanised mining creates many other opportunities that we have not fully articulated that could potentially overcome some of the burdens that the country suddenly faces.	Mechanisation creates opportunities to overcome burdens that the country faces.	Mechanisation creates opportunities to overcome burdens that the country faces.	Alternative industries.	Job displacement creates opportunities for the development of alternative niche markets.
And we definitely see mechanisation as a critical variable in the way forward and the future of mines. To that end, we've had a long discussion about reducing pay limits. If we reduce pay limits, we can obviously mine more grounds and we can sustain ourselves for longer, mining our ore body.	Mechanisation has the potential of reducing pay limits and to that extend it allows you the possibility of mining more ground and sustaining ourselves for longer mining the orebody.	Mechanisation reduces pay-limits and allow for the possibility of mining more for longer.	Reducing pay-limits allow for the possibility of mining more for longer.	Reduce cut-off grades.	Reduction in cut-off grades increase life of mine
We believe that mechanisation is a critical variable going forward, (a) from a productivity, (b) from a safety perspective. Mechanised mines are safer mines. We all want better safety to that end obviously critical that we have some form of mechanised means to remove our employee away from the faces. Got somebody on the face, they're exposed. How much longer can we continue to have fatalities in these industries? Where do we argue that if we had mechanised means in the face with remote control, autonomous mining or whatever the case might be, we'd have better safety...Mechanisation isn't just about mechanisation. It has a moral and safety imperative to it as well which we really are driving.	Mechanised mines are safer in that it removes the employees away from the face. If you have somebody on the face, they are exposed. Mechanisation has a moral and safety imperative to as well.	Mechanised mines are safer as it removes the employees from the face. Mechanisation has a moral and safety imperative.	Mechanisation removes the human from a dangerous area that is a moral and safety imperative.	Safety. Morally justified employment displacement	Creates a safe environment where people is not exposed to danger. Morally justified employment displacement
Mechanisation also is going to be better productivity, better face advance, improving outputs and cutting pay limits, and that's critical. We can prove that mechanisation reduces pay limits, we can mine more ground. We can create more jobs as well, we don't have to sterilise old mines. We can keep mining those mines that would have been closed down, for longer. And that's a critical variant in what very often the unions don't understand or don't believe and it will be an engagement going forward, process going forward to obviously put that in place.	With mechanisation you improve productivity, better face advance, improving outputs and cutting pay limits. In cutting pay limits we can create more jobs as we do not have to sterilise old mines.	Mechanisation improve productivity that cut pay limits that create more jobs where old mines have not been sterilised	Mechanisation improve productivity that cut pay limits that create more jobs where old mines have not been sterilised	Productivity, Reduce cut-off grades.	Improved productivity outputs. Reduction in cut-off grades increase life of mine
So, it is the silver bullet, I believe towards sustaining gold mines in South Africa and staying alive for longer. In addition to all of these other productivity in variants and so on. We are convinced, and my CEOS are also certainly convinced as well.	Mechanisation is the silver bullet (solution) for South African and staying alive for longer.	Mechanisation is the solution for a sustainable South African mining industry.	Mechanisation creates a sustainability	Sustainable.	Sustainable mining method.

<p>You're suddenly in a position to explore quicker, you can drill quicker, you can understand your ore body better. And if you're behind in development, on a drilling and blasting cycle you got to multi blast it. It's not always possible in an operating mine. This kind of kit, you know with an investment you could get ahead of yourself very quickly. You do your 120 meters, you're at the next intersection at 180 meters or whatever the mining layout is. You could really get ahead of yourself very quickly and do that work. I see rock cutting and road headers in the development phase is a step ahead of where we are now. Then you got all your rock boring tools. You've got your blind borers, you've got your raise borers, you've got box hole borers that definitely need to play a role in the future. Putting up your traveling ways with some kind of a box hole borer, not a box hole borer but a you know, we've got something we call a gripper that we're working on which is really a mini TBM. So, it's not ahead consumable to think your traveling way you send up with a mini TBM, you get on to reef, wat now? I do all my box holes, at least with mechanise as well. Now I've done my tunnels, I've done my excesses on to reef with mechanised equipment.</p>	<p>By making use of mechanised equipment to develop you are not constraint by a blasting cycle and you are in a position to explore quicker, you can drill quicker and you can understand your orebody better. Traveling ways can also be done by mechanical rock cutting equipment.</p>	<p>With mechanisation you are not constraint by a cyclic system that reduce productivity output.</p>	<p>Through mechanised mining you are able to produce 24/7 that dramatically increase productivity.</p>	<p>Increased face time</p>	<p>Improved productivity prospects through 24/7 mining method.</p>
<p>The flipside of that is you get, I'm quite convinced in my mind that technology in platinum can work. I really do believe that. The minute a lot of that equipment becomes commercially available, the platinum sector will definitely float.</p>	<p>I am convinced that technology in the platinum industry can work. The moment that equipment comes commercially available the platinum sector will thrive.</p>	<p>Technology in the mining sector can transform the industry into an attractive investment destination.</p>	<p>Technology create attractive investment opportunities.</p>	<p>ROI</p>	<p>Alternative application of technology to create attractive investment opportunities</p>
<p>Mechanisation for me in person is the way that we need to go if we really want to survive in the future... Obviously from an organisation we have to do that if we want to be the market leader in what we're doing and surviving it. That is our survival strategy and if we don't like that we will not survive.</p>	<p>Mechanisation is the only alternative if we want to survive in the future. From an organisation point of view, mechanisation is seen as the element that will allow the organisation to be the market leaders with a sustainable solution.</p>	<p>Mechanisation is the solution for a sustainable South African mining industry.</p>	<p>Mechanisation creates a sustainability</p>	<p>Sustainable.</p>	<p>Sustainable mining method.</p>
<p>If we go mechanisation, maybe we don't have a choice, we have to go mechanisation otherwise we have no jobs. It's not a choice of jobs and less jobs, no jobs or some jobs. But mechanisation, if we can start exporting, we can develop our own stuff that is applicable for more people that needs to go underground in the future and it's applicable in more other applications and we can start manufacture and export. The job from underground actually changed to a job in the industry, industrial. And industrial jobs are a much higher-level job that needs better skilled and educated people, better salaries, better everything.</p>	<p>Maybe we do not have a choice but to mechanise or else we do not have an industry and jobs related to that industry. If we however develop our own equipment and we can start exporting these equipment we can transfer jobs in the mining industry to jobs in the industrial industry which are a higher level job that needs better skills and education that earn better salaries.</p>	<p>Mechanisation is the solution for a sustainable South African mining industry. Mechanisation could lead to the development of alternative industries</p>	<p>Mechanisation is the solution for a sustainable South African mining industry. Mechanisation could lead to the development of alternative industries</p>	<p>Sustainable. Alternative industries. Upstream market growth.</p>	<p>Sustainable mining method. Job displacement creates opportunities for the development of alternative niche markets. Stimulate market growth in upstream industries.</p>
<p>If I can just on the safety side, that's just a worldwide trend comparing conventional mining, the mining method itself versus a trackless section for argument sake. In terms of mining, your exposure rate is much less. The amount of people that you operate is much less than what you'll have in a typical conventional section. So obviously your safety exposure by comparing a trackless operation to a conventional operation is worlds apart.</p>	<p>From a safety point of view the safety exposure rate is much higher in a conventional mining method compared to the trackless section</p>	<p>The safety exposure rate in conventional mining is much higher compared to a mechanised operation.</p>	<p>Mechanisation removes humans from the dangerous area.</p>	<p>Safety</p>	<p>Creates a safe environment where people is not exposed to danger.</p>
<p>On the operational side, typical drivers within the mining industry talks about tons – tons mined, tons moved or run off mine tons. Talks about labour efficiencies and again, between trackless and conventional is worlds apart. Fewer people in a trackless section compare to a conventional section which obviously in terms of your output then your efficiency measures in terms of square metre per man, run off mine ton per man, ounces per man produced, are much higher.</p>	<p>From a productivity point of view fewer people are employed within a trackless section compared to a conventional section which obviously in terms of output efficiencies are much higher.</p>	<p>Fewer people are employed in a mechanised mine that increase the output efficiency.</p>	<p>Fewer people are employed in a mechanised mine that increase the output efficiency.</p>	<p>Productivity</p>	<p>Improved productivity outputs.</p>

<p>On the cost side, that once again you can also divide into two categories: capex portion as well as an operational expenditure portion whereby on a trackless operation your initial capex is much higher than what it is in comparison to a conventional shaft, now excluding infra structures setup etc. Then obviously it is very cyclic, so you have every 5 years you have an enormous amount of capital that is boost into the balance sheet. In terms of operational expenditure, with labour being in SA 60 to 70% of your expenditure on a monthly basis, on a typical conventional mine you use just opposite on a trackless operation where your labour equates to about 45% of your total cost. So, comparing a capex and opex in terms of conventional versus trackless. Trackless or mechanised operation are high capital initially. Mid-year or midlife capital injections are in terms of operational cost running about a third less than what a conventional shaft is running at.</p>	<p>From a cost point of view a mechanised section has a higher initial capital requirement compared to a conventional shaft but has a third of the operational expenditure required because a trackless section labour bill equates to 45% of the total cost compared to 60-70% in a typical SA conventional mine</p>	<p>The running cost of a mechanised section is less than the running cost of a conventional section.</p>	<p>The running cost of a mechanised section is less than the running cost of a conventional section.</p>	<p>ROI</p>	<p>Alternative application of technology to create attractive investment opportunities</p>
<p>I think mechanisation is fundamental to South Africa’s future. For me, if we cannot mechanise operations a bit better, and I hate the mechanisation word. For me it’s more modernisation because it’s not just the mechanics of it, it’s the process of extraction and the process of beneficiation.</p>	<p>Mechanisation is fundamental to South Africa's future. But is more about the modernisation of the complete process of extracting and beneficiation than purely the mechanics of it.</p>	<p>Mechanisation is fundamental to the future of SA that includes the modernisation of the complete process.</p>	<p>Mechanisation is fundamental to the future of SA that includes the modernisation of the complete process.</p>	<p>Sustainable.</p>	<p>Sustainable mining method.</p>

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
So, it is a multi-prong sort of issue, I mean in a country where you got up to 40% unemployment, you are one of the largest employers in the GDP or in the economy itself. In the mining industry a lot of organised labour look to the mining companies to employ people. But maybe we should be employing them doing other things instead of going underground and mining. There are other aspects of touching that	In the mining industry a lot of organised labour look at the mining companies to employ people. /but maybe we should be employing them doing other things instead.	The mining industry is seen as a major employer.	The mining industry is seen as a major employer.	New mining methods not labour intensive.	New mining method reduces immediate direct job opportunities.
Epecially, you know the fact that a lot of these operations now have changed hands like for example where you had Harmony, that’s a classical example, Harmony buys all the old Anglo mines, so mined at an Anglo standard would deem to be uneconomical. Suddenly you have a change of management, so the assets stay the same, the mining method stays the same, the people stay the same and now suddenly they can do it profitably. So what changed from when Anglo owned them to Harmony owned them? Suddenly you can turn uneconomical stuff into economical stuff. Because all the fixed portions stayed the same. It was the same resource, it was the same mining method per say, so what learnings can we take out of that to make the next step?	Change in ownership in the past have resulted in mining operations changing from being uneconomical to being economical. Because all the fixed portions stayed the same (same resource, same mining method) learnings can be adopted from these transitions.	Structural changes such as changes in ownership have resulted in mining operations changes from being uneconomical to being economical.	Structural changes such as changes in ownership have resulted in mining operations changes from being uneconomical to being economical.	System optimisation	System optimisation is considered to be sufficient rather than a total transformation.
The big challenge once again remains the geology that is pertinent to narrow vein gold mining in South Africa....But if you look at the work that Anglo American or Anglo Gold in this country is doing. They say they rather just drill the gold out. So they are looking at different technologies in terms of never ever putting a person into a stope. They raise more the stuff out. That comes at a cost as well. That doesn’t really provide any appropriate opportunities for people. So to come back to your question: “Are there opportunities?” I think there are still large opportunities around. You need somebody, you need an organisation with a little bit of vision as well to see that this might be a slightly longer period of time	The geology that is pertinent to narrow vein gold mining in South Africa is a challenge. Companies look at different technologies in terms of never ever putting a person into a stope. These technologies such as drilling the gold out comes at a cost and does not really provide appropriate opportunities for people.	Because of the unique geology in South Africa the new mining methods being looked at does not provide adequate employment opportunities for people.	Because of the unique geology in South Africa the new mining methods being looked at does not provide adequate employment opportunities for people.	New mining methods not labour intensive.	New mining method reduces immediate direct job opportunities.
I think one of the biggest opportunities that are possibly missed out on, to answer this question as well, is that from a research perspective, I mean the existence of the CSIR for example. I mean over the years the likes of these guys [0:22:46-0:22:49 Voigt and Du Plessis.....], they were individuals that were employed in their younger days for mining tech by the CSIR looking at different ways of pre stressing ore bodies and knocking them out with a hammer. That level of research has disappeared. Most companies used to have continuous improvement organisations within the companies. Anglo Platinum for example or Anglo Gold or Anglo American. They used to have a researching development department. Those resources now have all been un bundled, they were redeemed to be not core. Now they are sitting in companies like TWP or RSV or they are sitting in these consultant companies and every time when they actually work is when the companies actually give them money to do so....Mining companies are now purely focused on return on investment. So CEO’s has done away with all those non-core assets and expecting industry to come up with those ideas but I mean, those ideas cost money.so I think allot of those opportunities are being missed and we are definitely not doing enough on the R&D side of coming up with different methodologies. I mean, it doesn’t just have to be mechanisation, I mean its education and training. Hugely important.	One of the biggest challenges is from a research perspective. In the past there were individuals that were employed by the CSIR for research and development in the mining industry but those level of research has disappeared. Most companies used to have continuous improvement organisations but these resources now have been un-bundled and deemed not to be core. The individuals are now at consulting companies and they only do research work when they actually give the companies money to do so. Mining companies are now purely focused on return on investment and has done away with all those non-core assets. So I think that allot of those opportunities are being missed and we are definitely not doing enough on the research and development side of coming up with different methodologies.	There is a lack of research and development being done compared to what happened in the past as most departments have been un-bundled and disappeared. A lot of opportunities are being missed as a result thereof.	There is a lack of research and development being done compared to what happened in the past as most departments have been un-bundled and disappeared. A lot of opportunities are being missed as a result thereof.	Lack of local research and development.	The lack of local research and development impaired our ability to develop tailor made solutions.
I mean, it doesn’t just have to be mechanisation, I mean its education and training. Hugely important.... We need to sometimes get the inspector who comes to inspect the mechanised operation that has never operated a mechanised piece of equipment to understand that there is certain idea simplicities that is attached to that. So it doesn’t help that he just walks in there because of his own ignorance, and I say that to all due respect, his or her ignorance, issued section 54. That’s not the right way to engage in such a sensitive subject because if you get six section 54’s of your own, the next minute that gets to the Board and they will say well let’s stuff all mechanisation and rather go back to conventional because then we will have less section 54’s. And we actually can’t afford to have all these stoppages all the time because if it goes to the credibility of the management and it comes with a potential legislative fine, and it’s also reputation that’s not great. So it’s quite incestuous this whole process at the moment and I think it just adds to the degree of non-success in some of the aspects around them.	Training and education are also hugely important. Sometimes inspectors comes to mines to inspect the mechanised operations and due to their own ignorance issues a work stoppage instruction (Section 54) that very often result in companies making strategic decisions of whether to mechanise or not because it will result in less stoppages. So it's quite incestuous this who's process at the moment and I think it just adds to the degree of non-success in some of the aspects around them.	Due to a lack of training and education inefficiencies in the form of work stoppages just adds to the degree of non-success.	Due to a lack of training and education inefficiencies in the form of work stoppages just adds to the degree of non-success.	Lack of training and education.	People are not adequately empowered through training and education.
Unless the mining companies continue to do what they were doing and source the capital goods from abroad.....The foreign companies would rather import because then they can have a subsidiary.....And that subsidiary will then buy from them and supply at double the price here which means they just move profit . So in general the foreigners would like to keep supplies from abroad because it keeps the option open to cheat, to transfer price or what OECD calls BEPS. Base Erosion and Profit Shifting. Because if you buy local, you can’t transfer price, because you’re in the same tax jurisdiction.	In the event that mining companies continue to buy mechanised equipment from international companies rather than local there exist a potential of base erosion and profit shifting. If you buy local you can't transfer pricing as you remain in the same tax regime.	If mechanised equipment is purchased from international companies rather than local there exist a potential of base erosion and profit shifting.	If mechanised equipment is purchased from international companies rather than local there exist a potential of base erosion and profit shifting.	Foreign equipment procurement.	Foreign equipment procurement could lead to base erosion and profit shifting.

If mechanisation is imported, then I would advise the unions very strongly, appose, appose, appose, strike, strike, strike, because there’s nothing in it for the nation then	In the event that mechanisation is imported I would advise the unions to strongly appose the strategy as there is nothing in it for the nation	If mechanised equipment are imported I would advise to appose it as there is nothing in it for the nation.	If mechanised equipment are imported I would advise to appose it as there is nothing in it for the nation.	Foreign equipment procurement. New mining methods not labour intensive.	Foreign equipment procurement could lead to base erosion and profit shifting. New mining method reduces immediate direct job opportunities.
But Anglo, no we’re in London. The world’s our oyster and we’re not in South Africa, we’ll develop our Chilean assets. Today we are in nickel and tomorrow we’re out of nickel, you’ve seen yourself. We could define it, you know that we’re global players. Precocious in a way. So, that’s from my point of view is, I don’t trust the foreign companies....They want their freedom to draw all their research overseas and the freedom then ultimately to transfer price. In my opinion.	There is a lack of trust with regard to multinational mining houses as they are seen as precocious in that they perceive themselves as global bullies. If the economic climate is not suitable for them they will rather develop assets in other countries. These companies want their freedom to draw research and investment overseas with the possibility to transfer pricing.	There is a lack of trust with regard to multinational employers and are perceived as global bullies.	There is a lack of trust with regard to multinational employers and are perceived as global bullies.	No common purpose.	There is a lack of trust and common purpose amongst mining constituencies.
So for the companies it’s clear that’s returns to shareholder. You know business is not moral or immoral; it’s amoral which has no morality. There is only one driver of business, it is return to shareholders. You then abide by laws, but if those laws weren’t there you would consider slavery business as a very good business proposition..... So, and from the Government it’s the same. But there you’re looking at the poverty at the people. You might call that values. From the Unions it’s returns to members.	Different mining constituency have very different agenda's. In considering mining houses that is perceived as pro-mechanisation it is clear that their only driver is on returns to members. But business is neither moral nor immoral but is considered to be amoral. Amoral by definition means an entity that has no morality. Therefore it is imperative that they abide by laws made by the respective government that consider the poverty of the people.	Misalignment of mining constituency agenda's and there is a lack of common purpose.	Misalignment of mining constituency agenda's and there is a lack of common purpose.	No common purpose.	There is a lack of trust and common purpose amongst mining constituencies.
All of these things need to be stipulated. And this also protects the good companies from the skabenga companies. If it’s stipulated, if it’s just voluntary, then only the good companies are going to do it and the skabenga companies aren’t. But if it’s stipulated, everyone’s got to do it and then you can set it lower now that everyone’s contributing.....We have 20 years of trusting them, and what did they do? They deemed us and bust us. So, why trust them? Do we trust them on R&D when they took it from the library, then the world to nothing? No, we don’t. I would say from a Government point of view wearing the national hat, once bitten, twice shy. There’s no reason to trust them.....We went the opposite route nationally. We got caught in that gear, open up, companies were allowed to leave which is lunatic, now other countries are laughing and we also lost all of our technology development. Basically they de-industrialised us.	For mechanisation to work the amount of R&D spend locally must substantially be increased. Instituting a legal framework for that does not suite multinational OEM's and there is also a lack of trust. There is a believe that by not creating a legal framework and retaining a free market system these companies will continue to de-industrialise the country.	For mechanisation to work a considerable amount of money need to be spent on research and development.	For mechanisation to work a considerable amount of money need to be spent on research and development.	No common purpose. Lack local of research and development.	There is a lack of trust and common purpose amongst mining constituencies. The lack of local research and development impaired our ability to develop tailor made solutions.
Is mechanisation in some form of another solution to unemployment and the eradication of poverty?..... That model needs to be done, because this is a dynamic model..... we say, when you have a static mining industry, the number of jobs in manual will roughly equate to the total number of jobs in mechanised but now you’ve got more jobs in supplier and mine and then in the manual supplier now looks like where you end up with a rough equation. Right? Then at the same time by mechanisation you move down your cut-off grade and you now got additional resources. So, now you got to build in a dynamic model, because when you do it, you now are going to get big amounts. You are going to have some extras. So this box now is greater jobs and then you’ve got to put a time dimension. So like with the time value of money where you discount your future returns, we need some discount rate on future jobs. But we have to count those jobs because if we mechanise, and a gold mine that’s going to shut in 5 years, you’ve seen the graphs so you have the presentation, is now going to shut in 10 years. We’ve got to look at those jobs.... So you can’t just look, NOW what’s going to happen, what’s going to happen over time?.... At the same time the mines that are on board, and they are not all of them, are realising that all of that still means that there’s a rump of jobs here that can’t be these which some, you know take Marikana; they’re rock drillers from Pondoland with standard four. They can’t be put on a machine because you got to have your matric to read a machine’s valuable, you got to read all of the instructions, they want a matric....So because of that, even though you get more jobs here, they were different skill set of jobs. So you get these people who fall of the back of the truck.	Mechanisation as a possible solution to unemployment and eradication of poverty is not as clear cut as some perceive it to be. The model needs to be done as it is a dynamic model. You need to off set the current manual labour numbers with the number of jobs in mechanisation. At the same time by mechanising you move down your cut-off grade and now you got additional resources. But this is not immediate future jobs and therefore you need to discount them. You also need to consider that a rump of jobs can not be traversed to mechanisation due to a significant skills gap.	Mechanisation as a possible solution to unemployment and eradication of poverty is not as clear cut as some perceive it to be. There is no immediate future jobs and a large portion of these jobs can not be transferred to mechanisation due to the significant skills gap.	Mechanisation as a possible solution to unemployment and eradication of poverty is not as clear cut as some perceive it to be. There is no immediate future jobs and a large portion of these jobs can not be transferred to mechanisation due to the significant skills gap.	New mining methods not labour intensive. Significant skills gap.	New mining method reduces immediate direct job opportunities. There exist a significant un-transferable skills gap.

