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Challenges and proposed solutions to the technical skills base within the mining industry

A research report submitted

by

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Abstract

Within the South African context, the mining industry is a major employer and a significant contributor to the economy. Production costs are ever increasing and for this industry to survive and remain financially viable, efficient technologies are continuously being explored and implemented to ensure the industries sustainability now and in the future. In order for this to be achieved, sufficient and competent technical skills, in the form of artisans, technicians and engineers are required. The mining industry is currently experiencing a shortage of these skills.

Twenty-one persons were interviewed, who are representative of three stakeholder groups: namely, regulatory bodies, educational institutions and mining companies to ascertain the challenges in terms of the technical skills and thereby, derive solutions for the industry. The data used to uncover the above was obtained using qualitative techniques applied to the three stakeholder groups.

This research presents the responses of those in-depth interviews from the various stakeholders obtained over several months of research. The challenges within the industry are disclosed and practical solutions presented to mitigate those challenges.

Keywords

- GCC - Government Certificate of competency, which is a certificate, issued by the Department of Minerals Resources (DMR) to engineers as a pre-requisite to perform certain functions in mines.
- MQA - Mining Qualifications authority.
- JIPSA - Joint Initiative in Priority Skills Acquisition.
- ALMP - Active Labour Market Policies.
- NCHE - National Commission on Higher education.

Declaration

I declare that this research project is my own work. The purpose hereof is in fulfilment for the degree of Masters of Business Administration GIBS (Gordon Institute of Business Science), University of Pretoria. This report has not been submitted for any degree and/or examination at any other tertiary institution before. I further declare that consent was awarded to me by the GIBS ethical committee to carry out this research.

Signature: _____

Rustum Norman

Date: 5 November 2010

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1. CHAPTER 1: Introduction to research problem

1.1 Illustration of problem

With the mining industry being a major employer (although a primary economic activity with agriculture) and a major contributor to the GDP within the South African context, the increased supply of technical skills, that is, artisans, technicians and engineers, to facilitate the envisaged growth by the South African government is key. In this regard, industry is constantly pursuing greater productivity targets through the introduction of new technologies, the use of production teams and multi-skilling and increased worker mobility (Dansereau, 2006).

Furthermore, the South African Government was presented in 2004 with the challenge of halving unemployment and poverty by 2014 (Government of South Africa, 2006).This was called the Accelerated and Shared Growth Initiative for South Africa (ASGISA).The feasibility of achieving this objective within the specified time was a result of the 3% average growth rate obtained from 1994 – 2004 and the expectation that this growth rate would continue to grow over the coming years.

In contradiction to what is required within the South African context, Lawless (2005, p.3) has stated, “Reduced industry demand, reduced numbers of

graduation, emigration, low rewards and engineering graduates being highly sought after by other economic sectors meant that personnel have left the market at a higher rate than those entering through tertiary institutions and immigration". In other words, supply of engineering professionals has not kept up with demand.

Furthermore, Lawless (2005, p.3) continues, "The trend is evident worldwide. In the developing world, lack of engineering capacity is hampering development". In support of the skills shortage, the consulting firm, Deloitte (Deloitte Consulting LLP, 2008), conducted a survey in which 54% of respondents cited shortage, motivation and retention of qualified talent as their top organisational challenge.

Furthermore, two reports indicating the need for an additional 1000 engineers and technologists / technicians and 7500 artisans per annum over the next four years were produced by the Joint Initiative for Priority Skills Acquisition (JIPSA) in support of ASGISA (National Business Initiative, 2006). In response to this, the National Business initiative (NBI) has facilitated a collaborative initiative called the Technical Skills Business Partnership (TSBP) (National Business Initiative, 2006).

The partnerships were initially composed of the following stakeholders:

- Sasol (Petrochemical industry);
- Arcelor Mittal (Manufacturing, steel and engineering industry);

- Transnet (State Owned Enterprise: Transportation);
- Eskom (State Owned Enterprise: Energy);
- Anglo Platinum, (Platinum mining); and
- Gold Fields (Gold mining).

The main focus of the partnerships was to develop gap-closing strategies and action plans to improve the participating companies' and their sector contribution towards alleviating the shortage in engineering and artisan skills in line with the JIPSA targets (National Business Initiative, 2006).

However, as can be seen from above, this initiative primarily focused on the demand of the labour market with little or no consideration for the supply (tertiary institutions) as well as the regulatory bodies. To date however, some of the above-mentioned stakeholders have withdrawn due to various reasons and the envisaged additional numbers of technical persons are yet to be realised.