<p>Mainly they lease it to farmers for low value crops like maize....and I’m going to put a question mark there, because we’ll see what happens; my argument to the Phakisa....I think the market works in agriculture. We’ve got loads of boere with financial alacrity. If there is a good use for that land, why do you believe that they are making less than they could make? Are they stupid? What am I missing here? Is there good fallow land? If it just needs irrigation from the mine which they say they can irrigate from the mine, well why is the mine not doing it? Are the mines stupid? You know our waste water that we can actually sell, but we’re stupid, we’re not trying to maximise in terms of it. I don’t see the market failure. So I’m a bit worried about that. They’re talking about a lot of jobs. Where’s the market failure?I’m not sure, there might be things like logistics. We’re very far from the big market for these high value crops, like paprika and oils and nuts and things like that, and essential oils, that maybe our boere and our Zimbabweans and Portuguese; they can’t get into those supply chain. They might getting into the global value chains where Government could help and through the airport, IDZ and coming in with maybe there are market failures about cargo. We don’t have open skies, we do internally, but we don’t internationally. There could be market failures there that we can fix. All I’m saying is, there will be some jobs here. I just wonder if it will be as big. Because they are identifying massive land. In the Rustenburg area, in the Carletonville area that the mines own. Maybe with a more integrated strategy could employ more people.</p>	<p>The idea of moving people that does not meet the requirements of a mechanised mine to agriculture is questionable. The reason for concerns over this strategy is that if this was in fact an opportunity why have people within the sector not make use of this opportunity yet? Therefore a clear market failure is not so forthcoming and concerns about the sustainability of such jobs are high.</p>	<p>Alternative industries that can accommodate the skills gap that does exist is questionable as there is no clear market failure.</p>	<p>Alternative industries that can accommodate the skills gap that does exist is questionable as there is no clear market failure.</p>	<p>Questionable alternative industries.</p>	<p>The sustainability of alternative job opportunities is questionable.</p>
<p>. So as a country currently, we are sitting with 25% unemployment, I think that is the number, so from a Government point of view, the interests from Government would be to actually seek industries and stimulate growth in industries that’s going to employ people...Hence the reason why our current Government is the biggest employer as it currently stands.</p>	<p>With an unemployment rate of 25%, government is seeking industry to stimulate growth where they employ more people not less. That is the reason why Government is the biggest employer in the country.</p>	<p>New mining method does not adequately address the current unemployment crisis South Africa is experiencing.</p>	<p>New mining method does not adequately address the current unemployment crisis South Africa is experiencing.</p>	<p>New mining methods not labour intensive.</p>	<p>New mining method reduces immediate direct job opportunities.</p>
<p>I think one of the major challenges that does exist, is that how do we introduce mechanisation without the “tag” that goes with it. Because invariably when you speak to any mining person about mechanisation, in the same breath they would say mechanisation equals job losses....Now to this extent I think the major obstacle is that there’s not anything feasible right now on the table to take over. That core of employment role that mining plays at the moment. And as largely because we are a net exporter of everything that we mine. As a collective and as a country, one of our biggest challenges has to be we need to understand how do we do beneficiation.</p>	<p>One of the major challenges that exist is the perception that mechanisation is associated with job losses. Because the SA mining industry is a net exporter of minerals there is not an immediate substitute for mining occupations.</p>	<p>A major challenge is the perception that mechanisation is associated with job losses. There is no immediate substitute for mining occupations.</p>	<p>A major challenge is the perception that mechanisation is associated with job losses. There is no immediate substitute for mining occupations.</p>	<p>New mining methods not labour intensive.</p>	<p>New mining method reduces immediate direct job opportunities.</p>
<p>if we look at our current conventional mining methods, it’s hand labour, it’s hard labour. It doesn’t require any form of education and hence, I mean the ease that we are able to source labour. I think the issue is that these people have to work somewhere. When we go to the mechanisation process and I should think that from a social point of view, as Government and industry we need to understand how do we go about doing so, how do we locally beneficiate? Because I don’t think I believe that if we don’t do that, the chances of mechanisation being successful, technically it might work but socially it won’t be acceptable.</p>	<p>Because the conventional mining method is based on manual labour, it does not require any form of education. When we go to the mechanisation process, Government and industry need find adequate substitutes for these low skilled jobs. In the event that they do not do that mechanisation might work technically but from a social point of view it won't be acceptable.</p>	<p>Conventional mining is based on manual labour that does not require any form of education. Government and industry need to find adequate substitutes for these low skilled jobs. Despite the fact that mechanisation are technically sound it won't be acceptable from a social point of view.</p>	<p>Conventional mining is based on manual labour that does not require any form of education. Government and industry need to find adequate substitutes for these low skilled jobs. Despite the fact that mechanisation are technically sound it won't be acceptable from a social point of view.</p>	<p>New mining methods not labour intensive. Significant skills gap.</p>	<p>New mining method reduces immediate direct job opportunities. There exist a significant un-transferable skills gap.</p>

<p>The only time that technology really comes to the fore, technology/mechanisation are used then interchangeably because to a large extent they are, is when there's a burning platform, when there is no future to do anything but to introduce technology or mechanise. To answer the question in terms of do I think that there is a technology available; I do think there is. Maybe not off the shelf, definitely not off the shelf technology and mechanisation that can be taken and introduce at the whim. I think there are a lot of challenges, but if we go and look at the amount of time that senior executives in gold mining companies spend and how much money they spend towards technology and mechanisation, I think we'll understand that it's not a burning platform yet. So I think there is technology available, but not in its current format. It will have to be adapted and it will have to be changed and we would have to deal with the changes that it does present and actually introduce them. But as long as, you know labour is relatively cheap, and we have relatively good margins, we probably won't introduce it. Specifically if you're sitting in an environment where from a regulatory point of view it's not been rewarded or incentivised to actually mechanise or introduce technology which is very much the current South African landscape where employment is a real, real challenge.</p>	<p>The only time that technology really comes to the fore is when a burning platform is created. Technology is available but it is not off the shelf solutions and there a lot of challenges related to this technology. If you consider the amount of time that senior executives in gold mining companies spend on how much money they spend towards technology it is safe to say there is no burning platform yet. As long as labour is relatively cheap and we have relatively good margins we won't introduce mechanisation. Currently we are in a regulatory environment that is not rewarding or incentivising to introduce technology that creates a real challenge.</p>	<p>The technology that is available is not off the self solutions and there does not exist a burning platform to initiate change.</p>	<p>The technology that is available is not off the self solutions and there does not exist a burning platform to initiate change.</p>	<p>Lack of local research and development. No burning platform.</p>	<p>The lack of local research and development impaired our ability to develop tailor made solutions. There is no burning platform yet to initiate radical change within the industry.</p>
<p>South Africa is a country, it's not a dripping roast at the moment and people are not too keen to invest serious amounts of capital in terms of long lead time projects which invariably, any gold mine is. From start of the sinking of a shaft to its first ounces is anything from 10 to 12 years and there are very few people or investors in the current climate that's prepared to take that risk.</p>	<p>South Africa as a country is not a appealing investment destination and people are not keen to invest serious amounts of capital in terms of long lead time projects which invariably any gold mine is. From the start of sinking a shaft to its first ounces is anything from 10 to 12 years and there are very view people/investors that is prepared to take that risk.</p>	<p>South Africa is not considered an appealing investment destination.</p>	<p>South Africa is not considered an appealing investment destination.</p>	<p>Unattractive investment destination.</p>	<p>Due to extended project pipelines and capital intensity of mining the industry is not seen as an appealing investment destination.</p>
<p>if we as business do not give viable opportunities, or off set points or alternatives for that matter, for Government and for labour to see what they will do with the big challenge, which is the fact that there is not going to be any employment if you don't go for mechanisation. Unfortunately if we don't take lead in that, it's not going to arrive by itself and so I really do think that beneficiation is a huge challenge for us to have work.</p>	<p>If we do not give viable options or off set points for Government and labour to understand that there is not going to be any employment if you do not go for mechanisation. Unfortunately business do not take the lead and as a collective we will not arrive by itself and therefore beneficiation is a huge challenge for us to create alternative job opportunities.</p>	<p>Due to a lack of common purpose amongst the mining constituency as a collective there exist a slim possibility of finding a viable solution.</p>	<p>Due to a lack of common purpose amongst the mining constituency as a collective there exist a slim possibility of finding a viable solution.</p>	<p>No common purpose.</p>	<p>There is a lack of trust and common purpose amongst mining constituencies.</p>
<p>I think the bigger issue here is from a global point of view, we also need to acknowledge that our Labour Law as it currently stands in South Africa, is unfortunately not geared towards as being competitive from a beneficiation point of view. If we had to compare us to China as an example, there is no comparison purely because the Labour Law is so cumbersome in South Africa. In fact to employ somebody here and unemployed somebody is virtually impossible....</p>	<p>From a global point of view South Africa's labour law is very cumbersome. To employ and unemployed someone in South Africa is virtually impossible. Therefore South Africa is not geared towards being competitive from a beneficiation point of view.</p>	<p>South Africa's labour law is very cumbersome and it is not geared towards being competitive.</p>	<p>South Africa's labour law is very cumbersome and it is not geared towards being competitive.</p>	<p>Legislation impair competitiveness.</p>	<p>Current legislation is being perceived as onerous and decrease competitiveness.</p>
<p>I believe there is a resistance to change which is because the risk is not understood and because people; I use the word empowered...in South Africa and it's a bitter taste in our mouths because we said Black empowerment which is giving something away for nothing. However, if you take a man who's grown up operating in a conventional mining operation and you say "yes, I want you under this construction section," you said empower, he's not empowered, he has no training, he has no skills, he has no appreciation, he doesn't know how the machines work, he does not know how they're supposed to work, he doesn't know what the basic safety features are. All the things which you would learn in the normal mill of things when you started on the mines in a conventional operation, he has to learn virtually by himself. That's scary. It's difficult. He doesn't want to change. I can understand that. I wouldn't want to go through that either. I would want people to know that I want somebody to train me, teach me, help me. Somebody to follow, somebody to lead, somebody to guide me in what are the most important things to do. So, introducing change is really what the difficulty is. And it's always difficult, doesn't matter where you are or what you're doing..It's not resistance to change; it's simply a disempowerment for the individual. He's not empowered, he's not taught, he's not instructed, he's not guided into what he should actually do. So that to me is the problem for the kind of change that we want to introduce in the mining industry.</p>	<p>There is a resistance to change because the risk is not understood and because people are not adequately empowered. Empowered refers to teaching the individual so that he has the appropriate skill and appreciation. He needs to know how the machine work and the basic safety features. Because it is out of his comfort zone it is scary and it is difficult and therefore he does not want to change. So introducing change is really what is difficult. So that to me is the problem for the kind of change that we want to introduce in the mining industry.</p>	<p>There exist a resistance to change because people are not adequately empowered. Empowered refers to education and training to gain the necessary skill.</p>	<p>There exist a resistance to change because people are not adequately empowered. Empowered refers to education and training to gain the necessary skill.</p>	<p>Lack of training and education.</p>	<p>People are not adequately empowered through training and education.</p>

<p>The Chamber of Mines research used to have over 600 employees of which about two thirds of them were graduates. Mainly from overseas as it happens because we couldn't get local people. We did preliminary research. Spend a lot of money on it. And some of the things I was talking about, things we could do today which would improve conventional mining, is work which came out of that research programme that was conducted. And that was all closed down in 1990 and since then we've done virtually nothing. If you want to tell what is happening at the moment with this mechanised mining which is going on now, you think LHD's and drill rigs and boulders and things, that predominantly are made by overseas suppliers; the Sandviks and Atlas Copco's.</p>	<p>Research in South Africa was historically very intensive and these work have reduced to nothing by 1990. Since then we have done virtually nothing. Research in mechanised mining are currently predominantly done by overseas suppliers.</p>	<p>Research and development in South Africa have reduced to nothing and is predominantly done by overseas suppliers.</p>	<p>Research and development in South Africa have reduced to nothing and is predominantly done by overseas suppliers.</p>	<p>Lack of local research and development.</p>	<p>The lack of local research and development impaired our ability to develop tailor made solutions.</p>
<p>So you have to thoroughly understand what the application is. I mean in this case, the application is now rig mining. What's the biggest issue in our rig mining? Solutions. And how do you manage to control that? we're sucked into selling things on the features, the add-ons and not on the basic functionality and how those changes we've made, will add to the value of the customer's operation.</p>	<p>Equipment manufacturers need to understand what the application of the solution is and how to manage and control it. But equipment manufacturers adopt marketing strategies where it is selling equipment based on features and add-ons rather than the basic functionality and how those changes they've made will add value to the customer's operation.</p>	<p>Equipment manufacturers are adopting marketing strategies where it is selling equipment based on features and add-ons rather than the basic functionality and how those changes will add value.</p>	<p>Equipment manufacturers are adopting marketing strategies where it is selling equipment based on features and add-ons rather than the basic functionality and how those changes will add value.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>...the mechanisation that's occurred in platinum, and that's only in platinum ore bodies less than 10 degrees. Once you've start using trackless equipment in depths greater than 10 degrees and then you have serious problems. And that's the reality in the gold mines, is that tragically all the gold mines virtually to today are greater than 10 degrees...it's less clear what the solution is in those areas.</p>	<p>Mechanisation is difficult in steep dipping orebodies with an inclination of 10 degrees and higher. Tragically all gold mine virtually today are greater than 10 degrees. The mechanised solution for those operations is less clear.</p>	<p>Mechanisation is difficult in steep dipping orebodies that include the majority of SA gold deposits.</p>	<p>Mechanisation is difficult in steep dipping orebodies that include the majority of SA gold deposits.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>But in the process, there's a couple of things we need to look at. To invest in a piece of equipment that costs a hundred million rand, you need to know where your reef is. You can't just go there thumb suck and say okay I assume it will be here and then tomorrow it's not there because you hit a fault, so down through and out your fault and the reefs disappeared. You need to know about that in advance. So, understanding the ore body and making it into glass so it can be transparent and see what it is, is one of the critical things</p>	<p>Because of the size of investment in mechanisation it is imperative that you need to have knowledge of the ore body being mined. It need to be transparent to identify abnormalities such as faults and dykes in advance.</p>	<p>Because of the size of the investment in mechanisation knowledge of the orebody is imperative.</p>	<p>Because of the size of the investment in mechanisation knowledge of the orebody is imperative.</p>	<p>Unattractive investment destination.</p>	<p>Due to extended project pipelines and capital intensity of mining the industry is not seen as an appealing investment destination.</p>
<p>Buying in from mine management is not so easy, because some of the devices that exist or technologies that exist are not readily implementory....The last thing you want to do as a mine manager, is to buy something for a hundred million, go underground and find it's parked in the corner and you ask the question why? He says it doesn't work because it breaks down, etc., etc., etc.</p>	<p>Getting buy in from the work force and mine management are not so easy as some of these devices that exist can not be readily implemented.</p>	<p>Getting buy in from the work force and management are not so easy as some mechanised solutions are not readily implemented.</p>	<p>Getting buy in from the work force and management are not so easy as some mechanised solutions are not readily implemented.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>Not all the mines will get into a mechanised mining solution because it's old. Ageing infrastructure, the shafts were not designed to put large pieces of equipment underground. The problem also is that some of the reef is just way too steep to deal with it. Some of the platinum mines, even as shallow as they are, the reef is very undulating. So, it's hard to follow that with a piece of equipment.</p>	<p>Some of the mines is just too old to mechanise and the infrastructure were not designed to handle large equipment underground. The inclination of some orebodies is too steep for current mechanised solutions. Undulation within the underground working also poses a significant challenge.</p>	<p>Current mining operations infrastructure does not catered for mechanised solutions and ore bodies are too steep and undulated. The mines are also just too old to mechanise.</p>	<p>Current mining operations infrastructure does not catered for mechanised solutions and ore bodies are too steep and undulated. The mines are also just too old to mechanise.</p>	<p>Current mechanised solutions not suitable. Unattractive investment destination.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. Due to extended project pipelines and capital intensity of mining the industry is not seen as an appealing investment destination.</p>
<p>People think that mechanisation is the silver bullet to solving our problem. It never will be, never is going to be and we're wasting our time on the matter. I speak to the term called mechanical mining. And there is a big difference between mechanisation, and I know it's pedantic, but there is a big difference between mechanisation and what I call mechanical mining. Mechanisation is a process which is been perfected for the needs bespoke of massive ore bodies in Canada and Australia. If you look at any mechanisation that acquires a machine to drill a hole, put explosives in and blast. That's what it is. Now if you do that in a South African context, you're just taking a human being away, putting a machine there with an operator, and you're doing the same. What do you change if you do that? How is it going to get cheaper? Since when has mechanisation ever been cheaper than cheap labour? And I say "cheap labour", that it is a lot cheaper than skilled operators</p>	<p>People think that mechanisation is the silver bullet that is going to solve our problem but it is not the case. Mechanisation means that you only replace the human with a machine but you're doing the same. In that sense it is not cheaper to mechanise than to remain with a conventional extraction strategy.</p>	<p>Mechanisation means that you replace a human with a machine but in doing that you remain the same. It is not cheaper to mechanise than to remain with the current conventional extraction strategy.</p>	<p>Mechanisation means that you replace a human with a machine but in doing that you remain the same. It is not cheaper to mechanise than to remain with the current conventional extraction strategy.</p>	<p>Current mechanised solutions not suitable. No burning platform.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. There is no burning platform yet to initiate radical change within the industry.</p>

<p>We leave about 40% of the gold behind because of the safety issue, because of the seismic stresses and the stress related mining, and it's only become like that in platinum more and more as you increase your depth, you leave more gold behind. From a macro perspective to safe guard seismic stress. And despite that, we still have seismic fatalities and huge seismic events because you scratch down from mother earth where there is one little hole or big holes you're going to have a response from it.....If you go mechanisation all the same reasons exist that currently are impediment towards opening up further reserves. That's the one reason. Mechanisation, drill a hole, put explosives in charge. No difference. You're stuck with exactly the same impediments you've got. So, there's nothing that's going to move the dial.</p>	<p>Currently the conventional mining extraction strategy leave about 40% of the ore reserves behind to safeguard against seismic stress. Despite that we still have seismic fatalities and huge seismic events. These constraints reduce the efficiency of the mining extraction strategy and increase the risk. Apply the same in a mechanised extraction philosophy there will be no difference.</p>	<p>Current safeguards against seismicity reduce extraction efficiency. With mechanisation there will be no difference.</p>	<p>Current safeguards against seismicity reduce extraction efficiency. With mechanisation there will be no difference.</p>	<p>Current mechanised solutions not suitable. No burning platform.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. There is no burning platform yet to initiate radical change within the industry.</p>
<p>You're going to lose anything from 20 up to probably about 30-35% of gold just because of the way you break the rock. You're not efficient...If you go mechanisation all the same reasons exist that currently are impediment towards opening up further reserves. That's the one reason. Mechanisation, drill a hole, put explosives in charge. No difference. You're stuck with exactly the same impediments you've got. So, there's nothing that's going to move the dial.</p>	<p>Because of the drill and blast practices you are loosing anything between 30-35% of the mineral just because of the way that you break the rock. Therefore you are not efficient.</p>	<p>Because we employ brill and blast practices we loose anything from 30-35% of mineral.</p>	<p>Because we employ brill and blast practices we loose anything from 30-35% of mineral.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>To add insult to injury on top of the fact that you're losing that gold in that initial process and multi core factor conversation after it, you're diluting it. So if you look at your average channel widths, human beings are human beings. They've got a certain height, 1.7m on average by statistics and 70kg's I think is the average for a human male. You are diluting in instances up to 2-3 000%. So what you're doing is, you transporting so much additional tonnage, which got no value to you through this entire processing...If you go mechanisation all the same reasons exist that currently are impediment towards opening up further reserves. That's the one reason. Mechanisation, drill a hole, put explosives in charge. No difference. You're stuck with exactly the same impediments you've got. So, there's nothing that's going to move the dial.</p>	<p>Because you have to extract the ore with human beings you need to create an adequate working area for the people to work in. In some cases you need to increase dilutions up to 2000%-3000%. You transport so much additional tonnage which got no value through the entire process. Apply the same in a mechanised extraction philosophy there will be no difference</p>	<p>Due to excessive dilution of the reef to make provision for adequate space will remain a challenge despite employing a mechanised extraction strategy.</p>	<p>Due to excessive dilution of the reef to make provision for adequate space will remain a challenge despite employing a mechanised extraction strategy.</p>	<p>Current mechanised solutions not suitable. No burning platform.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. There is no burning platform yet to initiate radical change within the industry.</p>
<p>If you put explosives in ore, and you're speaking about these depths and very complex ventilation and environmental conditions, you can't run these things 24/7. Conventional methods. You need something that allows you a 24/7 process. The key to it, is explosives. Why is it currently we got to clear people out, take a blast, clear the air through there? It's because of toxic noxious fumes that exposes. So if you eliminate, what is the one common theme in this entire process? It says, if you want to change the destiny, not incrementally, incremental won't help you, you've got to move the dial big time. You got to change something. And the one thing is to stop using explosive...if you stop using explosives, you will not have the time constraint....If you go mechanisation all the same reasons exist that currently are impediment towards opening up further reserves. That's the one reason. Mechanisation, drill a hole, put explosives in charge. No difference. You're stuck with exactly the same impediments you've got. So, there's nothing that's going to move the dial.</p>	<p>Because of the use of explosives in the conventional mining method at these depth and very complex ventilation and environmental conditions you can not run these things 24/7. We current need to clear people out, take the blast and clear the air through the working area. So you need to eliminate the common theme throughout the entire process in order to change the mining industries fundamentally as appose to incremental gains. Apply the same in a mechanised extraction philosophy there will be no difference</p>	<p>You need to eliminate the common theme throughout the entire process in order to change the mining industry fundamentally as appose to incremental gains. To apply the same fundamentals in a mechanised extraction philosophy will make no difference.</p>	<p>You need to eliminate the common theme throughout the entire process in order to change the mining industry fundamentally as appose to incremental gains. To apply the same fundamentals in a mechanised extraction philosophy will make no difference.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>Mechanisation is fundamentally still just like conventional methods, a very batch type of process. Batch shifts, batch cycles, everything is batches. You need to convert this into a continuous process. It doesn't rely upon consisting sections of time and batching and series of events. Only that allows you that, is mechanical breaking of rock and the exclusion of explosives as a principle.</p>	<p>Mechanisation is fundamentally the same as conventional mining in that it is a batch process. You need to convert it into a continuous process where it does not rely upon a specific sequence of events. Mechanical breaking of the rock with the exclusion of explosives as a principle allow you that opportunity.</p>	<p>Mechanisation is fundamentally the same as conventional mining in that it is a batch process. In order to change it you need to convert it into a continuous process of mechanically breaking the rock.</p>	<p>Mechanisation is fundamentally the same as conventional mining in that it is a batch process. In order to change it you need to convert it into a continuous process of mechanically breaking the rock.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>So, for me mechanisation is okay. Development, its worked okay. We haven't quite mastered it to be able to get our skills set and the applicability of our machinery to adapt to our currently environment and then we got this massive issue I believe, which is skill. If you look at Canada and Australia. Man, they're absolute magicians on those rigs. They come with a different education level, they come with a different outlook and they are paid very differently. Very, very differently. I mean an operator in Australia, rumour has it, gets paid equivalent to what a general manager in South Africa gets paid. And there's only a few of them, so you can afford it but the efficiency is not there yet, the way they do business. Their ore bodies. Mechanisation was designed to meet those ore body needs. And they just happened to start over 30, 40 years. Problem is we've tried to take that same thinking and place them into a South African context. And then we realised at a point but that's not going to work.</p>	<p>Mechanisation is a challenge in that South Africa does not have the required skill set. Where mechanisation does work is in countries like Canada and Australia where operators of equipment have the adequate skill set to operate those equipment an are very well compensated for this work. The equipment were designed for these massive orebodies and have evolved over 3 to 4 decades. We have tried to take that same thinking and place them into a South African context but it does not work.</p>	<p>Mechanisation is a challenge because South Africa does not have the required skills set. Current mechanised equipment is designed for massive ore bodies that have evolved over decades.</p>	<p>Mechanisation is a challenge because South Africa does not have the required skills set. Current mechanised equipment is designed for massive ore bodies that have evolved over decades.</p>	<p>Current mechanised solutions not suitable. Lack of training and education.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. People are not adequately empowered through training and education.</p>

<p>The problem with that process is OEM's are not in the best natural although they also have R&D to sell you something different. And where does the R&D come from? Where does the funding come from to create something different? Now we've been caught in this trap before where they got into bed several times with the mining industry. Only for the economy to turn on R&D to be cut and they get stuck with this proto type that they invested how much millions or tens of millions in and these are in the market, for now all of a sudden they cost cutting that. So, also understand that right. We got it wrong in the past. Usually that's why the OEM's are so sceptical of us when we speak of our technology from a South African perspective. We never get there...Somebody says the economy turns and then R&D stops, because it's not in our nature to be entrepreneurial.</p>	<p>In order to develop tailor made solution within the South African market we need to have R&D money to do that. These funds are unfortunately the money that is the first to be cut when the economy turns. Therefore the OEM's are sceptical to enter into R&D with South African mining companies. The reason for this is because the current mining houses does not have an entrepreneurial appetite.</p>	<p>In order to develop tailor made solutions we need funds for R&D. These funds are the first to be cut during an economic crises and not seen as a priority and lack entrepreneurial appetite.</p>	<p>In order to develop tailor made solutions we need funds for R&D. These funds are the first to be cut during an economic crises and not seen as a priority and lack entrepreneurial appetite.</p>	<p>Lack of local research and development.</p>	<p>The lack of local research and development impaired our ability to develop tailor made solutions.</p>
<p>Let's start off with the most common theme in all of it, is the whole idea that mechanisation and mechanical mining will steal jobs from people. Historically people have always argued that is the big reason why our technology attempts have failed because it's been sabotaged by organised labour and by their employees. I think to a certain degree yes. I think to a certain degree also because the way the story was carried across, was silly in my opinion. I mean you've heard after the Marikana events of companies saying we go mechanisation, we do away with some jobs is almost a threat to the process and I think it's that type of behaviour that creates more reason why organised labour and workforce believe this nonsense....I think it has been a problem in the past but I don't think it's the organised labour and the workforces' fault. I think it's the way we've portrayed the story and we've used it almost as if the Marikana event. As a threat to people.</p>	<p>There is a perception that by mechanising a mining operation you will steal jobs from people. Historically people have always argued that this is the big reason why our technology attempts fail because it is been sabotaged by organised labour and by their employees.</p>	<p>There is a perception that mechanisation will reduce job opportunities and this is considered the reason why this technology were unsuccessful during implementation.</p>	<p>There is a perception that mechanisation will reduce job opportunities and this is considered the reason why this technology were unsuccessful during implementation.</p>	<p>New mining methods not labour intensive.</p>	<p>New mining method reduces immediate direct job opportunities.</p>
<p>And I must admit, even with the alternative story, I battle after even 4 years now, to get it properly institutionalised in thinking from organised labour's perspective, that this is the way to go and why mechanisation and mechanical mining isn't a threat. So much as I've, and I'm telling this story, I think the historical means of telling it have created so much damage, the distrust, even the story I'm trying to tell which is from a slightly different angle, is difficult to land in their minds as trusted. But here's the way that we tell the story. We tell the story like this and I think it's really true. When I say I think, I believe that it's really, really true.</p>	<p>The fact that mechanisation has been portrayed as a threat to people have created so much damage, the distrust that even when the story is being told from a different angle is a hard sell. To get mechanisation properly institutionalised from a organised labour perspective is very difficult.</p>	<p>Mechanisation has been portrayed as a threat to people's livelihoods and created distrust amongst the mining constituency.</p>	<p>Mechanisation has been portrayed as a threat to people's livelihoods and created distrust amongst the mining constituency.</p>	<p>New mining methods not labour intensive. No common purpose.</p>	<p>New mining method reduces immediate direct job opportunities. There is a lack of trust and common purpose amongst mining constituencies.</p>
<p>What we forget not to tell them, but I also, and by the way I also think it's a concept and a construct of decision makers in organised labour and the branches, don't come with this education, don't come with this knowledge. So, it's also about educating them as well as having an appreciation to interpretation. And they won't know for instance the difference between a reserve and resource. Most of them don't come from the MRM departments, with level 1, 2, 3 ounces and SAMTRAC qualifications that understand the different classifications and how they work. They just know reserves, we mine them and resources are something else. It's partly also that they are not properly educated in the economics of mining.</p>	<p>People are not properly educated in the economics of mining and have not an appreciation to interpretation to understand that mechanisation or mechanical mining offers the only solution to the South African mining challenges.</p>	<p>People are not educated and do not have an appreciation of the concept to understand that mechanisation offers the only solution to South African challenges.</p>	<p>People are not educated and do not have an appreciation of the concept to understand that mechanisation offers the only solution to South African challenges.</p>	<p>Lack of training and education.</p>	<p>People are not adequately empowered through training and education.</p>
<p>You cannot integrate this new paradigm with old paradigm. It's a part of the failures of all previous mechanised attempts bespoke in a stope you can make it work but you can't make it work in a system because the infrastructure built to service that method is built on a conventional thinking. So, if you want to change it fundamentally to the ore bodies that lie at depth, you got to change the entire infrastructure that services this mining method</p>	<p>You can not integrate this new paradigm with an old paradigm where mechanisation are implemented within an infrastructure that was built to service a conventional mining layout. If you want to change the mining method to the ore bodies that lay at depth, you got to change the entire infrastructure that services this mining method.</p>	<p>You can not integrate the two paradigms within a common infrastructure. If you want to change the mining method you need to change the infrastructure.</p>	<p>You can not integrate the two paradigms within a common infrastructure. If you want to change the mining method you need to change the infrastructure.</p>	<p>Incompatible mining infrastructure.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult.</p>
<p>The fact technically or factually is you will not, with the current level 1 plans build of conventional mining presence be able to in the next 10 years displace that with mechanised mining</p>	<p>Technically and factually the current conventional mining presence will not be displaced with mechanised mining.</p>	<p>Technically it would not be possible to displace the conventional mining presence with mechanised mining.</p>	<p>Technically it would not be possible to displace the conventional mining presence with mechanised mining.</p>	<p>Incompatible mining infrastructure. Current mechanised solutions not suitable.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult. The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>