As recent as March 2009, 30% of employers within the mining industry submitted reports to the Mining Qualifications Authority (MQA) indicating that they could not find suitable people to fill positions within their organisations. These were 137 / 456 organisations indicating a scarcity of skills. In terms of the actual number of and skills required within the industry, as well as the actual subsector (as in March 2009), refer overleaf to tables 1 and 2 respectively (Mining Qualifications Authority, 2010).

Table 1. Scarce skills according to occupational group: March 2009

Occupational Group	Number needed	% of total employment
Directors and corporate managers	121	0.02
Professionals	**371**	**0.07**
Technicians and Trades Workers	**357**	**0.06**
Community and Personal Service Workers	1	0.00
Clerical and Administrative Workers	13	0.00
Sales Workers	1	0.00
Machine Operators and Drivers	92	0.02
Elementary Workers	24	0.00
Total	980	0.18

Source: Mining Qualifications Authority (2010)

Table 2. Scarce skills according to subsectors: March 2009

Subsector	Number needed	% of total employment
Total	96	0.14
Gold mining	191	0.12
PGM mining	259	0.14
Diamond mining	98	0.82
Other mining	148	0.28
CLAS	113	0.35
Services Incidental to Mining	68	0.20
Diamond Processing	1	0.07
Jewellery Manufacturing	6	0.12
Total	980	0.18

Source: Mining Qualifications Authority (2010)

As can clearly be seen from the numbers above, professionals (engineers), technicians and trades workers (artisans) are by far the skills required (and in short supply) across all subsectors within the mining industry.

1.2 Purpose of study

Why was this problem selected?

As mentioned above, with mining being a major employer and contributing significantly to the South African economy, the appropriate understanding and mitigation of insufficient competent technical skills to this industry cannot be over-emphasized. According to Walwyn (2008), mining and quarrying contributed 3% to the total GDP of R1.386 × 10^{12} that is, R 4.156 × 10^{10} of South Africa's GDP in 2004.

With South Africa effectively having two economies, that is, primary and tertiary, employing both unskilled and highly skilled (knowledge worker) individuals, the importance of supplying and matching skills to required key positions is paramount to the success or failure of the business and hence the mining industry as a whole.

The purpose of the study is to identify the overall technical skills base within the South African mining industry in terms of the supply of technical talent (tertiary institutions), the demand of those skills (mining industry) and the regulatory bodies linking and coordinating the demand and supply side of the industry.

In terms of technical skills, this paper focuses on artisans, technicians and engineering graduates who have obtained or are in the process of obtaining the Government certificate of competency (GCC).

After the identification of the status quo, practical solutions in mitigating the identified challenges are proposed as a means of bridging the gap between the demand and supply within the industry.

2. CHAPTER 2: Literature review

2.1 Introduction

Three areas for discussion are addressed, namely: the labour market, stakeholder theory and co-operation versus competition for sustainability of the industry as a whole.

2.2 The labour market

According to Erasmus & Loedolff (2006, p.264), the labour market, although difficult to define, “concerns itself with aspects such as the supply and demand for labour (the functioning of the market), unemployment and inequality, labour absorption capacity (percentage of new entrants to the labour market who find a job in the formal sector), discrimination and employment equity, wages and productivity, influence of trade unions and globalization, to name but a few”.

Unpacking the above, almost a decade ago, Kochanski & Ledford (2001, p.32) stated, “Supply has not kept up with the demand for these professionals, and it will likely get worse as the baby boomers begin to retire”. How true this turned out to be as the skills gap (mentioned overleaf) is ever increasing.

It has been mentioned by Kraak (2008), that the availability of technically skilled labour has become a critical issue in South Africa. Furthermore, the JIPSA has stated that severe shortages of artisanal labour is imminent in key sectors of the economy, exacerbated by government's massive investment in improved social and economic infrastructure over the next five years.

Gordon (2009, p. 34) mentioned, "The dawning of a new industrial age, a period characterized by a growing need for highly skilled technical workers", is upon us. Furthermore, the education-to-employment system will have to be re-looked at as the current system has created an ever increasing skills gap. The urgency thereof is illustrated in the following statement by Gordon (2009, p. 34), "if ever there was a time to get serious about helping workers acquire the right skills, this is it". Furthermore, in light of the mismatch between graduates and job market, Gordon (2009, p. 35) says, "The United States and most other nations are not producing enough graduates with the kind of technical, communications and thinking skills needed in the twenty-first-century workplace".

Closer to home, within the South African context, Pauw, Oosthuizen & Westhuizen (2008, p.45) states, "There is a general consensus that unemployment is structural in the sense that there is a mismatch between the types of workers supplied and those demanded in the labour market. While unemployment among low-skilled labour market participants remains stubbornly high, a severe shortage of skilled workers exists".