We've had 4 decades of trying to bring mechanisation into our stoping horizons and we haven't got it right. Not once.	Mechanisation does not work within the current gold stoping horizons as not once attempt over the past 4 decades were a success.	Not one attempt within the gold horizon was successful over the past 4 decades.	Not one attempt within the gold horizon was successful over the past 4 decades.	Current mechanised solutions not suitable.	The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.
Guys, there's no switch in this conversation. You cannot switch on mechanisation at the cost of switching off conventional. There's a point at which conventional has to die. For all safety mining otherwise there's nothing. There isn't a switch. It's a transition of thinking, social adjustment, labour force adjustment, different work skills. There's a whole lot of stuff.	You can not switch on mechanisation at the cost of switching off conventional. There is a point where conventional mining has to die and there should be a transition of thinking, social adjustment, labour force adjustment, different work skills etc.	Switching from mechanised operations to conventional include a transition of thinking, social adjustment, labour force adjustment and different works kills.	Switching from mechanised operations to conventional include a transition of thinking, social adjustment, labour force adjustment and different works kills.	No burning platform.	There is no burning platform yet to initiate radical change within the industry.
I can expand this to how we train mining engineers at Wits university and techs, and have to change fundamentally. You want a mining engineer as we have trained them, which is just general practitioners. I'm a mining engineer. Wrong type of person try to make mechanisation. Also engineers are wrong guys. So you need this high individual that's trained very differently to run with pure proper mechanical mechanised processes. We don't have any in South Africa. Why is Australia and Canada better in this? Because they are smarter, bull duster than smarter. Because they have 40 years of experience behind them.	Training of the management of the employers is not aligned with mechanised processes. The way in which Mining Engineers are trained is totally different from how they should be trained in a mechanised environment. Engineers in Australia and Canada are better equipped because of the amount of experience they have in this particular mining method.	Training and management of the employers is not aligned with mechanised processes.	Training and management of the employers is not aligned with mechanised processes.	Lack of training and education.	People are not adequately empowered through training and education.
Because, we don't have moral compass in our Government and that's a key stake holder in this process. There's so much happening in the background around of mineral rights and country wealth only going to the country and the investment discomfort they cause, and there's a whole lot of behaviours. The multinationals to a large degree of saying there are mining rights or the big companies we're going to hold onto them and mine them as best as possible. We are not going to put a lot into R&D to say just because we don't have that security of ten year in any case.	Because Government does not have a moral compass multinationals to a large degree hold on to the mineral rights that they have but will not put a lot into R&D because they do not have the security of 10 years in that case.	Companies will not invest intensively because they do not have the required security over the mineral rights.	Companies will not invest intensively because they do not have the required security over the mineral rights.	Unattractive investment destination.	Due to extended project pipelines and capital intensity of mining the industry is not seen as an appealing investment destination.
But the point is to develop appropriate technologies in our narrow reefs. It's not going take a year, 2 years, it's going to take 2 or 3 decades. So, you'll wait until 2025? Well, maybe. I don't know what the future holds. But I tell you it's going to be 20 or 30 years later before we can get into this stuff that we've left over here.	To develop mechanised solutions for narrow reefs is going to take decades to develop and perfect. The issue is that some of the mines with the current conventional layouts will no longer exist when it happens.	To develop mechanised solutions are going to take decades to develop and perfect. The conventional mines will no longer exist at that time.	To develop mechanised solutions are going to take decades to develop and perfect. The conventional mines will no longer exist at that time.	Current mechanised solutions not suitable. Lack of local research and development.	The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges. The lack of local research and development impaired our ability to develop tailor made solutions.
Uniqueness of ore bodies is the first part. South African ore bodies, narrow tabular ore bodies are unique. Fairly unique. You ask yourself why the rest of the world are not doing this? Or why? How do they do that? Where is there a place in the world that's mining a flat tabular body at ten degrees? They don't. They wait until the most of the places they're mining beyond the angular repost, they long haul open stoping. They've got all of those mining methods that they're using because they can use gravity. So, the ore bodies lend themselves vertical type ore bodies, or these other home ingenious ore bodies they have in Australia, lend themselves to board and pillar mining. If it's fairly wide, they go in bordered pillar, if it's vertical, they got stoping and other methods. But where you're sitting in that middle between the ten degrees and the 34 degrees, there's not a hell of a lot other people in the world that are mining those ore bodies. I'd like to see that. They're generally sterilised in a lot of the ore bodies if they are narrow. They're just forgotten about. They're seen as un-mineable. That's where the entire Wits basin, the entire bushveld complexes in those environments.	The South African ore body is a unique narrow tabular orebody that is sitting between 10 degrees and 34 degrees. Other countries with similar type of orebodies is generally sterilised in a lot of the ore bodies if they are narrow and declared un-minable. The entire Wits basin (gold) and Bushveld Igneous Complex (platinum) have this type of orebody.	The South African gold and platinum ore bodies have unique features that is not considered mineable anywhere else in the world.	The South African gold and platinum ore bodies have unique features that is not considered mineable anywhere else in the world.	Current mechanised solutions not suitable.	The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.
. And I don't think enough research and development has gone into that space over the last 20 years, not depth. The last 20 years buggerol research has gone into the actual mechanisation of a deep level gold mine face. There may have been various attempts at it, but nobody's cracked that code yet.	I do not think that not enough R&D has gone into that space over the last 20 years in deep level gold mining. There may have been various attempts but nobody has cracked it to date.	There is not a lot of research and development that have been dedicated to finding a solution.	There is not a lot of research and development that have been dedicated to finding a solution.	Lack of local research and development.	The lack of local research and development impaired our ability to develop tailor made solutions.

<p>On reef, then, you know you can, very often you do get fracturing and different elevations and faults and so on. And there again, you could do that with some kind of a monorail development and that can be drill and blast as you go. If you establish your raised line. But that will get your access to reef a lot, lot quicker. In the faces, itself in gold mining is really where our challenges lie. We just don't have, other than the jack hammer and all the other, scraper winch and so on that we have. What else have we got that we could actually mine the faces with? So, the primary mining tools that we're developing are aimed at that. Once we're on the reef, how do we then get the man away from the face? Have a tool that's remotely controlled or autonomously controlled where you can manipulate it from a distance, that drills the face for you. You then coming, assuming that you then even at that stage still blasted. You blast it you can then clean it via dozer or some other means, back into a gulley... The challenge with these kinds of equipment though, very often is that you are faced with, real challenges of faulting and throws and dykes and slips, etc., etc. You are probably going to land up the end of the day with some kind of a hybrid between a drill and a blast and where we've got long lengths that we can cut. We will cut the long lengths and we will have areas where we will still be drilling and blasting in the complicated areas</p>	<p>It is within the reef horizon that the challenge lies. We do not have other than the jackhammers and scraper winch that we can mine the faces with. Once you are on-reef you need to have a tool that is remote controlled or autonomously controlled where you can manipulate it from a distance. Drilling and cleaning of the face can be done remotely. The challenge with these kinds of equipment that you are faced with is faulting, throws and dykes and slips. At best you will probably land up with a hybrid system where you still drill and blast in complicated areas.</p>	<p>The challenges lay in the reef horizon especially with regard to geological discontinuities.</p>	<p>The challenges lay in the reef horizon especially with regard to geological discontinuities.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>With the current political reality that we're facing, there's almost from where we sit, the intend to want to stuff the industry up. What ways can we find to make it more tough for the guys to pack their bags and they go somewhere else? It doesn't go well from a political perspective. The political will, and I don't think it's in this country, to create that. And I think, let's call it the mine operators in this country are going to find it more and more difficult over time to meet the hurdles. Whatever hurdles the Government is throwing at them...They can regulate us into submission. This industry could be regulated into some kind of a status quo. Outside of the growth margin and in a declining trend rather than a rising trend. The politics will dictate where we land.</p>	<p>The current political climate is unfavourable to the mining industry in that there is a perception that mine operators are going to find it increasingly more difficult to meet the hurdles. Government can regulate us into submission that is outside of the growth margin and in a declining trend.</p>	<p>The current political climate is unfavourable to the mining industry and the perception is that the Government is going to regulate mining houses into submission.</p>	<p>The current political climate is unfavourable to the mining industry and the perception is that the Government is going to regulate mining houses into submission.</p>	<p>Legislation impair competitiveness.</p>	<p>Current legislation is being perceived as onerous and decrease competitiveness.</p>
<p>If you really look at South African mining, my view is that we significantly differ to the rest of the world. And there are three factors. The one is that our reefs that we are mining are very narrow reefs compare to the bulk reefs and the massive ore bodies in other places in the world. Secondly, we've got deep level mining that very few people have experience for in the rest of the globe. Thirdly, our dips are between 18 and 35 degrees, nobody else are mining at those dips. All the mechanised equipment that are built all over the world is rubber tired and those things can handle 9 degrees, at max 11 degrees, then we've got problems. So, that causes us to work on apparent dips that are not working for us.</p>	<p>The South African mining significantly differ from the rest of the world in that we mine narrow reefs compare to the bulk reefs and massive ore bodies all over the world. Secondly we got deep level mining that very few people have in the rest of the world. and thirdly our dips are between 18° to 35° nobody else in the world are mining at those dips. All mechanised equipment that are build all over the world is rubber tired that can only handle 9°-11°. anything above these inclinations poses a problem. Therefore it forces us to work on apparent dips.</p>	<p>The South African gold and platinum ore bodies have unique features that is not considered mineable anywhere else in the world.</p>	<p>The South African gold and platinum ore bodies have unique features that is not considered mineable anywhere else in the world.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>That's where the first complication is. All the big manufacturers, if you look at, I'm talking BIG mechanised manufacturers are overseas, in Europe and Russia. Those guys are mining massive ore bodies and their lowest kit is low profile that fits in a 2.1-meter stope width, mine width. Those machines are actually not designed for the South African mining industry. And what kills us, is that those machines fit in 2.1 and with our reefs at 0.6 to 1.4, 1.5. So, we get 100% dilution and the grade is just killing us...you've got very huge capital infrastructures to get the amount of metal or ounces on the bells that you are taking out or however you take it out, and we dilute it by 50%.</p>	<p>All the mechanised suppliers have machines to mine massive orebodies that have a minimum tramming height of 2.1 meters. These machines struggle to operate in a stoping width of 0.6-1.5 meters. The dilution when we opening up the stoping width is killing us. In addition you have huge capital infrastructure to move material that is diluted by 50%</p>	<p>All other mechanised operations have massive orebodies and opening up narrow reef orebodies increase dilution and the cost of extracting these diluted material is extensive.</p>	<p>All other mechanised operations have massive orebodies and opening up narrow reef orebodies increase dilution and the cost of extracting these diluted material is extensive.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>So, we always go back to conventional mining. Why? Because our reefs are that narrow and are very broken up. And mechanisation doesn't like, or those type of vehicles don't like all these different angles and broken up ground you need to work at angles...So, my personal view is that we don't have the right kit for the right application.</p>	<p>The tendency is always to go back to conventional mining because our reefs are that narrow and are very broken up. The technology that we are currently using does not like all these different angles and broken up ground. We don't have the right kit for the right application.</p>	<p>We do not have the right kit for the right application.</p>	<p>We do not have the right kit for the right application.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>

<p>...over the last 50 years is tried to go to mechanisation but what we’re trying to do is we want to replace the man with the machine within the same layout, same background, same infrastructure. And that’s where the biggest downfall is. Secondly, we want to try and develop one piece of kit where we don’t look at the full system, we need to get the whole full sweet system set up that’s different. And that’s why it is so difficult to change in South African mining</p>	<p>Over the last 50 years we tried to mechanise by replacing the man with a machine within the same layout, same background and same infrastructure. That is where the biggest downfall is. We also want to try and develop one piece of kit where we do not look at the full system that make it difficult to change South African mining</p>	<p>Over the last 50 years we attempted to replace man with a machine within the same infrastructure. That is where the biggest downfall lies.</p>	<p>Over the last 50 years we attempted to replace man with a machine within the same infrastructure. That is where the biggest downfall lies.</p>	<p>Incompatible mining infrastructure. Current mechanised solutions not suitable.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult. The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>If you want to make the machine smaller like we’re intend doing now, still to get those machines where people are going, doesn’t work. Most of the people that tried mechanisation, don’t go the full of walk, they go with a hybrid system where you then think of the cost for the mechanisation and the poor productivity from the end of labour cost from the human side. Two negatives don’t make a positive like in maths and that’s why most of the hybrid systems shunt to be faulty or to be not working at all</p>	<p>Most people that tried mechanisation very often adopt a hybrid system and then think the cost of mechanisation coupled to the poor productivity and high labour cost of conventional mining will work. Two negatives does not make a positive and that is why most of the hybrid systems are not working at all.</p>	<p>A combination of the two systems does not work in a hybrid type of system.</p>	<p>A combination of the two systems does not work in a hybrid type of system.</p>	<p>Incompatible mining infrastructure. Current mechanised solutions not suitable.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult. The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>The biggest challenge is, just take coal for an example. Coal was drill and blast when I started the mining industry 30 years ago. And it’s now fully mechanised long haul coal factories that are pushing out millions of tons. And they can produce coal at a fraction of the cost now profitably versus what they did 30 years ago. Now we need to do the same. But there is one fundamental difference. The one fundamental difference is that coal is 82 mpa in strength. We’re sitting in rock norites and those that are 240 mpa. The picks and the tungsten carbide and the diamond impregnated bits and so on, can only handle, well in the last 4 years it moved from 120 to 160 mpa. That is where the technology sits. There are tools that we’re using currently, what they call a disc cutter. A disc cutter where they’re doing raise boring and blind boring and so on with disc cutters. This is where you take a piece of steel and you push it into the rock, it makes fractures in the rock and actually breaks it. Now, to do that, you need 200 tons of weight behind you plus about another 400 tons of gripping force before you can get that steel pushed into the rock. As soon as you talk about those weights, you sit with something bigger than 2 of these venues. And that doesn’t fit in an 80-cm environment. So, our biggest challenge is how can we find ways of how we’re going to cut the rock? If we can find a tool that can cut the rock, then the whole dream starts opening up. Will we get there? Well in the progress that I’ve seen in the last 4, 5 years we are on a very steep learning curve and we’re getting there</p>	<p>The biggest challenge is that the current cutting technology in the form of tungsten car bite picks and drill bits can only handle between 120MPa and 160 Mpa. The Gold and platinum industry is sitting in norites of 240MPa. The cutting technology is not at a stage where it can effectively cut the gold and platinum bearing rock. The current technology that exist is not conducive for an 80cm environment.</p>	<p>The biggest challenge is that the cutting technology does not exist to effectively cut the gold and platinum bearing rock and is not conducive in a 80cm stoping width.</p>	<p>The biggest challenge is that the cutting technology does not exist to effectively cut the gold and platinum bearing rock and is not conducive in a 80cm stoping width.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>Working together? I think that is where the biggest problem is at the moment. We don’t see South Africa as a business. We see each company as a separate business and each one wants to do his own thing. And we pay the same 5 cents over and over and over. And that is where I feel we’ve got a downfall. If somebody is on to something and he is successful and he can show the first, second and third prototype, I think everybody else interested must climb in and assist and try to get to the ultimate. But we would rather kill the guy that is almost on a breakthrough than to support him. And that’s the mind-set we’re sitting with in South Africa, unfortunately.</p>	<p>The biggest problem that we have is that people in South Africa do not want to work together. We do not see South Africa as a business but rather separate business with their own interest and focus points. The end result is that we continuously pay the same 5 cents over and over and almost kill the guy that is almost on a breakthrough rather than to support him.</p>	<p>The mining constituency do not want to collaborate and work together to find a solution.</p>	<p>The mining constituency do not want to collaborate and work together to find a solution.</p>	<p>No common purpose.</p>	<p>There is a lack of trust and common purpose amongst mining constituencies.</p>
<p>My personal view is, I think we’ll have to hit rock bottom before people get the message because they don’t get the message. Look at how the mining industry is shrinking around us and nobody gets the message. I had a fortunate opportunity to recover three mines from brink of closure and it’s really only when the for-sale sign is on the front door when people start to think differently. And you need to get there before they start thinking differently. So, for me I think there’s going to be a lot more gold mines and platinum mines that’s going to close down before we will realise that there is a serious problem and we need to do something about it unfortunately. That resistance to change is peaking in this industry. Our other problem is that over the years, what I’ve seen in the last 30 years, is because of the down scaling, down scaling a lot less people were sign on and you’ve got a lot older range of people and the majority of the people want to see the next 4, 5 years out to go on retirement. They’re not interested in change at the moment and that is what’s causing even a bigger resistance to change</p>	<p>There is a perception that we going to hit rock bottom before a turnaround strategy will be bought into. The resistance to change is peaking in this industry partly because during the scaling down of operations a lot less people are signed on and hence we have a large majority of older generation employees that will go to retirement within the next 4 to 5 years. They are not interested in change at the moment that is causing a big resistance to change.</p>	<p>There is a perception that we will hit rock bottom before there will be a turnaround strategy. The resistance to change is peaking where there is no other option but to change.</p>	<p>There is a perception that we will hit rock bottom before there will be a turnaround strategy. The resistance to change is peaking where there is no other option but to change.</p>	<p>No burning platform.</p>	<p>There is no burning platform yet to initiate radical change within the industry.</p>

<p>If you look at the West Wits area, we've got ore bodies that's mining at depths between 3,500 meters and 4,500 meters. Typically, and that's just a lesson that I've learnt, is that the chances of succeeding in converting to a mechanised section and running that mechanised section through a conventional infrastructure is a major challenge... Infrastructure is key and I think we've seen big mines in South Africa and I won't necessarily mention the names, but massive ore bodies on gold new mines that have started up as trackless and for the last 15 years since it's been operational never got their feet because the infrastructure was not designed appropriately.</p>	<p>The chances of succeeding in converting to a mechanised section and running that mechanised section through a conventional infrastructure is a major challenge. Infrastructure must be designed appropriately for the mining method type.</p>	<p>The chances of success of a suitable mechanised fleet for the required orebody is the major challenge. Infrastructure need to be designed around such a mechanised fleet.</p>	<p>The chances of success of a suitable mechanised fleet for the required orebody is the major challenge. Infrastructure need to be designed around such a mechanised fleet.</p>	<p>Incompatible mining infrastructure. Current mechanised solutions not suitable.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult. The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>at the depth that we are sitting now, you know mechanisation sort of become a bit of a challenge. Mechanisation has been around for many years worldwide in our mines but obviously in South Africa there are certain limitation in terms of stoping with mining heights accessibility into that. I really think that the market really never developed in South Africa for mining narrow tabular body. Dipping anything less than 20 degrees to actually mine it in a mechanised fashion.</p>	<p>At the current depth we are sitting now, mechanisation becomes a bit of challenge. Mechanisation has been around for many years world wide but has got limitations in terms of stoping with minimum mining heights. I really think that the market really never developed in South Africa for mining narrow tabular ore bodies that very seldom dip anything less than 20 degrees to actually mine it in a mechanised way.</p>	<p>At the current depths mechanisation becomes a challenge and the current fleet is not suitable to mine the South African narrow orebodies in a mechanised way.</p>	<p>At the current depths mechanisation becomes a challenge and the current fleet is not suitable to mine the South African narrow orebodies in a mechanised way.</p>	<p>Incompatible mining infrastructure. Current mechanised solutions not suitable.</p>	<p>Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult. The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>We also spoke about depth which brings a significant heat factor which also makes you think differently or makes you think about the type of technology you want to implement. You cannot run a diesel engine at 32 degrees in a typical deep level gold mine or 37 degrees for that matter.</p>	<p>With depth which brings a significant heat factor into consideration makes you think about the type of technology you want to implement. You can not run a diesel engine at 32°- 37° that is a typical temperatures experienced in a deep level gold mine.</p>	<p>With depth the current mechanised solution will become increasingly less suitable to extract the gold and platinum reef bearing ore.</p>	<p>With depth the current mechanised solution will become increasingly less suitable to extract the gold and platinum reef bearing ore.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>A thing that is creeping up to us is DPM's. DPM's is really a show stopper in South Africa if you look at the proposed legislation. I don't think the industry as well as the employers who have to supply us come up with any solution to encounter legislation like that.</p>	<p>A thing that is really creeping up to us is Diesel particulate matter (DPM's) that could be a real show stopper if you look at the proposed legislation. I do not think that the industry as well as the suppliers have come up with a solution to counter legislation like that.</p>	<p>Diesel particulate matter is a real challenge in an underground mine and current mechanised solutions will have to be adopted without the use of diesel engines.</p>	<p>Diesel particulate matter is a real challenge in an underground mine and current mechanised solutions will have to be adopted without the use of diesel engines.</p>	<p>Current mechanised solutions not suitable.</p>	<p>The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.</p>
<p>Maybe I can also allude to legislation prime to be implemented very soon is all the changes that happened on the chapter 8. You sit with a very high initial capital cost that you need to incur when you start up mechanisation. Then all of a sudden you pick up another 200-million-rand bill on legislation been enforced down on the employers which in this current era in terms of the commodity prices and the uncertainties around the industry in South Africa very few people can actually afford.</p>	<p>Legislation in terms of Chapter 8 of the mine health and safety act put a financial strain on mechanised sections that include solutions to combat man-machine interface challenges within a confined space. In economic downturn and uncertainty around the industry make it financially unviable for most South African mines.</p>	<p>Mining legislation put a financial strain on mechanised sections that makes some section economically less viable..</p>	<p>Mining legislation put a financial strain on mechanised sections that makes some section economically less viable..</p>	<p>Legislation impair competitiveness.</p>	<p>Current legislation is being perceived as onerous and decrease competitiveness.</p>
<p>I think the South African miners as well as the people that are supplying us, have actually come to a dead lock now where we've got just this Space trucks that we want to introduce into the industry and which will cost us an arm and a leg and it's not really proven whilst we've got things on the operations which are actually very simple, very cheap.</p>	<p>People in the industry have come to a dead lock when they only consider untested technology as a solution to the industries challenge which very often are very expensive. They tend to overlook solutions on the operations which are actually, very simple and inexpensive.</p>	<p>People in the industry have come to a deadlock when they consider untested technology. They tend to overlook solutions on the operations which are less extensive.</p>	<p>People in the industry have come to a deadlock when they consider untested technology. They tend to overlook solutions on the operations which are less extensive.</p>	<p>System optimisation</p>	<p>System optimisation is considered to be sufficient rather than a total transformation.</p>
<p>I think the rate at which we develop our current systems are lagging.</p>	<p>The rate at which we develop alternative mining extraction strategies are lagging.</p>	<p>Alternative mining extraction strategies are lagging.</p>	<p>Alternative mining extraction strategies are lagging.</p>	<p>Lack of local research and development.</p>	<p>The lack of local research and development impaired our ability to develop tailor made solutions.</p>
<p>the external interference that you're having in certain provinces in South Africa. And that is one of the reasons why no one wants to invest in those areas because of what is happening in the areas around the mines. You can understand that a company's got obligation to give back to the communities in the areas where they're mining etc. But what is currently happening there is really not an investor friendly environment and I think that is unfortunately one of the single biggest things that has stopped the expansions within that...And obviously with that external factors, factors playing a role, it actually just pushes away foreign investors to come and invest there.</p>	<p>Because of external interferences does not create an investor friendly environment and that is one of the biggest challenges that South Africa face. These external factors pushes away foreign investment.</p>	<p>External interference does not create an investor friendly environment and pushes away foreign investment.</p>	<p>External interference does not create an investor friendly environment and pushes away foreign investment.</p>	<p>Unattractive investment destination. Legislation impair competitiveness.</p>	<p>Due to extended project pipelines and capital intensity of mining the industry is not seen as an appealing investment destination. Current legislation is being perceived as onerous and decrease competitiveness</p>

Sustainability is unfortunately lacking in the sense that we’re not developing small, medium enterprises to link to job creation and further education.	Sustainability is unfortunately lacking in the sense that we are not developing small and medium enterprises to link to job creation and further education.	Do to the lack of developing small and medium enterprises there is not alternative job opportunity for displaced mining occupations.	Do to the lack of developing small and medium enterprises there is not alternative job opportunity for displaced mining occupations.	Questionable alternative industries.	The sustainability of alternative job opportunities are questionable.
Then those ore bodies come in different degrees as well. Some are steep dipping, some are flat dipping, some are irregular, some are such closed proximity and it has certain geological complexities with them that if you take for instance certain gold mines have shale above it, and shale you can’t keep up. It falls and it just dilutes.	The orebody dips within the platinum and gold mines are very irregular with geological complexities associated with it that make mechanised mining in certain cases unviable.	Geological complexities makes current mechanised mining in certain cases unviable.	Geological complexities makes current mechanised mining in certain cases unviable.	Current mechanised solutions not suitable.	The current commercial mechanised solutions not suitable for SA ore bodies that does not address the fundamental challenges.
Lonmin wanted to mechanise but the infrastructure was not there to enable them to do that. That was one of the reasons amongst others that they failed to execute their strategy.	It is very difficult to implement mechanisation within an infrastructure designed for conventional mining. That is one of the reasons why mining houses such as Lonmin failed to mechanise.	It is very difficult to implement mechanisation within an infrastructure design for conventional mining.	It is very difficult to implement mechanisation within an infrastructure design for conventional mining.	Incompatible mining infrastructure.	Due to the incompatibility of mining infrastructure between the two extraction strategies converting an existing mine to mechanised operation is difficult.

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
So that growth aspect into the local market is somehow ended by the fact that you still have opportunities to purchase those solutions from outside of the country. So the real industrialisation of the mechanised mining opportunities that exist in South Africa still has a way to go	The growth aspect into the local market is limited by the fact that mining companies still purchase mechanised solutions from outside the country. So the real industrialisation of the mechanised mining opportunities that exist in SA still has a way to go.	Industrialisation of mechanised mining opportunities in not mature and the local market is limited.	Industrialisation of mechanised mining opportunities in not mature and the local market is limited.	Local R&D collaboration.	Local Research and Development collaboration is required to provide the best solution.
It needs to be sustainable and it needs to be done in a cost effective fashion. We’ve got gaps there, I mean our social sort of standing in the organisations, the way our organogram is structured, the way people perceive the value of a specific job. I think we’ve got a way to go there before we can actually get to a point where we can say mechanisation is THE ONLY way to do it.	It needs to be a sustainable and it needs to be done in a cost effective fashion. Our social sort of standing, the way our organisation is structured and the way people perceive the value of a specific job. We got to address these before we can get to a point where we can say mechanisation is the only way.	Mechanisation in mines is only possible if it is done cost effectively and sustainable. This means that the organisational structures and the way people perceive the value of a job occupation need to change.	Mechanisation in mines is only possible if it is done cost effectively and sustainable. This means that the organisational structures and the way people perceive the value of a job occupation need to change.	Holistic evaluation of business strategy.	The entire business strategy of the mining industry need to re-evaluated.
... So they are looking at different technologies in terms of never ever putting a person into a stope.So platinum [0:20:28] definitely a bit easier. The gold aspect still requires some work but maybe the opportunities lie in notched rubber tyre with track vehicles. Maybe it is a completely different mining method all together where the guys do drill the gold out or like for example you get some countries that you don’t mine the copper per say, they drill holes into the whole body and they leach the copper out. That’s also mining, that’s sort of in situ leaching. So maybe we need to look at those sort of opportunities as well. . There are different degrees of, there might not be any money in that for us as an OEM, but that’s where the market or the opportunity needs to move to. So it’s not always based on what we can offer as to whether or not something is going to be successful or not. Maybe it’s an uber type event and it needs to happen in a short type of innovation or technology that could exist out there..... Can it work for gold? Well it surely works in manganese. Why is it that it’s not working in gold? I think we need to unpack those sort of things. What are the hurdles to making it happen? If it’s the majority or the ore body or the depth below the surface? Let’s come up with a game plan or road map in terms of how to address those issues.	Different technologies are being looked at to never put a person in a stope. Despite the fact that platinum is easier to implement mechanisation and the gold aspect still requires some work there is different opportunities. These technologies does not necessarily benefit all constituents but that's where the market or the opportunity needs to move to. The challenges must be unpacked and a game plan/road map need to be developed to address those issues.	Technologies does not necessarily benefit all mining constituencies. The challenges need to be unpacked and a road map develop to address these issues.	Technologies does not necessarily benefit all mining constituencies. The challenges need to be unpacked and a road map develop to address these issues.	Stakeholder involvement	Stakeholder involvement is curtail to the success of implementing new technology.
If you think about where the real unsafe practice are putting people into a stope, this is when people walk between the last line of support and the unsupported face itself.....We need to understand that maybe mechanisation is not just a removal of everybody, but maybe we just dose the stuff on mechanisation or we water jet the stuff or we do something. I think it’s not that necessarily that you have zero people, because I don’t think that’s an idealised state because you still have to able to provide employment for people. But maybe that just don’t work in those identified endangered situations, that we try and mechanise those first as a way to getting the whole mechanisation concept understood. That it’s not a forced situation to try and replace people.	Mechanisation is not necessarily that you have zero people, because I do not think that’s an idealised state because you still have to be able to provide employment for people. But maybe that just don't work in those identified endangered situations. We must try and mechanise that functions first rather than getting the entire mechanisations concept understood. I believe this is not a forced situation to try and replace people.	Mechanisation is not an idealised state where you are able to provide employment for all the countries citizens but it also does not mean that you employ no people. The first priority should be to remove people from the dangerous areas.	Mechanisation is not an idealised state where you are able to provide employment for all the countries citizens but it also does not mean that you employ no people. The first priority should be to remove people from the dangerous areas.	Developing manufacturing capability.	The creation of manufacturing capability would create employee displacement opportunities.
Not a bad idea to maybe just cast your eyes into a different industry....I think that we’ve been stagnant for too long thinking that we’re industry leaders because we’ve always made so much money. . I think that really the success now of the industry is to be aware of what is happening in other industries. To stay abreast about what’s going on and possibly the adoption of, and not only the hardware. It could be organisational structures, it could be methodologies, it could be how we look at incentivising people, how we discipline people. I think there’s a whole battery of opportunities that exist out there.	Innovation does not stem from the mining industry alone. The mining industry have been stagnate for far too long and the real success now is to be aware of what is happening in other industries. These innovations does not have to be hardware only, but organisational structures, methodologies, incentivising people and how to discipline people. I think there is a whole battery of opportunities that exist out there.	Learnings and innovation from other industries is imperative to success of the mining industries. This does not only include hardware but include organisational structures and methodologies.	Learnings and innovation from other industries is imperative to success of the mining industries. This does not only include hardware but include organisational structures and methodologies.	Holistic evaluation of business strategy.	The entire business strategy of the mining industry need to re-evaluated.
The big challenge is that you have to understand that mechanisation’s success or failure thereof, is going to involve people. And if you don’t address the people issues that go with it and the socio economics issues that exist and you don’t have all those people employed, what happens then? They are individuals in that community, there are expectations and it becomes quite a challenge.	Mechanisation's success is dependant on people. If you don’t address the people issues that go with it and the socio economic issues that exist what happens then? Individuals within the communities have expectations and if those expectations are not manage it becomes a challenge.	The success of mechanisation is still dependant on people. Social economic challenges within the mining communities and employees need to be addressed for mechanisation to be successful.	The success of mechanisation is still dependant on people. Social economic challenges within the mining communities and employees need to be addressed for mechanisation to be successful.	Stakeholder involvement	Stakeholder involvement is curtail to the success of implementing new technology.
It’s got to be the way Finland did when Cameron/Cameron [0:03:00] university with VTT Tamrock developed the Toro. The mining company which is Otto Gumpu [0:03:08], was completely involved, it was not like: “Hey you guys what have you got for me. Hey it’s not good enough, I’m buying that.” Precautious, which our companies are like that, you know. They said we want a finished LHD and they will work together....Their commitment has to be to work together and they have said that they’re going to do that.	If mechanisation is opted for equipment need to be developed within a collaborative environment much like Finland did it when they developed the Toro LHD. There must be a commitment between suppliers and mining houses to work together.	Mechanised solutions need to be developed collaboratively where there is commitment between suppliers and users of these technologies.	Mechanised solutions need to be developed collaboratively where there is commitment between suppliers and users of these technologies.	Local R&D collaboration.	Local Research and Development collaboration is required to provide the best solution.
So, from a national point of view, the Phakisa is completely right. We need to recreate our R&D or what used to be here was our biggest [0:13:17], or what is the biggest in the world, mining technology development. It was then destroyed by our mining companies. It’s got to be recreated because without the R&D our supplier companies, like Fermel, all of them, they will not be able to keep up. And there will be a very strong argument coming from the mining companies to bring in capital goods from Europe.	We need to recreate research and development within the borders of South Africa. Without R&D SA's supplier companies will not be able to compete with multinational suppliers and there will be a strong argument from the mining companies to purchase capital goods from overseas.	Local research and development need to be reenergised in order to compete internationally and develop a local manufacturing industry.	Local research and development need to be reenergised in order to compete internationally and develop a local manufacturing industry.	Local R&D collaboration.	Local Research and Development collaboration is required to provide the best solution.
Where for instance Sweden and Norway are a bit out of date, but I think they still have the highest R&D spending in the world. You can check, but it’s about 2% of GDP, sorry 4% of GDP. Those are the highest that they spend. They know to stay ahead you keep ahead, to keep ahead you stay ahead. That’s double the US. I think the US is 2 % and we were going for 1 and we got to .8 and I think we’ve fallen back to .7% of our GDP goes into our R&D. That needs to lift.	In order for South Africa to develop R&D capabilities locally it need to follow the example of Scandinavian countries such as Sweden and Norway that spend up to 4% of GDP. They know to stay ahead you keep ahead and to keep ahead you stay ahead.	Local research and development need to be supported by the government to develop a local manufacturing industry.	Local research and development need to be supported by the government to develop a local manufacturing industry.	Local R&D collaboration.	Local Research and Development collaboration is required to provide the best solution.
If we muck together, we could use this as a fantastic opportunity to build mining supplies sector. Also the multipliers are massive. I’ve written on it, I’ve even coined the term lateral migration where I showed how mining supply companies in countries that were now mined out like Germany, had all re-invented themselves. Because they engineer intensive, they can make other things.....once you create those agile knowledge intensive industries, they go to weird and wonderful places.	If we all work together mechanisation could be a fantastic opportunity to build a mining supplies sector with massive multipliers (lateral migration). Germany have latterly migrated when their ore reserves were depleted and reinvented themselves. Because they are engineering intensive they had the opportunity to make other things.	With mechanisation the opportunity exist to create a manufacturing industry that would cause a lateral migration of job opportunities from the mining sector.	With mechanisation the opportunity exist to create a manufacturing industry that would cause a lateral migration of job opportunities from the mining sector.	Developing manufacturing capability.	The creation of manufacturing capability would create employee displacement opportunities.

In any case, what I'm saying is with platinum, I also think we should mechanise but there I make it absolutely conditional on building the local supply chain. And I think that we've got to start with 65% and move it up and up and up. 65% for maybe two or three years, 70% etc. Because remember that other percent is just leaking. Those jobs are leaking abroad. So, that's how we tackle it.	If we mechanise in platinum it must be conditional on building the local supply chain. In the event that the local supply chain is not developed these jobs will leak abroad.	Mechanisation is conditional on building a local supply chain. If local supply chain is not developed possible job opportunities will leak abroad.	Mechanisation is conditional on building a local supply chain. If local supply chain is not developed possible job opportunities will leak abroad.	Developing manufacturing capability.	The creation of manufacturing capability would create employee displacement opportunities.
. I think one of the major challenges that does exist, is that how do we introduce mechanisation without the "tag" that goes with it. Because invariably when you speak to any mining person about mechanisation, in the same breath they would say mechanisation equals job losses. So I think one of the major key challenges that we sort of have to be able to manage, is how do we bridge that? How do we do boast mechanisation and at the same time understand what do we do in the employment now? Now to this extent I think the major obstacle is that there's not anything feasible right now on the table to take over. That core of employment role that mining plays at the moment. And as largely because we are a net exporter of everything that we mine. As a collective and as a country, one of our biggest challenges has to be we need to understand how do we do beneficiation....How do we actually use and actually do our own equipment development and building thereof? And therefore be able to find another avenue of employing people in a higher skill.	When we introduce mechanisation we at the same time need to understand what do we do with employment opportunities. As mining is a net exporter of product there is not an immediate substitute for mining occupations and more need to be done in the beneficiation of these products as well as upstream opportunities in the form of development and manufacturing of equipment.	There is currently no immediate substitute for mining occupations and beneficiation of minerals and upstream opportunities in the form of the development and manufacturing of equipment are needed.	There is currently no immediate substitute for mining occupations and beneficiation of minerals and upstream opportunities in the form of the development and manufacturing of equipment are needed.	Developing manufacturing capability. Mineral beneficiation.	The creation of manufacturing capability would create employee displacement opportunities. Mineral beneficiation opportunities need to be exploited.
Whether we close the operation or whether we mechanise, because whether we like it or not, actually mechanisation does mean reduction in labour requirement. I think our inability to give an alternative to this labour, is what is a major obstacle in terms of introduction in both technology and mechanisation. I think as long as we don't understand what the social impact and social compact would require in what we need to do, to actually forward employment or other opportunities for this labour, that's how long it will take for us to successfully introduce mechanisation.	Whether we like it or not mechanisation means the reduction in labour requirement. I think our inability to give alternatives to this labour is the major obstacle. As long as we do not understand what the social impact of mechanisation entails and creation of alternative labour opportunities for this labour will prolong the successful introduction of mechanisation.	Mechanisation means the reduction of the labour requirement in the immediate mining sector. The countries inability to offer alternative job opportunities is a major obstacle. The social impact of mechanisation entails the loss of jobs within the mining sector and therefore alternative labour opportunities for these employees are paramount to the success of mechanisation.	Mechanisation means the reduction of the labour requirement in the immediate mining sector. The countries inability to offer alternative job opportunities is a major obstacle. The social impact of mechanisation entails the loss of jobs within the mining sector and therefore alternative labour opportunities for these employees are paramount to the success of mechanisation.	Developing manufacturing capability. Mineral beneficiation.	The creation of manufacturing capability would create employee displacement beneficiation opportunities need to be exploited.
It's an issue in terms of employers, us as business, it's an issue in terms of Government and it's an issue in terms of labour. And unfortunately what we find ourselves in at the moment, is that as business we're saying that 2025 is the final time. The cliff is fast approaching but our challenge is that from a Government and from a labour point of view, somehow that urgency is not shared. And that is why we typically having, sad examples of Blyvoor as a gold mine with a huge secondary reef opportunities now virtually sterilised on the back of we've exciting that we need to work using conventional methods going forward. I think probably that's one of the museum pieces that we lurks and shows us what the future is going to be. So I think as long as our tripartite are not aligned in terms of the goals that we have, we won't get there. Now again I believe that business needs to take the lead in this.	Considering the mining continuance there is a believe that the urgency of mechanising is not shared from a Government and labour point of view. We have sad examples of Blyvooruitzicht Mine with huge secondary reef opportunities that is now virtually sterilised. If the mind-set of all continuance is not aligned this is the future of gold mining in South Africa. There is a believe that business need to take the lead on this.	The urgency to mechanise is not shared by government and current mining labour and therefore there is a believe that business need to take the lead on this.	The urgency to mechanise is not shared by government and current mining labour and therefore there is a believe that business need to take the lead on this.	Stakeholder involvement	Stakeholder involvement is curtail to the success of implementing new technology.
Our history was predicated on people who were exposed in the early days of mining industry and as time has gone by and by the way of the political change in our country, we need to understand that invariably labour and Government was a seamless line. It was one feed stock. A lot of our laws are sort of overly in favour of labour and definitely not in favour of having a sustainable business going forward. I think ultimately the magic here is going to be that we need to get tripartite alliance and see if the light is a combine. Because if we don't, unfortunately as business alignment won't be able to make it work and the future will then be on the one hand, if that's the case. The future will very much be capital starvation, harvest strategies being employed by all major companies and then shutting down gold mines one after the other after the other. And over time basically we re-introducing these people back into society without a viable future....if we were able to as a Government, business and labour get together and they have a common understanding in of terms of how we will resolve beneficiation and embrace mechanisation, it will be successful.	Our history was predicated on people who were exposed. During the political change in South Africa we need to understand that invariably labour and government was a seamless line where the one fed the other. Therefore a lot of our laws are overly in favour of labour and definitely not in favour of having a sustainable business going forward. The magic here is going to be that we need to get tripartite alliance. Business alignment on its own will not work and the future will very much be capital starvation, harvesting strategies being employed by all major companies and thereafter mine closure. If Government, labour and business can get together and have a common understanding in terms of how we will resolve beneficiation and embrace mechanisation, it will be successful.	Within the political paradigm of South Africa Government and labour are perceived as a untied front in that the one is considered a feedstock of the other. Therefore labour laws in SA are designed to be overly in favour of labour. We require a tripartite alliance where all mining constituency need to have a common understanding in terms of how we going to sole this challenge.	Within the political paradigm of South Africa Government and labour are perceived as a untied front in that the one is considered a feedstock of the other. Therefore labour laws in SA are designed to be overly in favour of labour. We require a tripartite alliance where all mining constituency need to have a common understanding in terms of how we going to sole this challenge.	Stakeholder involvement	Stakeholder involvement is curtail to the success of implementing new technology.
Production has all to do with costs and making a profit and safety is all about looking after the employees. And if you do both those things, then you actually have a better operation.	Whenever production improvements are implemented on a mine we need to consider two things. It all has to do with costs and making a profit and safety is all about looking after the employees.	We need to consider cost effective measures within the mining methodology as well as the safety of the people working in the mines.	We need to consider cost effective measures within the mining methodology as well as the safety of the people working in the mines.	Cost effective measures.	Cost efficiency strategies need to be implemented to stimulate demand and curb the search for alternative investment opportunities.
I mean, you've grown up on the mines, you've seen these young mining engineers who come out of the universities and they first of all have got to go and operate rock drills and scraper winches and all that kind of shit. Nobody teaches them what to do about mechanised mining. And this is why I was instrumental in the formation of central mechanised systems at Wits University to have a venue where we could teach people about mechanised mining...But you got to actually have a process of teaching them. It's not resistance to change; it's simply a disempowerment for the individual. He's not empowered, he's not taught, he's not instructed, he's not guided into what he should actually do. So that to me is the problem for the kind of change that we want to introduce in the mining industry.	Training and education of employees in respect of mechanised mining is very important as it is currently lacking. You got to have a process of teaching them. It is not resistance to change per se it is simply a disempowerment of the individual. He is not empowered, he is not taught, he is not instructed nor guided in what he should actually do. So that to me is the problem for the kind of change	Training and education of employees are very important and is currently lacking. We have to have a process of addressing these deficiencies and to empower the individuals.	Training and education of employees are very important and is currently lacking. We have to have a process of addressing these deficiencies and to empower the individuals.	Education and training.	Empowerment through education and training to change negative perceptions.
the actual change is a major issue and it has to be managed. It has to be looked after, it has to be, there's a process that you can use to introduce change....They had to reinvent themselves. The mining industry has to do the same. It's not easy, it's difficult. It's painful. People have to learn new skills and new things. But they're perfectly capable of doing it.	The actual change from the current status quo to something different is the major issue and it has to be managed. It has to be looked after and there are processes that you can use to introduce change. The mining industry has to reinvent themselves. People have to learn new skills and new things but they are perfectly capable of doing it.	The mining industry need to reinvent themselves through learning new skills	The mining industry need to reinvent themselves through learning new skills	Transferable skill development.	Mining industry need to reinvent themselves and develop transferable skills.

<p>So do I think that technologies are available to transform the industry and do I think that they could be applied and again the answer is unequivocally, yes.....This is really, really important is that the, if you introduce a technology, a new technology, you have to reconsider your layouts. Because it's a system, it's a package, it's the totality that you need to get right...Some of them run 11 hour shifts. They are far more efficient than the ones who run 8 hour shifts. Why? Very simple. By the time you got down to the bleddie mine, you got on your machine, you got to be running it for maybe 3 hours before you have to pack up and go home again. So you got 8 hours of which 5 hours are lost. If you got 11 hours shifts, you are going to lose your 5 hours again but get 6 hours of production. So you're going to get twice as much production on your 11 hours shifts than your 8 hours shifts. You got to understand the implications. It's got to be holistic, it's got to be a system; it's got to be a package and the more of these things you can actually bring into it. So it's no good just coming along with this machine. You actually got to say this is what the machine is going to do, this is what the driller's going to do and this is what the supporting's going to do, this is how the rock handling's going to take place, this, this, this.</p>	<p>There are technologies available that can transform the industry but it is important to consider layouts, because it is a system. An example is shift durations. By shortening the shift durations you increase traveling time and productive time decrease. You need to understand these implications. It is got to be holistic and consider the entire system.</p>	<p>It is important to consider technology in a holistic way by considering mining layouts and system requirements.</p>	<p>It is important to consider technology in a holistic way by considering mining layouts and system requirements.</p>	<p>Mining infrastructure and system requirements.</p>	<p>Consideration of mining infrastructure and system requirements.</p>
<p>...they use to have those little belts that they put on the stoke and they tried to reduce the amount of development when they did it. It used to take them nearly 3 months to advance those conveyors. What do you do about production in that time? You haven't got any. What do you do as an alternative then? You make more face available, you invest more capital in opening up more face, which is not productive. These are the two capitals we are talking about. We are talking about the mine capital, cost of the mine, the cost of opening up face and we are talking about the equipment capital. And people don't see these as two separate things. They don't talk about them together. And yet the cost capital to open up the mine is substantially more than the cost of the equipment which is doing the mining.</p>	<p>The capital cost of opening up more ground is substantially more that the cost of equipment which is doing the mining. The infrastructure to support mechanised mining need to be considered holistically and need to be a prerequisite as the alternative might be more capital intensive than ensuring that the system is maintained.</p>	<p>The infrastructure to support mechanised mining need to be considered holistically</p>	<p>The infrastructure to support mechanised mining need to be considered holistically</p>	<p>Mining infrastructure and system requirements.</p>	<p>Consideration of mining infrastructure and system requirements.</p>
<p>Take away explosives. Look at some method of cutting the rock. Not so easy because the rock that we have is at about 220 MPa. So, it's super strong. And now we have to develop something that would allow for that technology. So, the focus areas in what we are looking at, is modernisation of current, mechanisation of the future, with ultimately getting to a 24/7 continuous mining method.</p>	<p>Mechanisation forms part of work streams developed by the Phakhisa development that include modernisation of the current, mechanisation of the future and ultimately getting to a 24/7 continuous mining method. Therefore mechanisation can not be considered in isolation.</p>	<p>Mechanisation can not be considered in isolation. Mechanisation include a protracted evolution of the modernisation of the current, mechanisation of the future and ultimately getting to a 24/7 continuous mining method.</p>	<p>Mechanisation can not be considered in isolation. Mechanisation include a protracted evolution of the modernisation of the current, mechanisation of the future and ultimately getting to a 24/7 continuous mining method.</p>	<p>Mining infrastructure and system. Protracted evolutionary transition process.</p>	<p>Consideration of mining infrastructure and system requirements. The mining industry will experience a protracted evolution of the mining method over time.</p>
<p>So, bringing technology in, is easy. Buy in from the work force is essential and not so easy. Buying in from mine management is not so easy, because some of the devices that exist or technologies that exist are not readily implementory. Take for example your cell phone. You get your cell phone day one, you spend two days figuring out how this thing work. But by the second week only are you fully comfortable with that. This is something you're going to use every day. Now something as simple as that, if a cell phone takes that time period, imagine a complicated piece of equipment that has got bells and whistles and all sorts of things all over the place. How do you expect with the levels of education that we have in the country and in the sector in particular, how do you expect that transition to happen? So, one of the processes we need to bring in as mine management to ensure that there is effective implementation, there's adoption and utilisation of the piece of equipment.</p>	<p>Getting buy-in from the work force and mine management is not so easy compared to bringing in technology. The transition of adopting the new technology need to be well thought through considering the current education levels etc. to ensure effective implementation.</p>	<p>The transition of adopting new technology need to be well thought through in order to get buy-in.</p>	<p>The transition of adopting new technology need to be well thought through in order to get buy-in.</p>	<p>Stakeholder involvement</p>	<p>Stakeholder involvement is curtail to the success of implementing new technology.</p>
<p>What happens to that person whose job is displaced by that piece of equipment? How do they get absorbed back into the work force? If not, what happens to them outside of that? And that's something what we need to consider.</p>	<p>An action plan need to consider that the person whose job is displaced by a piece of equipment need to be absorbed back into the workforce or elsewhere.</p>	<p>Job displacement need to be absorbed elsewhere</p>	<p>Job displacement need to be absorbed elsewhere</p>	<p>Transferable skills development.</p>	<p>Mining industry need to re-invent themselves and develop transferable skills.</p>
<p>the community in and around the shaft area. They see this truck coming in, big bulldozer and loader and a drill rig. The first thing is, hang on, that thing is going to take the job of my husband, my brother, my father, whatever. So, there's levels of consternation that happen just by not being involved in the process. We need to understand that.</p>	<p>The community need to be involved in the adoption of new technology to mitigate the risk of them retaliating against technology that they do not know.</p>	<p>The community need to be involved in the adoption of new technology.</p>	<p>The community need to be involved in the adoption of new technology.</p>	<p>Stakeholder involvement</p>	<p>Stakeholder involvement is curtail to the success of implementing new technology.</p>