The South African mining operations are still to a large extent very labour intensive, employing large numbers of unskilled labour, largely immigrants. In this regard, Trimikliniotis, Gordon & Zondo (2008, p.1324) stated, “Migration is no new subject for South Africa: what most persons would recall is the late 19th century migration when gold was discovered, whereby the combined effect of mining and industrialized centers’ attracted thousands of migrant workers from all over southern Africa”.

To facilitate the extraction of the gold, Alexander (2008, p.47) stated, “Without cheap, coal-derived power combined with low-cost labour, it would not have been possible to exploit the county’s deep-level gold reserves and without this there would have been no modernising revolution”. This low cost labour is currently still being supplied to the industry through a single agency, the Employment Bureau of Africa (TEBA), (Crush, Ulicki, Tseane, & Van Veuren, 2001).

To be globally competitive the industry has over the years begun to optimise its operations by introducing technology. In this regard, Bhorat (2000) alluded to an increase in the need for higher skilled workers within the current global context.

Furthermore, Kraak (2005, p.57) stated, “ The rise of the new global economy over the past two decades has meant that the attainment of comparative

advantage for individual nation states is now less reliant than earlier on low-cost cheap labour and cheap material inputs. Increasingly comparative advantage is achieved on the basis of high quality, high value-added export-orientated manufacturing and services". These required outcomes are only realised from sufficient persons with certain acquired skills.

There are three socio-economic forces driving the talent shortage (Gordon, 2009) namely:

- Global demographics, in line with what Guthridge, Komm & Lawson (2008) proclaimed. Worldwide there's a decline in birthrates and baby boomers retiring is on the increase, further exacerbating the situation;
- A cultural bias as depicted in terms of generational theory; and
- The skills gap.

Due to various contributing factors in South Africa, besides the three forces mentioned above, there seems to be a skills mismatch underpinning the concept of employability. Due to the dynamic world we live in, Houston (2005, p. 221) argues that, "Employability is increasingly being seen as necessary for individuals to ensure continuous life-time employment in the face of decreasing job security offered by firms".

In terms of the skills mismatch, Erasmus & Loedolff (2006, p.264) states, "It is argued that young people cannot find employment because they do not

possess the specialised skills required either by employers or for successful self-employment". Therefore, job creation has not matched the increase in labour due to this mismatch fuelling the unemployment rate within the South African context (Burger & Woolard, 2005).

Government regulation and policies shape the landscape in aligning the supply and demand of labour. In terms hereof, Erasmus & Loedolff (2006, p.266) states, "Training provided to the unemployed should form an integral part of active labour market policies (ALMPs).The links between the supply and demand of qualified labour can also be strengthened by ALMPs. A key policy initiative in making active measures more effective is to ensure a linkage between job placement, unemployment benefits and training".

Furthermore, in terms of Government regulation, Kruss (2004, p.675) states that, " the role for tertiary institutions, as laid out in the recommendations of the National Commission on Higher Education (NCHE) (1996) are three-fold namely:

- Human resource development: the mobilization of human talent and potential through lifelong learning to contribute to the social, economic, cultural, and intellectual life of a rapidly changing society;
- High level skills training: the training and provision of person power to strengthen this country's enterprises, services and infrastructure. This requires the development of professionals and knowledge workers with

globally equivalent skills, but who is socially responsible and conscious of their role in contributing to the national development effort and social transformation; and

- Production, acquisition and application of new knowledge: national growth and competitiveness is dependent on technological improvement and innovation, driven by a well organised, vibrant research and development system which integrates the research and training capacity of higher education with the needs of industry and social reconstruction".

In South Africa, the main problems within the labour market are: income inequality, unemployment, poverty and high labour costs (Erasmus & Loedolff, 2006).

Within the South African context, Intermediate skills (represented by shaded area in table 3 overleaf) are those qualifications below the Bachelor's degrees and above Grade 1-9 schooling (Kraak, 2008). Those are the pre-requisite qualifications required for artisans and technicians in the South African mining context.

Table 3. South Africa's National Qualifications Framework (NQF).