<p>So MEMSA is an ideal vehicle to overcome the obstacles of individual competitive approach. Competition is good, but I think collaboration, not collusion, is the way to take us forward. The example of that is in the R&D space. We've got several different R&D companies or organisations working to develop solutions. We start from the Universities to the Science Councils to parastatals such as a mine house safety council, all try to do different things in the same space. But what happens is, when you put a competitive bid out, to say we want a solution in this area, we want to do the follow things, I'll come in at the lowest possible price because I want to get the job. Is that the right solution? Maybe not. Because all I'm trying to do, is to undercut my competitors. Even though I don't know their cost structures and their pricing. But I know, if I come in low, I will get the job. So, when you put out competitive bids, you don't know necessarily if you'll get the best solution, you get the cheapest solution. However, the skills in different organisations, how do we tap into that? And the opportunity you provide here, let's say sit down in a room together, look at the problem statement, identify your skills and bring your skills to address the problem. That avoids this thing of being competitive, but rather collaborative in the process. It may be miss construed as price fixing and collusion, but I think that it's something that can be managed. And it's certainly not that...The barriers to overcome this, is the fact that even the end user places demands on you as the OEM's to come in at the cheapest price. So, that is something that we need to change.</p>	<p>Companies need to work together in a collaborative manner to develop solutions for the South African industry. A number of different R&D companies or organisations are working to develop solutions but when a competitive bid it being put out you don't know necessarily if you'll get the best solution, you get the cheapest solution. MEMSA as a cluster initiative from the DTI is an ideal vehicle to overcome the individual competitive approach. A barrier to overcome is that the end user often paces demands on suppliers to come in at the cheapest price that does not necessarily drive the same goal to provide the best solution.</p>	<p>We do not necessarily get the best solution as there is limited collaboration within the South African mining industry.</p>	<p>We do not necessarily get the best solution as there is limited collaboration within the South African mining industry.</p>	<p>Local R&D collaboration</p>	<p>Local Research and Development collaboration is required to provide the best solution.</p>
<p>If we can change the way we make resources more available so that we can start doing the beneficiation of our own resources, use it internally, it brings the cost down.</p>	<p>If we can changes the way how resources such as steel are easier to come by in South Africa we can start doing the beneficiation of our own resources we can drive the cost down.</p>	<p>Local raw material accessibility could stimulate the mineral beneficiation.</p>	<p>Local raw material accessibility could stimulate the mineral beneficiation.</p>	<p>Mineral beneficiation.</p>	<p>Mineral beneficiation opportunities need to be exploited.</p>
<p>That perception of this machine is taking away my job and my future? The cynical and easy answer would create difficulty. The correct approach is a long-term approach. It starts off with educational awareness. It has to. If we don't do this, this is the consequences. In the process of, so that's the first hurdle that we must overcome. The second part is, we need to create the manufacturing capability to demonstrate that we are employing people in that space. If we have the technology, that technology shouldn't be developed in Cape Town and then brought to Limpopo. That's the problem. Because the people in Limpopo are affected. So, can we create that manufactured capability in Limpopo so that people in that area can see the benefit of it, can understand that it's not just because they live in Limpopo...We need to create an opportunity where they can be absorbed. Whether it be training. Whether it be for development of the equipment, for servicing that equipment, etc...When you want to introduce technology, you need to look at the system of where am I going to put it, the consequences of it.</p>	<p>Education awareness is first and foremost needed to overcome the perception that mechanisation will take away people's future. The next step is to create manufacturing capability within the area that is affected. We need to create opportunities for the people that will be effected in mechanising the operation. When you introduce technology you need to look at the entire systems and the consequence of implementing the system.</p>	<p>Education awareness will overcome negative perception. We also need to create manufacturing capability within the affected are. When you introduce technology you need to look at the entire system and the consequence of implementing the system.</p>	<p>Education awareness will overcome negative perception. We also need to create manufacturing capability within the affected are. When you introduce technology you need to look at the entire system and the consequence of implementing the system.</p>	<p>Education and training. Developing manufacturing capability. Mining infrastructure and system requirements.</p>	<p>Empowerment through education and training. The creation of manufacturing capability would create employee displacement opportunities. Consideration of mining infrastructure and system requirements.</p>
<p>We need to be aware that not everyone will be absorbed. That's where Government needs to come in and say hang on, for this person who will lose his job and goes back to Transkei or what you may call it, Umtata, or back to Eastern Cape. What will happen to them? That's a discussion that hasn't taken place as yet. And we need to look at it.</p>	<p>For the individual that will not be able to be absorbed. Government need to come up with a different solution. This solution is not know at this stage.</p>	<p>Government need to come of with a different solution to absorbed the displaced labour.</p>	<p>Government need to come of with a different solution to absorbed the displaced labour.</p>	<p>Developing manufacturing capability.</p>	<p>The creation of manufacturing capability would create employee displacement opportunities.</p>
<p>Let's start off with the most common theme in all of it, is the whole idea that mechanisation and mechanical mining will steal jobs from people. Historically people have always argued that is the big reason why our technology attempts have failed because it's been sabotaged by organised labour and by their employees. I think to a certain degree yes. I think to a certain degree also because the way the story was carried across, was silly in my opinion. I mean you've heard after the Marikana events of companies saying we go mechanisation, we do away with some jobs is almost a threat to the process and I think it's that type of behaviour that creates more reason why organised labour and workforce believe this nonsense.</p>	<p>There is a perception that by mechanising a mining operation you will steal jobs from people. Historically people have always argued that this is the big reason why our technology attempts fail because it is been sabotaged by organised labour and by their employees. To a certain degree this is true but a big contributing factor is the way the story was carried across. In a lot of the cases mechanisation is being used as a threat to the process that creates even more reasons why organised labour and workforce does not by into mechanisation.</p>	<p>Perceptions need to be managed through education.</p>	<p>Perceptions need to be managed through education.</p>	<p>Education and training</p>	<p>Empowerment through education and training to change negative perceptions.</p>
<p>I said, let's start here, let's invest R&D, let's employ people within that R&D space, let's start testing in the resource base ounces and start playing with it. You employ more people and you're getting more ounces out. And hopefully you can make it the cheapest R&D process out and actually produce ounces while you're doing your R&D and developing your products. Eventually this method evolves into the resource base which currently isn't all here because economically viable.</p>	<p>We need to employ more people in the R&D space. By employing more people and getting more ounces out hopefully you can make it the cheapest R&D process out and actually produce ounces while you are doing your R&D and developing your products. Eventually this method evolve into the resource base which current does not exist due to it economic viability.</p>	<p>Local Research and Development need to be grown into a resource base that currently does not exist due to economic viability.</p>	<p>Local Research and Development need to be grown into a resource base that currently does not exist due to economic viability.</p>	<p>Local R&D collaboration</p>	<p>Local Research and Development collaboration is required to provide the best solution.</p>

<p>My argument is, I said let’s sell the story honestly for what it is. As not a threat to trying and kick the conventional miners out and replace with mechanisation. We’re too late, we’ve should have started this 30 years ago if we wanted to do that. Now you can ask yourself of 30 years ago what did they say to the people? 30 Years ago, they didn’t have the problem of running out of reserves. It wasn’t foreseeable at that point. Gold prices and exchange rates were different. So they didn’t have the story. What they had is we want to replace you guys, with machines. Argue that they should have been more sight full and said but hang on, maybe there’s a story that says our current method is just what it is and at a point it just doesn’t make money and we’re not a welfare organisation so there are zero jobs. However, if you work with us, we can change your mining method. There are other ounces there. That, a post to zero jobs from this point in. Yes, it will be fewer, but it is a different mining method. And as a post to zero, I’m going to have 10 000 people with the current levels over here we are maybe sitting at 180 000. But do you want 10 000 or do you want zero jobs? That’s the question. It’s not the question who you’re replacing. The fact technically or factually is you will not, with the current level 1 plans build of conventional mining presence be able to in the next 10 years displace that with mechanised mining.</p>	<p>The story need to be sold for what it is. Mechanisation is not a threat to try and kick the conventional miners out and replace them with machines. Our current mining method is nearing a point where it just doesn't make money and we will reach a point where these operations will shut down. There is however an opportunity to lower the cut-off grade by employing a different mining method that has reduced labour opportunities but you need to compare it to the zero jobs available if we do not do anything. The fact is that technically or factually you will not displace the current level of conventional mining presence with mechanised mining.</p>	<p>The story need to be sold that mechanisation is not a threat but conventional extraction methods is not financial viable. Opportunities exist to lower cut-off grades by employing alternative extraction strategies. Continuing with the current status quo will lead to major job losses in the industry.</p>	<p>The story need to be sold that mechanisation is not a threat but conventional extraction methods is not financial viable. Opportunities exist to lower cut-off grades by employing alternative extraction strategies. Continuing with the current status quo will lead to major job losses in the industry.</p>	<p>Education and training.</p>	<p>Empowerment through education and training to change negative perceptions.</p>
<p>Mechanisation or mechanical mining, for that to work, that is hugely an expensive one to develop. Two to run that type of mining process is usually expensive. So, if you got multiple forms of it, you will never get OEM’s to produce these machines. You need a common form. And the problem in that common form. So gold and platinum you could put together and say they can become a common base. As I said to you, that’s why mechanisation is as we know is successful in Canada and Australia, because it was built for that ore body. We need to build platforms for our ore bodies. And I think it’s possible, yes, we sit with a complex and all the bullshit of the past, but the point is it still exists, we can, we are innovative...The point is, if we don’t stand together and get common platform needs, you won’t get secondary industry like the OEM’s to support the economical and send no critical messages. That is our biggest problem.</p>	<p>You need a common platform that is tailor made for our orebody. It is very expensive to develop these equipment and also expensive to run it so you need to standardise to some extent. You can combine the Platinum and Gold orebodies and regard them as a common base. We are innovative enough to develop these platforms.</p>	<p>You need standardised equipment to effectively mine our orebodies and we are innovative enough to develop these platforms.</p>	<p>You need standardised equipment to effectively mine our orebodies and we are innovative enough to develop these platforms.</p>	<p>Local R&D collaboration</p>	<p>Local Research and Development collaboration is required to provide the best solution.</p>
<p>The curricle thing from the Government’s side is the Government truly believes that there’s a future in South African mining. They have to believe in research and development. You can imagine try to recapitalise the gold industry towards mechanisation. It’s an eye watering amount of money. So, there’s capital associated with a move in this direction. But if it’s tried and tested under research and development through a program of an injection of research and development from, and I’m saying from Government because the industry is already doing a hell of a lot. But we’re probably not doing it quick enough. In your whole business approach, you can’t from a shareholder’s point of view only just invest in South African research and development...And it’s the pace at which you can advance this research and development. And proof these concepts to work and then move to the next level that will be convincing to shareholders that’s too slow. Now if you want to do something about that, the critical variable is going to inject serious money into research and development from a Government’s point of view. You got to have those mechanisms in place to drive that research and development and get it to a point where you’ve almost subsidised it to a point like the Swedish Governments and all the Governments in Europe do. Where they’re supporting the industry, and make damn sure they’ve got a product to full production stage before they, you know those rules...So, the business realities of this country by politicians are instrumental in the outcome of what we are talking about here.</p>	<p>Government must truly believe that there is a future in South African mining. They have to believe in research and development that needs to come from Government because the industry is already doing a hell of a lot. To recapitalise the gold industry towards mechanisation cost a lot of money and to except the funds to come from industry alone is not considered viable. In a business you can not from a shareholders point of view only invest in South African research and development. The crucial variable is going to inject serious money into R&D from a Government's point of view and if you can get to a point where you are almost subsidised to a point like the Swedish Government and other in Europe and support industry in that they get a product to full production stage before it is implemented.</p>	<p>Government must truly believe that there is a future in South African mining through research and development to recapitalise the gold industry towards mechanisation.</p>	<p>Government must truly believe that there is a future in South African mining through research and development to recapitalise the gold industry towards mechanisation.</p>	<p>Local R&D collaboration</p>	<p>Local Research and Development collaboration is required to provide the best solution.</p>
<p>The one is leadership. Sensible leadership that can see the future, is really critical. And I’m afraid, there’s a lot of them falling by the wayside as we go. But visionary leadership in terms of what the art of the possible is critical to save this industry.</p>	<p>A critical success factor is visionary leadership in terms of what the art of the possible is to save the industry.</p>	<p>A critical success factor is visionary leadership.</p>	<p>A critical success factor is visionary leadership.</p>	<p>Visionary leadership</p>	<p>Visionary leadership is required to safe the industry from total collapse.</p>
<p>We’ve got to rapidly get the gold mining industry into a space where we can modernize and mechanise it to make it a better place. I’m extremely hopeful and I’m an eternal optimist, but the blinds are starting to close down in terms of reality...we think this is a never-ending resource but reality is that it will end. But it’s how long we can extend that. Mechanisation is a critical component of that.</p>	<p>We need to rapidly get the gold mining industry into a space where we can modernise and mechanise it to make it a better place. We think this is a never-ending resource but the reality is that it will end. Mechanisation is therefore critical component in order to extend the life of mines.</p>	<p>People need to be told that we desperately need to modernise and mechanise mine to extent their lives because it is not a never ending resource.</p>	<p>People need to be told that we desperately need to modernise and mechanise mine to extent their lives because it is not a never ending resource.</p>	<p>Visionary leadership. Education and training.</p>	<p>Visionary leadership is required to safe the industry from total collapse. Empowerment through education and training to change negative perceptions.</p>
<p>The next generation employees, XYZ generations aren’t going want to hang on the gat kant of a rock drill. That I can promise you. So, we got to respond and I think the modern generation will far easier see the benefits of mechanisation than somebody that’s grown up on the end of a rock drill for 30 years. He doesn’t want to change and he is holding on to that job. So, we’re going to have to make sure that in that transitional process, we accommodate our hand-held guys. As I’ve said before, you know in this transition to mechanisation, there’s going to be a 5-year period anyway. So, during this process, you’re going to be able to keep your people in the industry. Natural nitration will sort it out. The modern generation will come in and chip, off we go with the new kid that’s remote control, joysticks and all that kind of crap. It will be a different game.</p>	<p>The next generation of employees are not going to find the current methodology of mining appealing and we got to respond and we got to realise that we are in a predicament that modern generations will far easier see the benefits of mechanisation than the old generation that does not necessarily want to change. There will be a transition period where we going to able to accommodate for your hand held guys as well as the modern generation that will have mechanised solutions in extracting the ore body.</p>	<p>The next generation of employees are not going to find the current methodology appealing and we got to realise that mechanisation will be adopted far easier than the older generation. There will be a transition period where we will be able to accommodate both methodologies.</p>	<p>The next generation of employees are not going to find the current methodology appealing and we got to realise that mechanisation will be adopted far easier than the older generation. There will be a transition period where we will be able to accommodate both methodologies.</p>	<p>Protracted evolutionary transition process.</p>	<p>The mining industry will experience a protracted evolution of the mining method over time.</p>

If we're not going to develop our own design now, own fit for purpose mechanised equipment, we will not have a mining industry in South Africa in the future.	If we are not going to develop our own fit for purpose equipment to mechanise the industry we will not have a mining industry in South Africa in the future.	We need to develop our own fit for purpose equipment to mechanise mine otherwise we will not have a future.	We need to develop our own fit for purpose equipment to mechanise mine otherwise we will not have a future.	Visionary leadership. Local R&D collaboration	Visionary leadership is required to save the industry from total collapse. Local Research and Development collaboration is required to provide the best solution.
Because if you put in a 2 kilometre shaft down and you've already mined a radius of 6 kilometres around that shaft, you basically locked into a design. You can't change that design easily to a mechanised design, because you need to take Midas underground and assemble a machine there because it just doesn't fit. But it doesn't stop us from looking at new projects in a different way in applying new but then you need to go big or go home...Find a total different way of how can we transform ourselves that we can supply the world and still be the main macky without giving anybody else a window of opportunity to come in. How do we physically keep the monopoly here in South Africa?	With conventional mines it is difficult to mechanise because you are locked in a design but this does not stop us from looking at new projects in a different way but then you need to look at the full system. We need to find a total different way of how we can transform ourselves to be able to supply the world with minerals and create high enough barriers to entry to protect the South African economy.	Conventional mines is difficult to mechanise because your are locked in a design. We need to find a totally different way of how we can transform ourselves.	Conventional mines is difficult to mechanise because your are locked in a design. We need to find a totally different way of how we can transform ourselves.	Mining infrastructure and system requirements. Local R&D collaboration.	Consideration of mining infrastructure and system requirements. Local Research and Development collaboration is required to provide the best solution.
The second one is everybody says we're a price maker but we're not. We're actually a price taker because we don't define what the price is. The off take and we don't have enough off take otherwise the price would have been much better. We need to find applications for our own material...Unless you find solutions of how you could get rid of the metals so that there is a bigger demand, we're going always have a problem	In platinum everyone thinks we are the price makers but we do not define the price. We do not have enough take off and therefore we need to find applications for our own material. Unless we find solutions of creating a bigger demand we will always have a problem.	In platinum we are not a price maker and therefore we need to find applications for our own minerals. Unless we find solutions for creating a bigger demand we will continue to struggle.	In platinum we are not a price maker and therefore we need to find applications for our own minerals. Unless we find solutions for creating a bigger demand we will continue to struggle.	Mineral beneficiation.	Mineral beneficiation opportunities need to be exploited.
We must found out how we can make money at 500 dollars per ounce. How can we mine it cheaper, faster, quicker and more cost effective so that we can get more people to use it. Because people start finding alternatives for platinum because it's so expensive.	We need to find a way to mine cheaper, faster, quicker and more cost effective so that the cost can come down to stimulate demand. At the moment people are considering alternatives to platinum because it is so expensive.	We need to find alternative ways to mine more cost effective so that the cost of the minerals can reduce to stimulate demand.	We need to find alternative ways to mine more cost effective so that the cost of the minerals can reduce to stimulate demand.	Cost effective measures.	Cost efficiency strategies need to be implemented to stimulate demand and curb the search for alternative investment opportunities.
What I've seen at the moment, is just that, we have very good innovative local companies but they're trying to replicate everything else that everybody else in the world's got. They believe that's a success story. We don't have a South African situated, guaranteed proudly South African fleet that is for our conditions that we can basically export. We import everything. The creativity. We've got very creative people. I meet a lot of South Africans that work for overseas companies, but they're not here in South Africa. They're not working in South Africa. We somehow blocked that we don't get the creative guys here. The creative guys actually either disappear, or leave or go away. To be blunt with you, I think the South African companies need a mind-set shift. I see some of it happening now, but they need a big mind-set shift to R&D and find applications that are different to what they've got at the moment.	Local companies require a mind shift to R&D change as they are trying to replicate what everybody else in the world got. We do not have South African companies that provide a fleet for our conditions and that are creative.	Local companies require a mind set change towards research and development as they currently only attempt to replicate what is already existing. We do not have South African companies that provide a fleet for our conditions.	Local companies require a mind set change towards research and development as they currently only attempt to replicate what is already existing. We do not have South African companies that provide a fleet for our conditions.	Local R&D collaboration.	Local Research and Development collaboration is required to provide the best solution.
We really need an application for narrow reef that can fit for our conditions. It's rough, it's tough, it's wet, it's dark and it's hot. Seismically active but that should not scare us. We know how to it. I know a lot of South African managers that are very successful in other countries as managers. But I know very few overseas guys that come here and are successful South African managers. Because the world is different. South African managers get trained to deal with complexity and with variation and change. They can do that well. It's a question of doing it in a different mind-set with technology.	South African managers get trained to deal with complexity and with variation and change. They can do that well. They need to however adopt a different mind-set with technology.	South African managers are trained to deal with complexities and with variation but need to adopt a different mind-set towards technology.	South African managers are trained to deal with complexities and with variation but need to adopt a different mind-set towards technology.	Education and training	Empowerment through education and training to change negative perceptions.
And what does that technology look like and are we prepared to pay some lessons in order to find this solution? I think a lot of people give up in round 2. What I've now realised, is only by about prototype six where you see real success. But somebody must make the prototypes. And somebody must be willing to pay the first school fees before everybody else do it faster.	We need to be prepared to pay the first school fees in order to find the solution. We give up too easy. Some must make and test the prototypes.	We need to invest in research and development and be prepared to expect failure as part of the process to find the ultimate solution.	We need to invest in research and development and be prepared to expect failure as part of the process to find the ultimate solution.	Local R&D collaboration	Local Research and Development collaboration is required to provide the best solution.
Working together? I think that is where the biggest problem is at the moment. We don't see South Africa as a business. We see each company as a separate business and each one wants to do his own thing. And we pay the same 5 cents over and over and over. And that is where I feel we've got a downfall. If somebody is on to something and he is successful and he can show the first, second and third prototype, I think everybody else interested must climb in and assist and try to get to the ultimate. But we would rather kill the guy that is almost on a breakthrough than to support him. And that's the mind-set we're sitting with in South Africa, unfortunately.	The biggest problem that we have is that people in South Africa do not want to work together. We do not see South Africa as a business but rather separate business with their own interest and focus points. The end result is that we continuously pay the same 5 cents over and over and almost kill the guy that is almost on a breakthrough rather than to support him.	The biggest problem we have in South Africa is that people do not work together. We do not see the country as a business but rather separate companies with their own interest and focus points. The end result is not collaborative effort to provide the best possible solution.	The biggest problem we have in South Africa is that people do not work together. We do not see the country as a business but rather separate companies with their own interest and focus points. The end result is not collaborative effort to provide the best possible solution.	Local R&D collaboration	Local Research and Development collaboration is required to provide the best solution.

<p>is that we want to give people everything and we want to supply them with housing, with cars, with electricity and with water and all that. And we pump a lot of money in there and I think it's totally skew. We should pump that into the industry and build our own things and get everybody that there is a career path for people, there's a growth path for people and they can decide for themselves what money they want to make. They will buy their own house, they will buy their own water, they will buy their own electricity. We've got our whole recipe the wrong way around as where the people just need to think they sit now and wait and somebody else is going to feed them where we should actually build factories, get jobs, get better skilled jobs, get better things that's manufacturing. Give people their pride back and let them decide for themselves what they want to do. If they buy their own houses, their own electricity and all of this, they've got jobs, the whole all the mass work, the whole system works. Where we've got it the wrong way around, where 5% of the people in the country needs to support the country. Why isn't 95% of the people contributing to the country to make it a better place? And that's really how I see where is the fundamental change. We need to change the labour laws, we need to change the way we think about things and pump all this money that we pump into free housing, water and electricity, we need to pump it into industry and build our own industry. And find ways of how we can export and how we can grow. People will look after themselves.</p>	<p>We need to give people their pride back and ability to decide themselves what to do. We have got our recipe the wrong way around. Where people just need to think they now sit and wait for someone else to feed them. We need a fundamental change in our labour laws and the way we think about things. We need to divert all of the money that we pump into free housing, water and electricity and pump it into industry and find ways of how we can export and grow the industry. People will look after themselves.</p>	<p>We need to give people their pride back as well as their ability to decide for themselves. We need a fundamental change in our labour laws and divert government funds towards growing the industry.</p>	<p>We need to give people their pride back as well as their ability to decide for themselves. We need a fundamental change in our labour laws and divert government funds towards growing the industry.</p>	<p>Education and training. Local R&D collaboration.</p>	<p>Empowerment through education and training to change negative perceptions. Local Research and Development collaboration is required to provide the best solution.</p>
<p>I think this is a tri partied alliance and I think organised labour, Government Institutions and employers need to sit around a table and pave out what is needed within the next 10 years to sustain the next 50 years going forward. At this point and time, it is not a healthy situation. There are too many interference, there are too many organised labour issues that's keeping us from focusing on what we need to do to extract precious metals out of South Africa.</p>	<p>We require the collaboration of Government, organised labour and employers to pave the way forward. Currently there are too many distractions that refrain us from focusing on what we need to do to extract precious metals out of South Africa.</p>	<p>We require the alignment of all stakeholders as there are currently too many distractions.</p>	<p>We require the alignment of all stakeholders as there are currently too many distractions.</p>	<p>Stakeholder involvement</p>	<p>Stakeholder involvement is curtail to the success of implementing new technology.</p>
<p>shareholders like I mentioned, people only live once and they only have a small window where they live in. They must get returns within that small window because if a guy has 25 years on average to live, he is not going to invest where he only will get in 25 years a return on his investment. Human nature we only live till a certain age. Your working life in essence is from basically 20 odd years old to call it 60 years old, if you are lucky. That's your working career and you have to in that time, you have to make a life due to yourself. If you are an investor, you are not going to look at a different window for yourself.</p>	<p>We need to understand that investment and the return on these investments have a finite life. A investor have on average a predefined working career in which he has the possibility to invest and need to receive a return on that investment within that timeframe. Therefore investment into mining endeavours that exceed these timelines will result in unattractive investment destinations.</p>	<p>Investment into mining endeavours that exceed predefined timelines will result in unattractive investment destinations</p>	<p>Investment into mining endeavours that exceed predefined timelines will result in unattractive investment destinations</p>	<p>Cost effective measures.</p>	<p>Cost efficiency strategies need to be implemented to stimulate demand and curb the search for alternative investment opportunities.</p>
<p>but I think this is going to be protracted evolutionary because there is still a big resource left. You cannot just look in the South African context, you must look in the world context. Gold mining, because we are price takers, more so on gold mining are suppose versus the platinum mining however, platinum is in my opinion going to always still be a price taker, because there is a huge amount of resources in the world. Although you want to have this common approach, although you want to have a certain methodology, if you're not going to be able to make money from doing what you want to do, although you have the best ideas in the world, you will not be able to do that. Till such time as, it can actually happen. And everyone gets onto it. So, I would say evolutionary, most definitely and it will be a journey that will be going on for a couple of more generations after us.</p>	<p>You need to consider the possibility that the transition from conventional to mechanisation is going to be a protracted evolution and it will be a journey that South Africa will be going on for generations to come.</p>	<p>We need to consider the possibility that the transition from conventional to mechanisation is going to be a protected evolution that will occur over a period of time.</p>	<p>We need to consider the possibility that the transition from conventional to mechanisation is going to be a protected evolution that will occur over a period of time.</p>	<p>Protracted evolutionary transition process.</p>	<p>The mining industry will experience a protracted evolution of the mining method over time.</p>
<p>You need to sort of link it to where there is no alternative and then you put the brains there where the alternative is and that's when out of desperation you probably get people that cannot remain where they are because they don't have a choice. They must change. As soon as you don't have a choice, that's when the true evolution starts happening. Then you gradually transcend through the industry.</p>	<p>It is unfortunate but there will not be an alternative being considered unless there is no other choice but to change. As soon as you do not have a choice that is when the evolution starts happening that will gradually transcend through the industry.</p>	<p>There will not be an alternative being considered unless there is no other choice but to change. As soon as you do not have a choice that is when evolution starts and will gradually transcend through the industry.</p>	<p>There will not be an alternative being considered unless there is no other choice but to change. As soon as you do not have a choice that is when evolution starts and will gradually transcend through the industry.</p>	<p>Protracted evolutionary transition process.</p>	<p>The mining industry will experience a protracted evolution of the mining method over time.</p>
<p>Because, to talk to me now about gold mining and the problem there when I sit on a shallow mine that can till 2079 operate how it's operating now, with today, don't ask me. You're going to waste my time. I'm not going to put energy into that. My situation is different. I'm looking towards having a career and the now and with what I have now. For the next 10 years, I have a plan, a solid plan and then for 10, 15 years after that, 10 years, there's going to be hay day in this area. But if you talk to me and to a guy in the Free State, you're going to get two 180-degree different stories. And I can tell you his commitment on finding a solution to just get another year and another year and another year, is going to be a lot more fundamental than what our approach is here. I think you need to have that sort of understanding throughout labour, Government, employers and so forth. Until you don't have that, and sort of ring fence certain areas to deal with things, you're not going to get it right.</p>	<p>You do not have to have a holistic approach with the transition of conventional mining to mechanised mining. You need to ring fence certain areas that does not have any alternative but to change and the commitment with regard to change will be so much higher than an industry that does not have any burning desire to change.</p>	<p>We need to ring fence certain areas that does not have any alternative but to change as their commitment will be higher that an industry that does not have a burning desire to change.</p>	<p>We need to ring fence certain areas that does not have any alternative but to change as their commitment will be higher that an industry that does not have a burning desire to change.</p>	<p>Protracted evolutionary transition process.</p>	<p>The mining industry will experience a protracted evolution of the mining method over time.</p>

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
I think there are many good aspects that you can take from the historical methodologies or strategies that we employed. I mean, one of the big things was that the manner in which the work was done in those days, was based on a team effort.	Historical mining methodologies was based on teamwork.	Conventional mining encourage teamwork.	Conventional mining encourage teamwork.	Employment opportunities	Conventional mining encourage teamwork that creases large amounts of employment opportunities.
From a gold mining perspective the manner in which the mine was laid out would always be development. That gave us a very good view of what was going to happen into the future	From a gold mining perspective the mining layout lend itself to development. That allowed companies to have a good view of what is happening in the future.	A conventional extraction strategy include extensive development work that allows for transparency.	A conventional extraction strategy include extensive development work that allows for transparency.	Transparency	Conventional mining relies on development that creates a transparency of the orebody.
So that's the strategy that I think was employed many, many years, it needed to happen. Footwall drives, whether they'd be in advance of the phase or lag or lead. And the very strict discipline that was required in mining an underhand or overhand Christmas tree type shape. I mean when I first became a shift boss doing those plans from a start on the CPA plans filling them in. I mean you were absolutely nailed if you're upward panel ran ahead of your downward panel. You know, because of the fact then you're out of sequence. So I think it definitely enforced a certain level of discipline in those days where as now	There is a very strict discipline that is required that needs to be enforced for conventional mining methods	Conventional mining is based on a strict disciplined process	Conventional mining is based on a strict disciplined process	Strict disciplined approach	The process involves a strict disciplined process that does not require a high skill.
So platinum is different. We have with Zimbabwe but even excluding Zimbabwe, the bulk of the world's reserves, resources and production. So, if using current methods, right, platinum mines are making a loss, then because we are the biggest supplier and a mine shut, the price should go up. Once platinum in the chain held by the companies, held by the traders, held by the fabricators like BASF, has been flushed out. In the longer term, platinum is very different. We could be price makers. If we had a platinum DTC, like diamonds have, diamond trading company and we sold through a single channel sites like they do, we could set the platinum price like De Beers does. You could virtually set it by withholding supply. And keeping the stable price, right? So, that's why platinum is very different. Platinum, we can continue, we can non mechanise completely, we'd be okay. Some mines would shut now, but reopen later. They shut now, withdraw supply, price would go up and reopen.	Platinum is different from gold mining in South Africa. Platinum mines in SA holds the bulk of the world's reserves, resources and production, we could be price makers. Therefore we can continue with the current status quo or we can non mechanise complete we still will be economically viable as we have the monopoly. Some mines will shut now, withdraw supply and the price will go up. This will enable them to reopen later.	South Africa holds the worlds largest ore reserve of platinum that could make South Africa potential price makers	South Africa holds the worlds largest ore reserve of platinum that could make South Africa potential price makers	Large mineral deposits.	South Africa have the largest platinum deposit in the world that could create a monopolistic environment.

Well, we haven't touched on health and safety. That's a big thing, is take people out of harms way. As I've said, when I worked for NUM, that was, bugger the harm, give us danger pay. It's all about paying. But these are alpha male men. Where mining is vary, you can get stats SA, I just did a study on it, if you want the figures. We have increased female, but it's from like 8% to 16. And they're nearly all on the surface. It's a very male orientated job and males tend to be tough kind of thing. They are very proud of I remember being in Sheffield in the coal mine, and these guys, from crawling around on their knees they all lost their knee caps. And that was like a sign of a man, ja, that's it. And who made the money? Was the coal company long gone? But they were laughing, at their machoism, I mean, you were a man if you've lost your knee caps from crawling around under those continues mining supports. There's a bit of that. But either way, the State's responsibility is not what the union wants; is for safe, decent work. And that's a big advantage.	Consideration with regard to health and safety in a conventional mine is that the industry was historically dominated by men and putting themselves in harms way is a sign of manhood. Therefore health and safety is not really a focus point of unions and will be used to negotiate higher remuneration (danger pay) than attempting to eliminate the risk. The heath and safety narrative is a Government priority rather than a Union priority.	Health and safety considerations drives higher remuneration without the need for higher education levels.	Health and safety considerations drives higher remuneration without the need for higher education levels.	Above average salaries for high risk jobs.	Risk occupations creates high remuneration opportunities without the need for higher education levels.
If they continue with their foreign mechanisation, then I would say it's very strongly that platinum don't mechanise. Do not mechanise in platinum because, you think, they're not going to go under, because we are the price maker. We are over 50% of raw supply and there's no ways that the price doesn't adjust. Because where else are you going to get platinum? Where are they banded, nearly all other platinum is not primary. It's a by-product and no risk. If there is a shortage, they can't produce more platinum. They're driven by nickel production..... I don't believe in this myth. I also don't believe there are alternatives. We've had auto capped legislations since the 70's and everyone was researching. In fact, the flurry of research, have you had to do a graph of the time on the amount of research, the flurry was in the 80's and 90's. But eventually they just were not getting anywhere. So I don't think substitutes would be a problem....There has been an increase from 20 to 26 or something, there will be small gains, but not massive. I think that secondary as they call it supply will remain fairly constant...Platinum we don't have to mechanise. Platinum would be nice, it's got a lot of positive things. Nationally in terms of jobs, with really only a negative if we don't get this model in terms of fiscal take.	If they continue with foreign mechanisation, then the platinum industry must not mechanise. Because South Africa is producing over 50% of the raw product we can consider us as the price maker. Everywhere else platinum is not primary but a by-product and there is no risk as they can't produce more platinum, they are mainly driven by Nickel production. There is also no alternative to platinum and secondary supply of platinum through recycling remain relatively constant.	Because South Africa is producing 50% of the minerals we can consider us as price makers as there is no substitutes for the minerals we have. Therefore it is possible to protect employment within the industry as we are not dictated by competition from outside.	Because South Africa is producing 50% of the minerals we can consider us as price makers as there is no substitutes for the minerals we have. Therefore it is possible to protect employment within the industry as we are not dictated by competition from outside.	Labour intensive	Extraction strategy extensively utilize a localised commodity in the form of large amounts of labour without the need of high education levels.
if we look at our current conventional mining methods, it's hand labour, it's hard labour. It doesn't require any form of education and hence, I mean the ease that we are able to source labour.	When you look at the current conventional mining method it's hand labour that does not require any form of education and hence it is easy to source labour.	Conventional mining is making use of hand labour that does not require any form of education and it is easy to source labour.	Conventional mining is making use of hand labour that does not require any form of education and it is easy to source labour.	Labour intensive	Extraction strategy extensively utilize a localised commodity in the form of large amounts of labour without the need of high education levels.

I believe that there are quite a number of things technical improvement we could do to conventional mining which would make it safer and more productive. And at the end of the day, if we're not productive and not making money, then you close the mine down. So the inherent assumption with everything I've said up till now, is that it has to be productive, it has to be cost effective. If it's not cost effective, why bother? And I believe that there are ways of making it safer and more productive that we could apply to conventional mining with currently available technology which is not yet and not currently used in mines.	There is a believe that a number of technical improvements can be done to the conventional mining method that would make it safer and more productive. This is currently available technology which is currently not being used in mines.	Technical improvement can optimise the current mining method that is not being utilised.	Technical improvement can optimise the current mining method that is not being utilised.	Conventional mining modernisation	Through isolated technical improvement to the existing conventional mining methodology could lead to productivity and safety improvements.
I'm saying that there are some technologies which I wouldn't call mechanised mining. What I would refer to is that you could introduce these technologies. Let me give you a simple example. A water hydraulic rock drill. Now water hydraulic rock drill is twice as effective as a pneumatic rock drill. End of story. So with one water hydraulic rock drill you can drill twice as many holes, which means you can have half the number of people drilling holes. Those people are the most [07:54] from the mine, from rock falls and the like. So you can actually half the number of people exposed to danger. If you half the number of people exposed to danger, you will probably end up by having half the number of accidents and fatalities which occur in that population at the moment. So it's very simple. So actually you need to improve the drilling, you need to improve cleaning, you need to improve the support. You need these whole bunch of things you need to do. And there are technologies and there are others which are available which could be put together which would give us a better mining process, a conventional mining process and still not being mechanised in mining. It would be safer and it would be more productive. And those are the only two words which have real relevance.	You do not have to introduce mechanised mining in order to improve the productivity of people in a conventional mine. As an example, the introduction of water hydraulic rock drills are twitch as efficient as pneumatic rock drills. This efficiency improvement can reduce the number of people in the stope face and hence the amount of people exposed to risk.	You do not have to implement mechanised mining in order to improve the productivity in a conventional mining layout.	You do not have to implement mechanised mining in order to improve the productivity in a conventional mining layout.	Conventional mining modernisation	Through isolated technical improvement to the existing conventional mining methodology could lead to productivity and safety improvements.
we need to optimise the current mines. It's not necessarily you take a mine that is sitting out at the far West Rand, it's got maybe 5 to 10 years' life of mine. It's not possible for that mine to put in large amounts of capital into investment for a couple of hundred million rand to give them a few more extra in terms of years. One of the options that are meant to optimise for what they are doing currently, tweak a little bit here and there in the processes to give them that efficiencies but maybe extended for 5 years with no significant capital investment. That's the first idea, so modernisation of the current mining.	For some mines with a relatively short LOM it is not possible to acquire large amounts of capital to mechanise that only extend them for a few extra years. Modernisation of the current mines therefore entail optimisation of the current process in order to give the operation marginal efficiency improvements in order to extend their life for another 5 years without significant capital investment.	For mines with a short LOM it is not possible to acquire large amounts of capital to mechanise. Modernisation of the current mines entail optimisation of the current process to allow marginal operational efficiency improvements.	For mines with a short LOM it is not possible to acquire large amounts of capital to mechanise. Modernisation of the current mines entail optimisation of the current process to allow marginal operational efficiency improvements.	Conventional mining modernisation	Through isolated technical improvement to the existing conventional mining methodology could lead to productivity and safety improvements.

<p>But in the process, there's a couple of things we need to look at. To invest in a piece of equipment that costs a hundred million rand, you need to know where your reef is. You can't just go there thumb suck and say okay I assume it will be here and then tomorrow it's not there because you hit a fault, so down through and out your fault and the reefs disappeared. You need to know about that in advance. So, understanding the ore body and making it into glass so it can be transparent and see what it is, is one of the critical things.</p>	<p>Looking at the process conventional mining make it easier to re-establish after intercepting geological discontinuities such as faults and dykes if compared to a more mechanised approach making use of equipment. It is not just the time to re-establish but also the cost involved. Mechanised equipment that requires huge capital investment need to be more productive in order to realise a return on investment. If these assets are not sweat properly it will end up costing you more than manual labour extraction strategies that requires less start-up capital.</p>	<p>Conventional mining make it easier to negotiate geological discontinuities such as faults and dykes compared to a mechanised approach. Mechanisation requires a large amount of capital investment and need to be more productive to realise the return on investment.</p>	<p>Conventional mining make it easier to negotiate geological discontinuities such as faults and dykes compared to a mechanised approach. Mechanisation requires a large amount of capital investment and need to be more productive to realise the return on investment.</p>	<p>Process flexibility.</p>	<p>Conventional mining requires less capital to start-up and allow for flexibility in the process to handle low utilisation and geological discontinuities.</p>
<p>Because if you modernise the current, you actually preserve jobs by allowing just a small tweak for example shift optimisation. So, the person has to travel from the shaft to the work place, is 4 km's.... So, the face productivity time is dramatically reduced and reducing as we go forward. If we can optimise methods of how people can get to the work place a lot faster, it means that there is more productivity. They can still drill and blast and do whatever. If you control water, if you control air, if you control just timing processes, logistics underground, we can optimise the mining to become more efficient. It means continuity of mining so we can mine a lot more without having to put large pieces of equipment underground. So, is conventional mining still something that will happen? But we just need to make sure that it happens efficiently and effectively.</p>	<p>Conventional mines can be modernised without having to adopt full mechanisation. This may include efficiency optimisation practices that include shift optimisation, If we can optimise methods of how people can get to the workplace faster it will improve productivity. If you can optimise time processes and logistics underground mine can become allot more efficient.</p>	<p>Conventional mines can modernise without having to adopt full mechanisation. By optimising time processes and logistics an underground mine can become a lot more efficient.</p>	<p>Conventional mines can modernise without having to adopt full mechanisation. By optimising time processes and logistics an underground mine can become a lot more efficient.</p>	<p>Conventional mining modernisation</p>	<p>Through isolated technical improvement to the existing conventional mining methodology could lead to productivity and safety improvements.</p>
<p>But the complexity of these ore bodies, the steepness of it, it was just far easier just to continue with manual labour, with tried and tested methods that we know.</p>	<p>Due to the complexities of these ore bodies and the steepness of it is easier just to continue with manual labour whit trailed and tested methods.</p>	<p>Due to the complexities of these ore bodies and the steepness of it is easier just to continue with manual labour whit trailed and tested methods.</p>	<p>Due to the complexities of these ore bodies and the steepness of it is easier just to continue with manual labour whit trailed and tested methods.</p>	<p>Proven extraction strategy</p>	<p>Due to all the complexities involved in these orebodies maintain the status quo has its benefits.</p>

<p>Your Achilles hill are these narrow tabular bodies. Finished and clear. How do you get a machine in there that can actually drill, blast and clean that? And Anglo is doing their research obviously with ultra-low profile stuff now, which I'm quite sure will work because of the diff. Gold is a different challenge. You're massively deep, you're faced with really different conditions in terms of face to support distance, platinum six meters, for us it's 3,5 to 4. Now you have to start looking at that operating envelope of 1.2 meters by a 4-meter aperture and say, what de hell can I do in there when I've got to drill roof bolts, I've got to put in nets, I've got to put in machines, I've got to put in people. The constraint of that environment, that just chase people away from developing equipment that can do that. If I can say, I don't think there's been a deliberate move just to hang on to conventional. I think people have tried all sorts of things. They've tried drill rigs, they've tried this and that. But fundamentally it still means you need a man in the face.</p>	<p>The biggest challenge is these narrow tabular ore bodies. In some platinum mines with flatter dipping orebodies they have successfully mechanised with steeper dipping order bodies at extreme depths it is very difficult to mechanise. The constraint of the environment is just as such that people refrain from developing equipment that can do that. There has not been a deliberate move to hang on to conventional mining and they have tried allot of different solutions. But fundamentally it still means you need a man in the face.</p>	<p>The biggest challenge in narrow tabular orebodies that is steep dipping is that it is very difficult to mechanise. There was no deliberate move to hang on to conventional mining but people are reluctant to develop equipment to work within these confined spaces.</p>	<p>The biggest challenge in narrow tabular orebodies that is steep dipping is that it is very difficult to mechanise. There was no deliberate move to hang on to conventional mining but people are reluctant to develop equipment to work within these confined spaces.</p>	<p>Proven extraction strategy</p>	<p>Due to all the complexities involved in these orebodies maintain the status quo has its benefits.</p>
<p>So, we always go back to conventional mining. Why? Because our reefs are that narrow and are very broken up. And mechanisation doesn't like, or those type of vehicles don't like all these different angles and broken up ground you need to work at angles.</p>	<p>The tendency is always to go back to conventional mining because our reefs are that narrow and are very broken up. The technology that we are currently using does not like all these different angles and broken up ground.</p>	<p>There is a tendency to always go back to conventional mining because of the ore body. Mechanised solutions find it difficult to negotiate different angles and broken up ground.</p>	<p>There is a tendency to always go back to conventional mining because of the ore body. Mechanised solutions find it difficult to negotiate different angles and broken up ground.</p>	<p>Proven extraction strategy</p>	<p>Due to all the complexities involved in these orebodies maintain the status quo has its benefits.</p>
<p>I also think that with the gold mining industry as well as platinum industry in South Africa, it's actually a very easy ore body. It's tabular, it's narrow, it's not very steep, so it's actually very easy to mine it on a conventional way.</p>	<p>The gold and platinum orebody is relatively easy to mine in a conventional way as it is narrow, tabular and is not very steep.</p>	<p>The gold and platinum orebody is relatively easy to mine in a conventional way as it is narrow, tabular and is not very steep.</p>	<p>The gold and platinum orebody is relatively easy to mine in a conventional way as it is narrow, tabular and is not very steep.</p>	<p>Proven extraction strategy</p>	<p>Due to all the complexities involved in these orebodies maintain the status quo has its benefits.</p>
<p>From a nationalistic point of view, if you could employ more people there will be still taxes to more people that can still fit Government pockets to do better. Whereas currently, less people work because whatever operation you have, and you are excessively taxing those little people to give grants to the majority that's not working. It's an actual fact, if you look at it even in capitalism there's socialism. It's just pissing off the people that's working that must pay the taxes and the people that's getting, it's for nothing and they would want more by doing less or less than what they are currently doing. It's actually, synonymous, it's just a methodology of how funds transfer.</p>	<p>From a purely national point of view it is better to employ more people that contribute to the tax revenue generated than excessively taxing the minority to be able to pay grants to the fast majority of people. It creates an unhealthy situation where people working will be discontent with the fact that employed people are taxed more compared to people receiving money for doing nothing.</p>	<p>From a National point of view it is better to employ more people with a lower pay scale than fewer people with a higher pay scale.</p>	<p>From a National point of view it is better to employ more people with a lower pay scale than fewer people with a higher pay scale.</p>	<p>Socio-economic imperative</p>	<p>From a Socio-economic perspective employing more people with a lower salary is better than only a few people with high salaries.</p>

it buys us still some time to get perceptions and thought and thinking towards the other side of the pendulum because the unfortunate thing is the people that are currently working at the mines only have a finite life in any case and it's not for them that we have to look, we need to look at the generation that's going to follow. So, I think the big advantage at this stage, is we still have a resource that can be mined conventionally and it buys us some time.	Conventional mining buys us some time to get the perceptions and thinking towards an alternative solution aligned for the next generation	Conventional mining buys us some time to get the perceptions and thinking towards an alternative solution aligned for the next generation	Conventional mining buys us some time to get the perceptions and thinking towards an alternative solution aligned for the next generation	Proven extraction strategy	Due to all the complexities involved in these orebodies maintain the status quo has its benefits.
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Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
But unfortunately greed plays a big role in corporate companies. They have declared ounces, CEO’s get paid on ounces produced and that creates that pull aspect where people become a commodity. You can drill them up a storm. We are saddened to tell you that we have lost the lives of three guys in a rock fall but within the next day it is back to finding a new resort	Greed plays a big role in corporate companies. CEO's get paid on ounces produced that creates a pull aspect where people becomes a commodity.	Incentive schemes of mining CEO are based on ounces produced and with the lack of other performance indicators people becomes a commodity.	Incentive schemes of mining CEO are based on ounces produced and with the lack of other performance indicators people becomes a commodity.	Disjointed stakeholder values	Misaligned focus points deter collaboration amongst stakeholders in a paradigm where teamwork is paramount.
I think mining is not as sexy as what it used to be 40 years ago. I think that young people, or young incumbents are far wiser now because of things like the internet. They know that there’s other opportunities out there for them and if you have to track the age of rock drill operators that exists in mines now, if you have a look at how that age has migrated over a period of time, you probably will find that the average age of a rock drill operator now is probably 40 years plus.	Mining is not as sexy as what it used to be 40 years ago. Young incumbents are more technologically orientated. The average age of a rock drill operator is now probably +40 years.	Mining is not regarded as an attractive job occupation anymore.	Mining is not regarded as an attractive job occupation anymore.	Talent sourcing	Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.
There are no new incumbents coming into the mining industry, even if we could say that we make sure that a rock doesn’t fall on your head or we will make sure you don’t get injured by applying different technologies or innovations. I still think that the, and I use the word “sexiness”, the sexiness of being a miner is not quite where it used to be	There are no new incumbents coming into the mining industry. The sexiness of being a miner is not quite where it used to be.	Mining is not regarded as an attractive job occupation anymore.	Mining is not regarded as an attractive job occupation anymore.	Talent sourcing	Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.
I think there are many good aspects that you can take from the historical methodologies or strategies that we employed. I mean, one of the big things was that the manner in which the work was done in those days, was based on a team effort. I think that is quite disjointed and fragmented, it’s more process oriented than team oriented and I think that’s something that we need to look at.	The historical mining methodologies is based on teamwork. Currently it is quite disjointed and process orientated rather than team orientated.	Labour intensive practices are reliant on teamwork. Currently the mining industry is more process orientated rather than team orientated.	Labour intensive practices are reliant on teamwork. Currently the mining industry is more process orientated rather than team orientated.	Talent sourcing	Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.
Unfortunately as the economics of the operations sort of changed and people want to cut costs, they cut back on drilling that natural or reserved developments which we could actually see what was going to happen going forth. If you don’t have sufficiently developed ore reserves, you start doing silly things to try and catch up afterward	As the economics of the operation change and people want to cut costs, they cut back on development that offer a more accurate model of the orebody. If you don't have sufficiently developed ore reserves, you start silly things to catch up.	During economic downturn conventional shaft normally cut cost through the reduction of development that offer you a more accurate model of the orebody.	During economic downturn conventional shaft normally cut cost through the reduction of development that offer you a more accurate model of the orebody.	Inflexible methodology	Contrary to believe flexibility within a conventional methodology is practically very limited.
So I think it definitely enforced a certain level of discipline in those days where as now I don’t see that same level of discipline. Now it’s just getting the tons at any cost and so those sort of back to basics values that existed in the mining industry, that I think are implied in a certain degree on some operations but maybe not as many as what it should be	The level of discipline has deteriorated and focus have moved to getting tones at any costs. Those back to basic values that existed in the mining industry is not so forth coming as it should be.	Conventional mining requires a high level of discipline and focus that is not so forth coming as it should be.	Conventional mining requires a high level of discipline and focus that is not so forth coming as it should be.	Talent sourcing	Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.
So I think the one is the different stake holders. I think the stake holders have different agendas... and it’s a sad statement [0:14:16], it’s the person that makes the investment that needs to get the return. Because I mean that’s why we make investments and opportunities is to get some kind of return for the money that you put in. And I think there’s quite a bit of, like I said, between those four individuals or most four different groups because some of their behaviours or some of their practices that are being enforced by Government don’t necessarily allow you to be as innovative as you want to. So it’s more of a compliance issue than trying to come up with different ideas in terms of how we can be a little bit more flexible in producing costs being safer and the likes. I think the expectations from employee’s side as well because of the fact that we live, specifically in South Africa, we live in an economy where unemployment is rampant. The different organised labour unions or the ends thereof don’t only compete for the fact that they want to represent the employee probably, but they also compete for sustainability amongst themselves. . So you will do everything to try and make sure, although it might not be the correct thing to do in terms of what’s best for the industry, that’s a bit of a self-preservation thing that you do for yourself. So there’s a bit of misalignment as to the amount of effort that goes into trying to resolve those four stakeholders...So there was a big challenge, I think the four constituents are sometimes at loggerheads and are looking at opposite directions and not focusing on what could be the preferred solution. Even amongst, you know you’ve been with this for a while, even amongst the OEM’s. There are very few opportunities where OEM’s will come and sit and talk about potential opportunities for the better of the industry. They would rather develop a technology of their own because then that’s a competitive advantage going forward. Where’s we will try to ensure that the industry is healthy because of the fact it’s a benefit for the country and if that whole industry implodes then none of us has a business in any case.	The different stakeholders have different agenda's. Investors needs to get a return on the investment made. Government don't necessarily allow for innovation as it is more of compliance rather than coming up with different ideas of being more flexible. Employee expectations within an economy where unemployment is rampant also creates a threat. Organised labour do not only represent the employees but also compete amongst themselves that does not necessarily mean whatever they pursue is the best for the industry but out of self preservation. So there's a misalignment. I think the four constituents are sometimes at loggerheads and are looking at opposite directions and not focusing on what could be the preferred solutions. Even amongst OEM's there is very little collaboration and would rather develop a technology on their own because then that's a competitive advantage going forward. There is no attempt to try and ensure that the industry is healthy and the fact that it is a benefit for the country. If that entire industry implodes then none of the OEM's has a business in any case.	There is a disconnect with regards to stakeholder values. Investors, Government, employees, organised labour and OEM's have all misaligned focus points and therefore collaboration is very limited	There is a disconnect with regards to stakeholder values. Investors, Government, employees, organised labour and OEM's have all misaligned focus points and therefore collaboration is very limited	Disjointed stakeholder values	Misaligned focus points deter collaboration amongst stakeholders in a paradigm where teamwork is paramount.
is that, the South African, specifically the gold mining industry is built on a legacy in which we really had migrant labour which was an untapped resource of labour that was available in the early days of gold mining for quite a marginal cost. As well as electricity and water was fairly inexpensive, if you had to compare to world standards...So one of our biggest threats is that, you know as South Africa is a country that is developing, unfortunately or fortunately, our labour cost is on an annual basis increasing at least by 6 or 7%. So work and jobs that we were able to do historically with hand labour, now all of a sudden becomes actually more advantageous to look at mechanisation to sort of offset this ever increasing cost that is associated with labour.	Historically the gold mining industry was build on an untapped relatively inexpensive resource of migrant labour as well as inexpensive electricity and water cost. During the development of the South African commodity these resources is no longer that inexpensive and financially mechanisation is seen as a method to off set this ever increasing cost.	Historically South Africa had an advantage of cheap labour that had a minor impact on the financial model. Currently labour cost on a typical conventional shaft is between 65% and 75% of the total bill.	Historically South Africa had an advantage of cheap labour that had a minor impact on the financial model. Currently labour cost on a typical conventional shaft is between 65% and 75% of the total bill.	Escalating wage bill.	Above inflationary wages have an adverse effect on financial viability labour intensive industries such as conventional mining.
is that the dynamic or the source of migrant labour that we had in history, is changing because we need to understand that we have young people that get educated and go to school and now are not very interested in actually doing hard labour. And the consequence and despite this proven technology that hasn’t changed in hundred years, we actually are not going to have people to do it in the near future. Which is a significant threat. So apart from the cost of the labour, actually the interest from the labour to do the job is also not really there and that’s becoming an increasing and bigger challenge	The disadvantage is that young people that get educated and go to school are not really interested in actually doing hard labour. As a consequence and despite this proven technology that hasn't changed in the last century we are not going to have people in the near future to do the job.	The disadvantage is that the younger generation are finding manual labour unattractive and as a consequence deter young talent from the industry.	The disadvantage is that the younger generation are finding manual labour unattractive and as a consequence deter young talent from the industry.	Talent sourcing	Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.

<p>So it’s now in our interest as well as Government’s interest actually to find a way of doing exactly that. Introducing mechanisation so we can pull on the life of our ore bodies, because apart from the social economics side of things. Technically, there’s only a, from a techno economic valuation point of view. We can’t ventilate some of the places where our ore bodies extend to. We cannot secure seismic release in places where a lot of our ore bodies are. Although to a large extent the grade of our gold ore bodies has been protecting us to a large extent in tough times, I do think that going forward you know, even if our grade as it stands, won’t be able to afford us the opportunity to be globally competitive. So I think as a South African industry we’ve got a huge challenge given that as South African mines we are narrow tabular, and by its definition “narrow tabular”, means that it’s not open cast and akin to anything we do globally. I think we’re a niche market and what has made us successful, has been cheap labour, cheap water, cheap electricity and high grades. And I think as we start ticking them off, we don’t have cheap labour anymore, electricity has become increasingly expensive, and therefore the stars are certainly not aligning long term for us and we need to be able to mechanise to be able to secure a future. Specifically being as gold producers globally competitive.</p>	<p>Introducing mechanisation is seen as the only option going forward. Technically we can not ventilate some of the places our ore bodies extend to. We can not secure seismic release in places where a lot of ore bodies are. To a large extend the grade of gold has been protecting us in the past but going forward it would become tougher to remain globally competitive. South Africa has a huge challenge in that their mines are narrow tabular and are therefore a unique orebody with unique challenges. What made us successful in the past was cheap labour, cheap water, cheap electricity and high grades. We do not have these competitive advantages anymore.</p>	<p>Technically the conventional mining methodology relies on conditions that requires a lot of input cost to extract the remaining orebody. Due to the high cut-off grade the majority of resources left within the platinum and gold industry are sterilised.</p>	<p>Technically the conventional mining methodology relies on conditions that requires a lot of input cost to extract the remaining orebody. Due to the high cut-off grade the majority of resources left within the platinum and gold industry are sterilised.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>Because from a global point of view, South Africa’s gold mining in history, is every year, it is a sunset, very much viewed as a sunset industry. Every year we unfortunately produce less and that’s off the back of a lot of our ore reserves being sterilised and they’ve being sterilised because either we don’t have a technical way of mining them, where mechanisation would be able to give us say, an answer or a way, or secondly just because from a cost point of view, we can’t handle it. And very specifically on a lot of our marginal gold deposits which we have across South Africa.</p>	<p>From a global point of view, every year the South African gold industry produces less and therefore is seen as a sunset industry. This is because a lot of our ore reserves is being sterilised because technically we don't have a way of mining it or we can not mine it cost effectively.</p>	<p>A lot of the ore reserves is being sterilised because we do not have the technical means to extract it cost effectively.</p>	<p>A lot of the ore reserves is being sterilised because we do not have the technical means to extract it cost effectively.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>I think the bigger issue here is from a global point of view, we also need to acknowledge that our Labour Law as it currently stands in South Africa, is unfortunately not geared towards as being competitive from a beneficiation point of view. If we had to compare us to China as an example, there is no comparison purely because the Labour Law is so cumbersome in South Africa. In fact to employ somebody here and unemployed somebody is virtually impossible.</p>	<p>From a global point of view South Africa's labour law is very cumbersome. To employ and unemployed someone in South Africa is virtually impossible.</p>	<p>Rigid legislation creates a methodology that has limited flexibility.</p>	<p>Rigid legislation creates a methodology that has limited flexibility.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>Our history was predicated on people who were exposed in the early days of mining industry and as time has gone by and by the way of the political change in our country, we need to understand that invariably labour and Government was a seamless line. It was one feed stock. A lot of our laws are sort of overly in favour of labour and definitely not in favour of having a sustainable business going forward. I think ultimately the magic here is going to be that we need to get triparttheid alliance and see if the light is a combine. Because if we don't, unfortunately as business alignment won't be able to make it work and the future will then be on the one hand, if that's the case. The future will very much be capital starvation, harvest strategies being employed by all major companies and then shutting down gold mines one after the other after the other. And over time basically we re-introducing these people back into society without a viable future...Because unfortunately once you’ve been a rock drill operator underground, you can’t go and work in a Checkers. The gap in terms of remuneration is too big. A rock drill operator at least earns R13 500 - R14 000 where as a person that works in a Checkers as an example works for R6 000. The divide is too great.</p>	<p>Our history was predicated on people who were exposed. During the political change in South Africa we need to understand that invariably labour and government was a seamless line where the one fed the other. Therefore a lot of our laws are overly in favour of labour and definitely not in favour of having a sustainable business going forward. The magic here is going to be that we need to get triparttheid alliance. Business alignment on its own will not work and the future will very much be capital starvation, harvesting strategies being employed by all major companies and thereafter mine closure. Overtime the re-introducing of mining people back into society will be without a viable future because of a extremely big remuneration gap.</p>	<p>Rigid legislation creates a methodology that has limited flexibility.</p>	<p>Rigid legislation creates a methodology that has limited flexibility.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>It’s very simple. If I look at conventional mining. Conventional mining is a low skilled occupation. It’s hard, it’s arduous and it’s lots of physical strength and it’s in a dangerous environment.</p>	<p>If you look at conventional mining it is a low skilled occupation, it is hard that requires a lot of physical strength and it is in a dangerous environment.</p>	<p>Conventional mining requires a low skilled occupation with physical strength and that is working in a dangerous environment.</p>	<p>Conventional mining requires a low skilled occupation with physical strength and that is working in a dangerous environment.</p>	<p>Talent sourcing</p>	<p>Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.</p>
<p>For everything is conspiring against that working. The duration of the shifts. The fact that we only work 11 days in a fortnight. Everything is the section 54’s cryptic cause, there’s a whole bunch of things which are actually saying that our productivity is in fact decreasing, and don’t forget of course aids. Not so much as the people dying from it, but the people going sick without having to go to work. All these things mean that the average worker is less productive. The operating costs are higher, so you get the double whammy, is producing less and it costs you more and therefore the economics just go out the window</p>	<p>There are a number of challenges that are working against conventional mining. The duration of shifts, the fact that we only work an 11 day fortnight, section 54 instructions issued for safety related issues and the aids pandemic. All of these things mean that the average worker is becoming less productive. The operating costs are Highers and therefore the economic viability is decreasing of operations.</p>	<p>Shift durations and safety stoppages all limit productivity and increase operating cost. The economic viability of operations are negatively effected with all these legislative requirements.</p>	<p>Shift durations and safety stoppages all limit productivity and increase operating cost. The economic viability of operations are negatively effected with all these legislative requirements.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>the mining industry in gold and platinum reaches a cliff of 2025, 2030 and where it’s just not sustainable anymore. So, we won’t be able to continue mining the way we are come 2020 to 2030. Which means that in that sector there’s about 200 000 jobs that would be at risk if you come to it. Now it’s not just the 200 000. For every person employed in mining, that reach to 1 to 10 or 1 to 15 are the number of dependence associated with that. So, 200 immediately are very quickly becomes 2 million or 3 million if you use 15 as a number.</p>	<p>The conventional mining methodology is no longer a sustainable extraction strategy where it is forecasted that by the year 2025 - 2030 the platinum and gold industries will reach a cliff. The impact of this sunset industry is a potential 200 000 direct job losses but indirectly it could impact as much as 2 to 3 million citizens as a result of the multiplying factor.</p>	<p>Conventional mining methodology is no longer a sustainable extraction strategy.</p>	<p>Conventional mining methodology is no longer a sustainable extraction strategy.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>Obviously with the current legislation we don’t mine every single day. There are certain days, Sundays in particular that you are not allowed to do that. But if you look at the current mining method. We mine, the shifts start at 6 o’clock, we blast at 2 o’clock. The next shift only goes down at 4 o’clock. At 4 o’clock, because you have to clear the panel of all the blasting fumes. You have to clear the panels to allow for the rock mass to settle. In terms of, if you consider mining to be a rock factory, it’s a very stop-start affair. So how do you get to bring it more efficient as a 24/7 mining operation?</p>	<p>With the current legislation in place we are not allowed to work every single day, Sunday in particular. The drill and blast mining method compared to a typical 24/7 rock factory is a very stop-start affair that makes it vey inefficient.</p>	<p>With the current legislation shift schedules discourage efficiency and create a inflexible mining methodology.</p>	<p>With the current legislation shift schedules discourage efficiency and create a inflexible mining methodology.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>

<p>The second component that we’ve come across, is the ability to get information in real time. Now real time is relative. So currently the way it works, and you would know this as well, is that the shift goes down, the shift boss goes down in a couple of hours later after the crew has been in. They wait for the operator to start-up operations, then the entry exam and then they go into the shaft and start mining. Then the shift boss comes in and the mine overseer comes in. What happens after that is that they write a report, then they do the logbooks, they go to surface, punch it into the computer and it follows the chain of command. So, from miner to shift boss to mine captain, section manager, production manager, mine manager then it has to filter all the way back down again. That process can take some time. But what if there is an immediate issue happening on the face? You can call for the rock engineer to come down and they come down with a cage later but that person also has to follow a process. I used to be a rock engineer in the mine, so you crawl underground and you make your examinations, your observations and your recommendations. You give instructions or recommendations to the crew on what they need to do, but you still need to formulise it. So, you get to surface, you write your report, you pass it to your boss and once again the chain of command. So, by the time it goes from the rock engineer office to the mine manager or production manager all the way back to the miner who has to implement it, it’s probably about a day and a half or two days. All happens in the underground environment. That face has moved forward if you take to blast 2 metres ahead of it. So, the conditions that you have observed at the time, are no longer there. It actually may be worse or better. You haven’t really dealt with the situation. Furthermore, if there is a loss of water pressure along the way so the guy doesn’t get a chance to drill. What does your mine captain say when you come up, did you blast? If you say no, you’re in trouble first before they say well, okay what was the reason? But if you as a shift boss know that there’s a water pressure drop at the shaft area itself, you can immediately start making changes to the system and then you can either correct it or you can make another plan to do something else. But we don’t have that capability right now.</p>	<p>Information in the current conventional mining process follows a time consuming process that delay the ability to make informed decisions within a ever changing environment. The capability to get real time information is not available right now.</p>	<p>Delayed information sharing hamper informed decision making in an ever changing environment</p>	<p>Delayed information sharing hamper informed decision making in an ever changing environment</p>	<p>Lower output efficiency.</p>	<p>Output efficiency reduces when manual labour is compared to mechanised processes.</p>
<p>So, what we have to do, is we have to mine this currently because we have people in there and we have support that needs to be put in. This additional, if that’s 20 centimetres, as we say is the maximum, this 30 here and this 30 is not an issue. This 60 centimetres is of no value to us of what so ever. But what we have to do, we have to take it from 3 km’s underground, take it all the way to surface and deal with that. So, can we look at a method in this mining, that allow for just extracting that portion? What does this mean? It means that for the current mining, the reason why it stops here, is we have to leave pillars and it’s just uneconomical to mine. The dollar value for gold is far greater than our current costs. Because maybe 2 or 3 grams a ton because of the dilution of that. Take out the dilution factor, 2 or 3 grams a ton, suddenly becomes 50 grams, or 100 grams and becomes a payable option that you want to mine. So, that’s basically what this is.</p>	<p>With the current conventional mining method stoping heights are increased because people are being used to extract these ore. Dilution in the form of increased stoping heights reduces the grade of ore being extracted. This in-turn that increases the cost of extracting such ore as a portion of ore is not worth anything but you extract it in the same expensive way as the precious metal bearing ore. This contribute to the overall cost of extracting the ore and by default have a negative impact on the economic viability of such operation.</p>	<p>Dilution in the form of increased stoping heights reduce the grade of the ore being extracted and increased the cost of extracting the mineral.</p>	<p>Dilution in the form of increased stoping heights reduce the grade of the ore being extracted and increased the cost of extracting the mineral.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>Because one of the reasons that we face as a, or problems we face is investors don’t want to put money into a mine that’s got high risks in terms of health and safety. You have to put people in the underground environment, you got all the dust and all the noise so you got occupation and health issues. So, because there’s a noise and health issue it’s still critical for this sector. It’s something to address. Then you got the issue of fatalities and injuries. Those two things are creating that we move to 4000 metres below surface, is going to be something that sits on your mind as an investor. That’s a lot of money to put on people’s lives. That’s a risk.</p>	<p>Investors do not want to invest in a mine that's got a high risk in terms of health and safety. With the current conventional mining method a lot of health and safety issues lowers the investment appetite amongst the investing community because of the particularly high risk and moderate returns from these investments.</p>	<p>Investors are deterred from an investment with a high risk in terms of the health and safety of employees.</p>	<p>Investors are deterred from an investment with a high risk in terms of the health and safety of employees.</p>	<p>Unattractive investment opportunity</p>	<p>Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>that a gold mine currently sitting at 3 000 metres below surface, it will move to 4 000 metres below surface. The rock stresses go up automatically. So, that means even before you start mining, the rock is already fractured. It will be more difficult to keep that rock supported, so that you can allow people to go in. The risk of injuries and fatalities go up automatically as a result of that.</p>	<p>Within a gold mine that is currently at a depth of 3000m below surface will eventually move to 4000 m below surface. At these depths the rock is already fractured and will become increasingly more difficult to support the hanging. The risk therefore increases exponentially with conventional mining methods as you mine deeper</p>	<p>Mining at depth increases the safety risk due to fractured rock formations that becomes increasing more difficult to support.</p>	<p>Mining at depth increases the safety risk due to fractured rock formations that becomes increasing more difficult to support.</p>	<p>Unattractive investment opportunity</p>	<p>Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>conventional mining for that reason will never be in my view, safe to the point that you can guarantee zero. I understand the vision of zero harm, I understand the politics and the leadership in relation of creating a vision that says something. Something to hold on, to get all of that. But the reality of it, it will never be possible if all we do is carry on with conventional mining methodologies which are labour intensive where people are involved predominantly in multi complex, multi facet processes where they will make mistakes and in an inherently unsafe environment which is not all on site. You will have continued incidents, accidents and potential fatalities. On that premise, you need to change something fundamentally about your mining method.</p>	<p>Conventional mining will never guarantee zero harm to people. Despite the politicians and leadership that created this vision the reality is that it will not be achievable with conventional mining methodologies which are labour intensive and are exposed to an inherently unsafe environment. To achieve zero harm you need to change something fundamentally about your mining method.</p>	<p>Conventional mining will never guarantee zero harm to people that is inherently labour intensive within a hazardous environment.</p>	<p>Conventional mining will never guarantee zero harm to people that is inherently labour intensive within a hazardous environment.</p>	<p>Unattractive investment opportunity</p>	<p>Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>We leave about 40% of the gold behind because of the safety issue, because of the seismic stresses and the stress related mining, and it’s only become like that in platinum more and more as you increase your depth, you leave more gold behind. From a macro perspective to safe guard seismic stress. And despite that, we still have seismic fatalities and huge seismic events because you scratch down from mother earth where there is one little hole or big holes you’re going to have a response from it.</p>	<p>Currently the conventional mining extraction strategy leave about 40% of the ore reserves behind to safeguard against seismic stress. Despite that we still have seismic fatalities and huge seismic events. These constraints reduce the efficiency of the mining extraction strategy and increase the risk.</p>	<p>Due to seismic activity more than 40% of the available ore reserves are left behind locked up in pillars to reduce seismic events that reduces efficiency and increases the cut-off grade.</p>	<p>Due to seismic activity more than 40% of the available ore reserves are left behind locked up in pillars to reduce seismic events that reduces efficiency and increases the cut-off grade.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>You’re going to lose anything from 20 up to probably about 30-35% of gold just because of the way you break the rock. You’re not efficient.</p>	<p>Because of the drill and blast practices you are loosing anything between 30-35% of the mineral just because of the way that you break the rock. Therefore you are not efficient.</p>	<p>Because of drill and blast practices more than 30% of the mineral are being lost that reduces efficiency.</p>	<p>Because of drill and blast practices more than 30% of the mineral are being lost that reduces efficiency.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>

<p>To add insult to injury on top of the fact that you’re losing that gold in that initial process and multi core factor conversation after it, you’re diluting it. So if you look at your average channel widths, human beings are human beings. They’ve got a certain height, 1.7m on average by statistics and 70kg’s I think is the average for a human male. You are diluting in instances up to 2-3 000%. So what you’re doing is, you transporting so much additional tonnage, which got no value to you through this entire processing</p>	<p>Because you have to extract the ore with human beings you need to create an adequate working area for the people to work in. In some cases you need to increase dilutions up to 2000%-3000%. You transport so much additional tonnage which got no value through the entire process.</p>	<p>Because you extract the mineral making use of manual labour specific conditions within the working face need to be maintained. Mining working heights increase dilution and reduces efficiency dramatically.</p>	<p>Because you extract the mineral making use of manual labour specific conditions within the working face need to be maintained. Mining working heights increase dilution and reduces efficiency dramatically.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>If you put explosives in ore, and you’re speaking about these depths and very complex ventilation and environmental conditions, you can’t run these things 24/7. Conventional methods. You need something that allows you a 24/7 process. The key to it, is explosives. Why is it currently we got to clear people out, take a blast, clear the air through there? It’s because of toxic noxious fumes that exposes. So if you eliminate, what is the one common theme in this entire process? It says, if you want to change the destiny, not incrementally, incremental won’t help you, you’ve got to move the dial big time. You got to change something. And the one thing is to stop using explosive...if you stop using explosives, you will not have the time constraint.</p>	<p>Because of the use of explosives in the conventional mining method at these depth and very complex ventilation and environmental conditions you can not run these things 24/7. We current need to clear people out, take the blast and clear the air through the working area. So you need to eliminate the common theme throughout the entire process in order to change the mining industries fundamentally as appose to incremental gains.</p>	<p>Because we make use of explosives in a conventional mining method at extreme depths all personnel need to be extracted before blasting can take place. This in turn creates a batch process flow that have limited optimisation opportunities.</p>	<p>Because we make use of explosives in a conventional mining method at extreme depths all personnel need to be extracted before blasting can take place. This in turn creates a batch process flow that have limited optimisation opportunities.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>Mechanisation is fundamentally still just like conventional methods, a very batch type of process. Batch shifts, batch cycles, everything is batches. You need to convert this into a continuous process. It doesn’t rely upon consisting sections of time and batching and series of events. Only that allows you that, is mechanical breaking of rock and the exclusion of explosives as a principle.</p>	<p>Conventional mining is fundamentally a batch process. You need to convert it into a continuous process where it does not rely upon a specific sequence of events. Mechanical breaking of the rock with the exclusion of explosives as a principle allow you that opportunity.</p>	<p>Conventional mining is a batch process that limit optimisations opportunities into a more continuous process.</p>	<p>Conventional mining is a batch process that limit optimisations opportunities into a more continuous process.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>we’re price takers. We get what we can get. So, gold price falls through the floor, you got to find different ways of responding to that challenge. But if you look at an average of 6,5% increase on your cost price per year, you look at Eskom which gone up from 9% to 19% in three years. And we don’t know where that ends. Your input cost of labour lies on 55%, your Eskom is sitting at 19%, you don’t have hell of a lot for other costs that land up in your cost basket. If you look at just those optics, of those rising prices and they’re rising at a higher rate than what the gold prices are rising, you know that you’re going to hit the wall at some stage... My fear is, with the kind of rapid decline that you described just now, I’m not sure if we’re going to be in time to catch an industry that 5 years out is already half falling over and half dead. So, I think we’re going to land somewhere in between. We’ll get some of this technology working. We’re going to have massive impacts in terms of community on gold mines and platinum mines in the future – it’s going to get worse. If we don’t see a resurgence in price on the platinum side which enables, let’s call it future re-employment of, just for the current workings as it were. I’m afraid it’s not going to be pretty, it’s not a good picture at the moment.</p>	<p>Within the gold sector we are regarded as price takers and not price makers. Due to the conventional layout that are implemented within SA the labour and electricity cost make up a large portion of the input cost. Due to its above inflation increases of labour and electricity over the years this conventional mining is increasingly under threat due to the economic viability of the method. With the kind of rapid decline I am not sure if we are going to be in time to catch an industry that is already half falling over and half dead. We are going to have massive impacts in terms of the community on gold mines and platinum mines in the future. It is going to get worse as I do not see a resurgence in the commodity price to enable future re-employment.</p>	<p>The gold industry is regarded as a price taker and due to the very nature of conventional mining labour and electricity costs influence cut-off grades extensively. Higher than inflation increases within these categories negatively effect the economic viability of these operations.</p>	<p>The gold industry is regarded as a price taker and due to the very nature of conventional mining labour and electricity costs influence cut-off grades extensively. Higher than inflation increases within these categories negatively effect the economic viability of these operations.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>With the current political reality that we’re facing, there’s almost from where we sit, the intend to want to stuff the industry up. What ways can we find to make it more tough for the guys to pack their bags and they go somewhere else? It doesn’t go well from a political perspective. The political will, and I don’t think it’s in this country, to create that. And I think, let’s call it the mine operators in this country are going to find it more and more difficult over time to meet the hurdles. Whatever hurdles the Government is throwing at them...They can regulate us into submission. This industry could be regulated into some kind of a status quo. Outside of the growth margin and in a declining trend rather than a rising trend. The politics will dictate where we land.</p>	<p>The current political climate is unfavourable to the mining industry in that there is a perception that mine operators are going to find it increasingly more difficult to meet the hurdles. Government can regulate us into submission that is outside of the growth margin and in a declining trend.</p>	<p>The current political environment is regarded unfavourable and there is a believe that Government intense to regulate the mines into submission.</p>	<p>The current political environment is regarded unfavourable and there is a believe that Government intense to regulate the mines into submission.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>Now the problem is that we are on conventional mining and conventional mining has worked for us for many years and was good for us and is still good for us. However, conventional mining has got 2 problems. The one is labour costs that are on the increase and commodity prices are not increasing. Most of our mines are running at 70% of total costs as labour cost and that’s double-digit figures. Secondly our productivity halved while we were doing that. The second point for me is that the people in South Africa are now doing work environment change. Nobody wants to do physical work. In the past, the people that did the physical work underground, were migrant people from homelands and those people grew up in altitudes. They’re very fit, very strong and they can work for a day, because they’ve grown up in very low oxygen environments. I think that’s where the fundamental difference is. Now that we get localised and we get to employ people and shadow the head gear, it’s a different twosome that we’re working with.</p>	<p>Conventional mining has two problems. The one is labour cost that are on the increase compared to commodity prices . Most of these labour intensive mines are running a wage bill of 70% of the total cost. Secondly our productivity halved because South Africans are now doing the physical work. In the past the people that did the physical work underground were migrant labour from homelands and people grew up at altitude. They are very fit, very strong because they've grown up in very low oxygen environments. Now we get localised people that we employ for this type of work.</p>	<p>Due to the labour cost increases and the inability to find people with the required physical attributes to work in the given environment</p>	<p>Due to the labour cost increases and the inability to find people with the required physical attributes to work in the given environment</p>	<p>High cut-off grade. Talent sourcing</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves. Due to the nature of job occupations the industry fail to attract new talent that have dire consequences.</p>
<p>I think with the increase in our labour cost, with the increase in legislation with all the caring portions that’s coming in, that is correct and solid and I do believe in that. That’s the way it needs to be. It is going to kill the conventional industry. To put a conventional mine up now in South Africa takes you 10 years before you put the first ounces or put the first money on the table. Nobody is willing to wait for that long-term investments anymore. You don’t see a lot of mines, so no 1 is we’ll have to find ways of extracting it much faster.</p>	<p>Due to the increase in labour cost and increase in legislation is going to kill the conventional industry. To put up a conventional mine in South Africa takes you 10 years before you put the first ounces on the table. Nobody is willing to wait that long term investment therefore we need to find ways of extracting it much faster.</p>	<p>Due to the labour increases and legislation adjustments, conventional mining will soon become uneconomical.</p>	<p>Due to the labour increases and legislation adjustments, conventional mining will soon become uneconomical.</p>	<p>High cut-off grade. Unattractive investment opportunity</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves. Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>

<p>If I can just on the safety side, that’s just a worldwide trend comparing conventional mining, the mining method itself versus a trackless section for argument sake. In terms of mining, your exposure rate is much less. The amount of people that you operate is much less than what you’ll have in a typical conventional section. So obviously your safety exposure by comparing a trackless operation to a conventional operation is worlds apart.</p>	<p>From a safety point of view the safety exposure rate is much higher in a conventional mining method compared to the trackless section</p>	<p>The safety risk within a conventional mine is much higher compared to a mechanised mine.</p>	<p>The safety risk within a conventional mine is much higher compared to a mechanised mine.</p>	<p>Unattractive investment opportunity</p>	<p>Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>On the operational side, typical drivers within the mining industry talks about tons – tons mined, tons moved or run off mine tons. Talks about labour efficiencies and again, between trackless and conventional is worlds apart. Fewer people in a trackless section compare to a conventional section which obviously in terms of your output then your efficiency measures in terms of square metre per man, run off mine ton per man, ounces per man produced, are much higher.</p>	<p>From a productivity point of view fewer people are employed within a trackless section compared to a conventional section which obviously in terms of output efficiencies are much higher.</p>	<p>Fewer people are employed within a mechanised section compared to a conventional section that increases the output efficiency dramatically. .</p>	<p>Fewer people are employed within a mechanised section compared to a conventional section that increases the output efficiency dramatically. .</p>	<p>Lower output efficiency.</p>	<p>Output efficiency reduces when manual labour is compared to mechanised processes.</p>
<p>I think there has been a time in South Africa when labour was cheap. There has been a time in South Africa that there was so much labour available that you actually threw people to a project or a problem and you don’t feel the impact of the labour cost on the financial model at the end of the day. However, that has changed. As I mentioned earlier, on a typical conventional shaft you are running at labour cost of approximately 65 to 75% of your total bill.</p>	<p>There was a time in South Africa that labour was cheap and available that you actually threw people to a project or a problem with very little impact of the labour cost on the financial model. However, that has changed where a typical conventional shaft the labour cost is approximately 65% to 75% of your total bill.</p>	<p>Historically South Africa had an advantage of cheap labour that had a minor impact on the financial model. Currently labour cost on a typical conventional shaft is between 65% and 75% of the total bill.</p>	<p>Historically South Africa had an advantage of cheap labour that had a minor impact on the financial model. Currently labour cost on a typical conventional shaft is between 65% and 75% of the total bill.</p>	<p>Escalating wage bill.</p>	<p>Above inflationary wages have an adverse effect on financial viability labour intensive industries such as conventional mining.</p>
<p>Labour has become, and I said it’s your single biggest expenditure on a conventional mine and it demands for higher salaries, the demand for inefficiencies, the demand for 5-day work weeks and all of that become more evidence every year. As a lot of mining houses going into wage negotiations in the middle of the year. And you look at the demands that’s been set up front, you actually ask yourself the question, or you actually just rubber stamp it to say that if we’re going to continue the way we are continuing, we will not have a mining industry left in South Africa except those that are mechanised. I think organised labour is one of our biggest threats that we sit with.</p>	<p>Due to organised labour that continuously demand higher salaries and demand for labour inefficiencies such as 5 day work weeks we will not have a mining industry left in South Africa except those that are mechanised. Organised labour is one of the biggest threats within the industry.</p>	<p>Due to the above inflation salary increases and the demand for other labour inefficiencies such as a 5 day work week are putting the mining industry at a cross road in terms of financial viability.</p>	<p>Due to the above inflation salary increases and the demand for other labour inefficiencies such as a 5 day work week are putting the mining industry at a cross road in terms of financial viability.</p>	<p>Escalating wage bill. High cut-off grade.</p>	<p>Above inflationary wages have an adverse effect on financial viability labour intensive industries such as conventional mining. A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>The third point is the cost of mining. I mentioned that we’ve got platinum mines mining an excess of 2000 meters. We’ve got gold mines mining an excess of 4000 meters. Now, obviously your price of mining becomes enormous in that regard if you take into account support strategies and refrigeration strategies etc. I’m not a pessimist, I’m a realist that within the next 15 years we are going to sit with these areas with proper ore bodies underneath that will not be mined because we firstly don’t have the technology available to mine it and secondly mining at that current efficiencies that we’ve got or not, no one will invest money in an account that’s not going to show any return.</p>	<p>Despite the fact that within gold and platinum we have massive ore bodies, we will sterilise the majority of this minerals because the cost of mining it has become uneconomical and because we do not have the technology available to extract it more efficiently. This is not a lucrative industry to invest in as it is bound to show no return.</p>	<p>Despite the fact that South Africa has fast amounts of platinum and gold deposits still left the cost of mining has made it uneconomical. This is therefore not an attractive investment opportunity.</p>	<p>Despite the fact that South Africa has fast amounts of platinum and gold deposits still left the cost of mining has made it uneconomical. This is therefore not an attractive investment opportunity.</p>	<p>High cut-off grade. Unattractive investment opportunity.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves. Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>The point that you mentioned earlier, if you are a holder of a lease area and you have the mineral rights and your plan is to set up a mine, to set it up in a conventional method, would be suicidal...I think South Africa especially on the platinum side has got a lot of reserves that are untouched. And I’m specifically talking the Eastern limb areas which are great ore bodies. I mean it’s ore bodies which you can mechanise. It’s very simple mining methods. It’s safe, it is cheap, it’s effective. You can really move it.</p>	<p>If you are the holder of a lease area and want to create a new mine it would be absolutely suicidal if you plan to set up the mine with a conventional mineral extraction strategy. If you have ore bodies that you can mechanise it is a simple method that is safe, cheap and its effective.</p>	<p>Mechanisation is more efficient and safe than a conventional mining extraction strategy.</p>	<p>Mechanisation is more efficient and safe than a conventional mining extraction strategy.</p>	<p>Lower output efficiency. Unattractive investment opportunity.</p>	<p>Output efficiency reduces when manual labour is compared to mechanised processes. Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>In essence when you look at the conventional sort of thinking and methodology gets a labour intensive or highly labour intensive workforce, but it’s unfortunately not sustainable in the sense that you have to still make money</p>	<p>Due to external factors such as wage escalations the conventional methodology is not financially sustainable.</p>	<p>Due to external factors such as wage escalations the conventional methodology is not financially sustainable.</p>	<p>Due to external factors such as wage escalations the conventional methodology is not financially sustainable.</p>	<p>Escalating wage bill.</p>	<p>Above inflationary wages have an adverse effect on financial viability labour intensive industries such as conventional mining.</p>
<p>the fact is, as we are mining, where you can still mine currently today conventional, that resource you are depleting and the resource that’s left, you can actually not go and mine conventional. Even if you wanted to...it’s physically not possible to go and mine there. Not with the current methodologies that we employ conventionally. So, for me is we do not have a choice...it’s hot, it gets extremely hot. Even big 3-megawatt fridge plants can’t anymore make it suitable conditions at certain areas. Like I said, platinum is even getting to the stage where it’s going to be equivalent to what you have at deep level. So, it’s an imperative. It’s a humanitarian imperative</p>	<p>The fact is that the resource that can be mined conventionally today is depleting and the residual resource can not be mined conventionally even if you wanted to. It is physically not possible to go and mine there with the current methodologies that we employ conventionally. We simply do not have a choice. It gets extremely hot and megawatt fridge plants can't create suitable conditions anymore. It is a humanitarian imperative.</p>	<p>The resource that can be mined today is depleting and the residual resource can not be mined conventionally as it is physically impossible to go and mine there with the current methodologies. We can not create suitable conditions for the extraction of minerals using a conventional extraction strategy.</p>	<p>The resource that can be mined today is depleting and the residual resource can not be mined conventionally as it is physically impossible to go and mine there with the current methodologies. We can not create suitable conditions for the extraction of minerals using a conventional extraction strategy.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>We just had people that got killed at Khuseleka. Seismicity and all sorts of things. Those things are going to escalate. There’s a morality aspect even towards conventional mining. Are you prepared to leave people dead? Guess what? That is what’s going to happen.</p>	<p>Seismicity is going to escalate and rock burst are going to become a common occurrence. The moral aspect is that in such an event you are more than lightly going to be faced with hard decisions such as if you are going to be prepared to leave people dead underground?</p>	<p>Due to mining at depth seismicity and rock burst are going to become a common occurrence. The hard reality is that due to the safety imperative and moral obligation a point will be reached where we can not continue with mining conventionally in future.</p>	<p>Due to mining at depth seismicity and rock burst are going to become a common occurrence. The hard reality is that due to the safety imperative and moral obligation a point will be reached where we can not continue with mining conventionally in future.</p>	<p>Unattractive investment opportunity</p>	<p>Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>

<p>But to unleash your potential, you need to do something differently. I’m going back to what I consider modernisation to be, is I’m not saying that conventional mining you might have to have a modernised conventional approach. I’m not taking completely the methodology of conventional mining out of the picture. I’m saying it is a modernised approach to certain methodical and processes that you employ to extract what you need to extract.</p>	<p>In order to unleash the potential the South African mining industry got you need to do something different. This can not be merely a modernised conventional extraction strategy but rather taking the entire conventional methodology out of the picture and applying different mythological processes to extract what need to be extracted.</p>	<p>In order to unleash the potential of the South African mining industry you need radical transformation to merely a modernised conventional extraction strategy.</p>	<p>In order to unleash the potential of the South African mining industry you need radical transformation to merely a modernised conventional extraction strategy.</p>	<p>Inflexible methodology</p>	<p>Contrary to believe flexibility within a conventional methodology is practically very limited.</p>
<p>For me it boils down to, we’re a human body and we can operate with a human body in a certain condition. If we’re not going to operate in that certain condition, you need to find ways to enable you to operate in that certain condition. So, we know that with what we have left in the gold mining industry per say, is we have a resource that potentially can be extracted but it has very high heat, it has a big stresses ground conditions due to geological complexities that deal with that. And, associated with that, it is very confined and it is diminishing grades. Fairly lower grade. I think in a sense logistically more complexed to get, because you have to go deeper and deeper and deeper and you have to go in further and further and further to extract it</p>	<p>For a human to play a pivotal role in the ore extraction strategy you need to find ways to enable the human body to operate in that certain condition. In the current gold industry we need to extract ore in an environment associated with very high heat in a highly stressed areas in respect of ground conditions and geological complexities that is very confined with diminishing grades. Therefore it becomes more complex to execute this strategy.</p>	<p>For a human to play a pivotal role in the ore extraction strategy, conditions need to be created for humans to operate it in. In the current gold industry this environment is associated with high heat in a highly stressed area with geological complexities to execute this strategy.</p>	<p>For a human to play a pivotal role in the ore extraction strategy, conditions need to be created for humans to operate it in. In the current gold industry this environment is associated with high heat in a highly stressed area with geological complexities to execute this strategy.</p>	<p>High cut-off grade. Unattractive investment opportunity.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves. Due to the high health and safety risk to employees the required rate of return on increases above a realistic achievable point making it an unattractive investment opportunity.</p>
<p>Then you have aspects of, you know there’s for instance the environmental things like, call it carcinogenic that can be carcinogenic. There are environmental health considerations that also impacts on you as a human person. If you have to look at physical capability of humans, you cannot put a guy underground for two weeks, three weeks, four weeks or whatever the case might be and he doesn’t see the sun. There’s going to be health problems, there’s going to be social issues. We are by human nature designed to be in a certain way.</p>	<p>The environment could be carcinogenic and because the human body by nature is designed in a certain way it create limitations such as shift durations and environmental conditions that need to be suitable for the human body to operate in. Ore orebody by nature is not conducive to such environmental conditions and therefore you need to create such environment at a specific cost.</p>	<p>The human body by nature is designed in a certain way that creates limitations such as shift durations and environmental conditions that need to be suitable for the human body to operate in. Therefore you need to create such environment at a specific cost.</p>	<p>The human body by nature is designed in a certain way that creates limitations such as shift durations and environmental conditions that need to be suitable for the human body to operate in. Therefore you need to create such environment at a specific cost.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>
<p>from a productivity point of view, as we go deeper in variably our currently conventional labour force we become more inefficient and therefore makes a lot of our ore reserves obsolete...South African gold mines are extremely deep and progressively deeper which makes our day, our working day so much shorter...So the percentage of time that we spend travelling to the working place, and our employees travelling to the working place, is quite extensive meaning that the productive hours that’s available, is quite limited.</p>	<p>As we go deeper in variably our current conventional workforce become more inefficient and sterilise a lot of our ore reserves. South African gold mines are extremely deep and as we progress deeper the working day becomes so much shorter. With an increase in travelling time productive hours are limited.</p>	<p>As we go deeper the workforce in a conventional mine becomes more inefficient and a lot of our ore reserves are being sterilised. South African gold mines are extremely deep and as we go deeper the working day becomes so much shorter.</p>	<p>As we go deeper the workforce in a conventional mine becomes more inefficient and a lot of our ore reserves are being sterilised. South African gold mines are extremely deep and as we go deeper the working day becomes so much shorter.</p>	<p>High cut-off grade.</p>	<p>A conventional mining methodology requires specific conditions to extract the mineral that comes at a high cost. High Cut-off grades sterilise the majority of the remaining ore reserves.</p>

Meaning unit	Condensed meaning unit	Code	Sub-categories	Category	Theme/Main category
Especially, you know the fact that a lot of these operations now have changed hands like for example where you had Harmony, that’s a classical example, Harmony buys all the old Anglo mines, so mined at an Anglo standard would deem to be uneconomical. Suddenly you have a change of management, so the assets stay the same, the mining method stays the same, the people stay the same and now suddenly they can do it profitably. So what changed from when Anglo owned them to Harmony owned them? Suddenly you can turn uneconomical stuff into economical stuff. Because all the fixed portions stayed the same. It was the same resource, it was the same mining method per say, so what learnings can we take out of that to make the next step?	Because all the fixed portions stayed the same. It was the same resource, it was the same mining method per say, so what learnings can we take out of that to make the next step.	Learnings need to be taken form conventional modernisation attempts to be implemented elsewhere.	Learnings need to be taken form conventional modernisation attempts to be implemented elsewhere.	Modernisation success learnings	Modernisation of conventional mines that has been successful need to be well documented so that other industry role players can gain the knowledge of those successes
So platinum is different. We have with Zimbabwe but even excluding Zimbabwe, the bulk of the world’s reserves, resources and production. So, if using current methods, right, platinum mines are making a loss, then because we are the biggest supplier and a mine shut, the price should go up. Once platinum in the chain held by the companies, held by the traders, held by the fabricators like BASF, has been flushed out. In the longer term, platinum is very different. We could be price makers. If we had a platinum DTC, like diamonds have, diamond trading company and we sold through a single channel sites like they do, we could set the platinum price like De Beers does. You could virtually set it by withholding supply. And keeping the stable price, right? So, that’s why platinum is very different. Platinum, we can continue, we can non mechanise completely, we’d be okay. Some mines would shut now, but reopen later. They shut now, withdraw supply, price would go up and reopen.	Platinum is different in that South Africa could be the price makers. If we had a platinum trading company similar to diamonds and we sold through a single channel like diamonds do, the industry can set the price. Therefore with platinum we can continue with conventional mines and even non mechanise completely. If mines shut down due to being non economically viable would result in a withdrawal of supply and the price will go up. Hence mines will shut now but will reopen later.	If we could establish a Platinum trading company similar to what we have in diamonds price security and the fact that South Africa has the majority of the worlds resource could result in the platinum industry remaining conventional for years to come and even non-mechanise completely.	If we could establish a Platinum trading company similar to what we have in diamonds price security and the fact that South Africa has the majority of the worlds resource could result in the platinum industry remaining conventional for years to come and even non-mechanise completely.	Platinum trending company	With the establishment of mechanism such as a Platinum trading company to regulate the price of platinum, South Africa can non-mechanise all platinum operations and establish themselves as a major employer.
Well, we haven’t touched on health and safety. That’s a big thing, is take people out of harms way. As I’ve said, when I worked for NUM, that was, bugger the harm, give us danger pay. It’s all about paying. But these are alpha male men. Where mining is vary, you can get stats SA, I just did a study on it, if you want the figures. We have increased female, but it’s from like 8% to 16. And they’re nearly all on the surface. It’s a very male orientated job and males tend to be tough kind of thing. They are very proud of I remember being in Sheffield in the coal mine, and these guys, from crawling around on their knees they all lost their knee caps. And that was like a sign of a man, ja, that’s it. And who made the money? Was the coal company long gone? But they were laughing, at their machoism, I mean, you were a man if you’ve lost your knee caps from crawling around under those continues mining supports. There’s a bit of that. But either way, the State’s responsibility is not what the union wants; is for safe, decent work. And that’s a big advantage.	Consideration with regard to health and safety in a conventional mine is that the industry as historically dominated by men and putting themselves in harms way is a sign of manhood. Therefore health and safety is not really a focus point of unions and will be used to negotiate higher remuneration (danger pay) than attempting to eliminate the risk. The heath and safety narrative is a Government priority rather than a Union priority.	Consideration whit regard to the health and safety of employees in the industry is not really a focus point but rather seen as leverage to negotiate higher wages.	Consideration whit regard to the health and safety of employees in the industry is not really a focus point but rather seen as leverage to negotiate higher wages.	Health and Safety dilemma	The Health and Safety narrative is not necessarily a priority of all stakeholders but rather seen as providing leverage to negotiate higher salaries without an education prerequisite.
Production has all to do with costs and making a profit and safety is all about looking after the employees. And if you do both those things, then you actually have a better operation.	Whenever production improvements are implemented on a mine we need to consider two things. It all has to do with costs and making a profit and safety is all about looking after the employees.	Whenever modernisation is attempted on a mine the cost as well as safety of employees need to be a priority.	Whenever modernisation is attempted on a mine the cost as well as safety of employees need to be a priority.	Modernisation priorities	During the modernisation of mines priorities need to be established.

<p>The second component that we’ve come across, is the ability to get information in real time. Now real time is relative. So currently the way it works, and you would know this as well, is that the shift goes down, the shift boss goes down in a couple of hours later after the crew has been in. They wait for the operator to start-up operations, then the entry exam and then they go into the shaft and start mining. Then the shift boss comes in and the mine overseer comes in. What happens after that is that they write a report, then they do the logbooks, they go to surface, punch it into the computer and it follows the chain of command. So, from miner to shift boss to mine captain, section manager, production manager, mine manager then it has to filter all the way back down again. That process can take some time. But what if there is an immediate issue happening on the face? You can call for the rock engineer to come down and they come down with a cage later but that person also has to follow a process. I used to be a rock engineer in the mine, so you crawl underground and you make your examinations, your observations and your recommendations. You give instructions or recommendations to the crew on what they need to do, but you still need to formulise it. So, you get to surface, you write your report, you pass it to your boss and once again the chain of command. So, by the time it goes from the rock engineer office to the mine manager or production manager all the way back to the miner who has to implement it, it’s probably about a day and a half or two days. All happens in the underground environment. That face has moved forward if you take to blast 2 metres ahead of it. So, the conditions that you have observed at the time, are no longer there. It actually may be worse or better. You haven’t really dealt with the situation. Furthermore, if there is a loss of water pressure along the way so the guy doesn’t get a chance to drill. What does your mine captain say when you come up, did you blast? If you say no, you’re in trouble first before they say well, okay what was the reason? But if you as a shift boss know that there’s a water pressure drop at the shaft area itself, you can immediately start making changes to the system and then you can either correct it or you can make another plan to do something else. But we don’t have that capability right now.</p>	<p>Information in the current conventional mining process follows a time consuming process that delay the ability to make informed decisions within a ever changing environment. The capability to get real time information is not available right now and this need to be an action step.</p>	<p>Timeous information availability is key to the modernisation of current conventional operations.</p>	<p>Timeous information availability is key to the modernisation of current conventional operations.</p>	<p>Modernisation priorities</p>	<p>During the modernisation of mines priorities need to be established.</p>
<p>I think the future holds great opportunity that we can differentiate between juniors and majors. So, first thing is, which is not even probably part of your context we are speaking about. The industry needs to get a healthy junior market in place because there are huge amounts of opportunities in small ore bodies. Which are not been touched because of the fact that this has been a major based industry. Only majors, big companies have played a role. Why is that important? Because it’s, who starts off a small company? Who starts off mining in the backyard? There has to be entrepreneurs, there got to be people who are innovative, creative thinkers. Big firms are generally lethargic and not creative of anything. So, we have this innovation tense, but it generally never works for variety of reasons...This junior industry needs to start because within that creates a flair of entrepreneurship. Creates an impetus, a balance, a pulling and pushing of ideas...What I would like to exist, is the junior side of stuff. Which is purest intentional industrialisation, economic viability of mining small ore bodies. In a sincere fashion. Yes, it might not be all bells and whistles that the multinationals have, but there is such a big open space for that. That’s a big component. That’s a totally uncapped in our country. So that needs to be created and it will give jobs, it will do a whole lot of stuff and if you create enough of it, you could have two or three big mines worth of employment...So that’s an opportunity that’s totally uncapped from a labour jobs creation perspective and then another very important thing by their very nature they’re entrepreneurs. If you stop mixing them with the multinationals, their thinking starts influencing multinationals.</p>	<p>The future holds great opportunities if South Africa can differentiate between juniors and major mining corporations. The industry needs to get a healthy junior market as there are huge amounts of opportunities in small ore bodies which are not being touched because of the fact that this has been a major based industry where only big companies have played a role. There has to be entrepreneurs that are innovative and creative thinkers that is currently lacking with big corporations. The junior industry needs to start because within that creates a flair of entrepreneurship. It creates impetus, a balance and a pulling and pushing of ideas.</p>	<p>The future of South Africa may hold great opportunities if the industry can differentiate between junior and major miners. A health junior market holds large opportunities in accessing small orebodies. The introduction of the entrepreneurial spirit of junior miners could be the differentiating factor for the industry.</p>	<p>The future of South Africa may hold great opportunities if the industry can differentiate between junior and major miners. A health junior market holds large opportunities in accessing small orebodies. The introduction of the entrepreneurial spirit of junior miners could be the differentiating factor for the industry.</p>	<p>Junior miner introduction</p>	<p>By creating a junior miner market the introduction of entrepreneurial spirit within the existing market could be the differentiating factor.</p>
<p>But to think that you’re going to be able to absorb a continuous wage bill without doing things smarter and better and continuously improving, the game will end. That’s a logical conclusion. So, you’ve got to find other ways of doing things.</p>	<p>You need to do things smarter and better and continuously improve to be able to absorb a continuous wage bill. We need to find other way of doing things.</p>	<p>Continuous improvement is imperative within the modernisation paradigm.</p>	<p>Continuous improvement is imperative within the modernisation paradigm.</p>	<p>Modernisation priorities</p>	<p>During the modernisation of mines priorities need to be established.</p>

<p>The next generation employees, XYZ generations aren't going want to hang on the gat kant of a rock drill. That I can promise you. So, we got to respond and I think the modern generation will far easier see the benefits of mechanisation than somebody that's grown up on the end of a rock drill for 30 years. He doesn't want to change and he is holding on to that job. So, we're going to have to make sure that in that transitional process, we accommodate our hand-held guys. As I've said before, you know in this transition to mechanisation, there's going to be a 5-year period anyway. So, during this process, you're going to be able to keep your people in the industry. Natural nitratron will sort it out. The modern generation will come in and chip, off we go with the new kid that's remote control, joysticks and all that kind of crap. It will be a different game.</p>	<p>The next generation of employees are not going to find the current methodology of mining appealing and we got to respond and we got to realise that we are in a predicament that modern generations will far easier see the benefits of mechanisation than the old generation that does not necessarily want to change. There will be a transition period where we going to able to accommodate for your hand held guys as well as the modern generation that will have mechanised solutions in extracting the ore body.</p>	<p>There will be a transition period where the industry will accommodate for both conventional mines as well as the mechanised methodologies to extracting the orebody.</p>	<p>There will be a transition period where the industry will accommodate for both conventional mines as well as the mechanised methodologies to extracting the orebody.</p>	<p>Co-existence</p>	<p>During the transition period from old to new technologies there will be a transition period where both mechanised as well as conventional methodologies will co-exist.</p>
<p>If you start to look at South Africa, every mining house was an international mining house and the last couple of years we actually seen a swing in that. The nice thing is the proudly South African companies where the expertise of mining in South Africa really sit, have seen the opportunity and is picking up these as the big companies are getting rid of. And actually, is busy turning them around and I think the gold mining has got a very good example of that where they actually extended the life of big operations. 10 15 years beyond what the expectation of the big international player was. I really think that the proudly South African companies, and you can say Bafokeng Rasimone and you can talk about Sibanye on the platinum as well as on the gold side is really showing the world that we can take assets that international companies don't want anymore. And by applying the basics and optimising and doing what we are good at as South Africans, and actually extending life of those and with doing that, there is obviously a big benefit to our country. There is a big benefit to the community that surround us and I think lastly, we're fighting the big fight of unemployment together and that's really where you see the difference.</p>	<p>There is a trend where international mining houses is selling their marginal assets off to proudly South African companies where the expertise of mining in South Africa really sits. These new employers have proven that they can turn these marginal mines around and extend their life of mine up to 10 to 15 years beyond what was expected with big international players. By applying the basics, optimising and doing what we are good at as South African's we can actually extend the life of these assets that prove to be beneficial to the country as a whole.</p>	<p>Where major miners are relinquishing mining assets to junior miners could be the differentiating factor for the struggling mining sector.</p>	<p>Where major miners are relinquishing mining assets to junior miners could be the differentiating factor for the struggling mining sector.</p>	<p>Junior miner introduction</p>	<p>By creating a junior miner market the introduction of entrepreneurial spirit within the existing market could be the differentiating factor.</p>
<p>I think, we can still with the same amount of resources have a more modernised approach, not a mechanised approach. A little bit more of a modernised approach which can still employ the same amount of people and up skill the same amount of people and get a longer sustainable solution in place.</p>	<p>Without shedding jobs, conventional mines can to some extent be more modernised and upskill the workforce until such time that a long term sustainable solution are in place.</p>	<p>Conventional mines can to some extent modernise and upskill the workforce until such time that an alternative solution are in place.</p>	<p>Conventional mines can to some extent modernise and upskill the workforce until such time that an alternative solution are in place.</p>	<p>Co-existence</p>	<p>During the transition period from old to new technologies there will be a transition period where both mechanised as well as conventional methodologies will co-exist.</p>

To whom it may concern

14 November 2017

I hereby declare that I am a professional editor and have edited and proofread the following dissertation:

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By

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As a professional editor with an English major obtained from the University of Pretoria in 2003, I am also a Full Member of the Professional Editors' Guild and a member of SATI (membership number 1002503).

Yours sincerely



Mrs Lené Kraft