Education band	NQF level	Skill band	Qualification type
Higher education and training band	8		Doctorates
	7		Masters
	6	**High skills**	Bachelor's degrees
	5		University of Technology Certificates and Diplomas
Further education and training band (A combination of Senior and technical college provision) secondary schooling and technical college provision)	4	**Intermediate skills** (Post-school to pre-degree certificates and diplomas)	College Certificate N3 /Grade 12 schooling
	3		College Certificate N2 /Grade 11 schooling
	2		College Certificate N1 /Grade 10 schooling
General education and training band training band	1	**Entry-level skills** (nine years of compulsory schooling)	Grade 1- 9 schooling

Source: (Kraak, 2008)

In terms of graduate engineers, Lawless (2005, p.135) states, "A great deal of effort is required to develop sound training regimes which will stimulate young graduates and grow the capacity required. Few companies carry out structured work-place training any longer. Owing to pressure on profit margins and little capacity or time to train young staff, all wish for instantly trained or fast-tracked staff, that is, they want the product but are not prepared to take responsibility for the process. As a result job hopping and poaching of comprehensively trained staff are rife, especially among previously disadvantaged individuals (PDIs)".This statement can be applied across all engineering disciplines within the South African mining industry. To be appointed as an engineer within the South African mining context, following the attainment of the tertiary

qualification, the obtaining of the GCC is a pre-requisite. This in itself creates a constraint in that the pass rate of the GCC exam, written bi-annually is around 11%.

Kraak (2008, p. 198) argues, “There’s essentially two causal factors which have given rise to this incoherence in the labour market for technically skilled labour. These are, firstly, the demise of a structured labour market for apprenticeship and the technical professionals and para-professions since the mid -1980’s and secondly, the dual demands placed on the learnerships to meet both demand-led training from the needs of employers and supply-side training initiatives encouraged by government in support of unemployed youth”.

In terms of employment equity within the SA labour market, Fallon & Lucas (1998, p.15) states, “Despite the relaxation of apartheid in the 1980’s and 1990’s and its total abolition in1994, there are still substantial wage differential between the racial groups. On average, Whites earn over 5 times the African wage and almost 3 times that of other Black groups”. In light of the above, the labour market has not been representative of the population of South Africa; however, improvements in this regard are being made.

Building onto equity developments within the mining industry, Mohamed & Roberts (2008, p.30) stated, “The metals and engineering industries were central to the apartheid industrial development model. They have also been some of the first to face direct pressures for change”. The change mentioned

here is that of the Black economic empowerment (BEE) imposed by Government legislation on industries in the quest for employment equity.

In terms of the Unions influence within the South African mining industry, the major force especially amongst the non to semi-skilled employees is the National Union of mineworkers (NUM.) In this regard, Wood & Dibben (2008, p.671) has stated, “The issue of how to mobilize a wide range of union members through workplace democracy and collective action is significant for understanding contemporary industrial relations within the global context. In South Africa, this is particularly interesting given its political and economic history and relatively recent democratisation. The South African trade union movement represents a source of inspiration to organized labour worldwide, but has faced many challenges over the years”. The proper understanding of the Union and active engagement between management and the NUM representatives are paramount to the ongoing viability of the industry within the South African context.

In terms of the impact globalisation has had on labour within the industry, Grubb (2009, p.30) has stated, “The relative costs, productivity, supply, availability and demand for labour vary widely. Changes in the academic world have led to a steep decline in the supply of traditional metallurgists, partially offset by increased numbers of more broadly trained materials engineers”.

2.2.1 Structured labour market of yester-year

Kraak (2008, p. 200),argues that prior the 1994 democratic elections, “South Africa developed a highly structured and racially exclusive occupational labour market for artisans and technically trained para-professionals such as technicians and technologists. Key role players in these arrangements were the large mining and manufacturing employers and the large state-owned enterprises, the white trade unions, the white technical colleges and white learners. It was these institutions that produced large numbers of artisans for both their own needs, but also for those small firms reliant on poaching to meet their artisanal needs”.

Replacing this structured labour market approach, a global shift towards a vast and unstructured external market has grown. In this new context, labour markets are unregulated and flexible providing no guarantee in job placement (Kraak, 2008).

Unemployment within the South African market has therefore grown. In this regard, Banerjee, Galiani, Levinsohn, McLaren & Woolard (2008, p.716) has stated, “New entrants into the labour market tended to be relatively unskilled. At about the same time, the overall demand for labour leveled-off and in the mining and agricultural sectors, the demand for labour, especially less-skilled labour, fell”. Furthermore, Banerjee et al (2008, p.716) concludes by stating, “The employment share and real wages of high-skilled workers have increased

as industries shifted towards more skilled workers". This most definitely includes the mining industry as well.

Furthermore, Kraak (2008, p. 200) states, "Work placement becomes a matter of individual choice and not an institutional or structural arrangement as was the case for certain occupations in the past". With reference to table 4 below, the mining industry being a "price taker" and demand for the South African commodities set by over-seas markets, the South African mining houses are constantly trying to meet that demand with supply. This could be the explanation for the spikes in 1995 and 1997. However, the percentage change in new apprenticeship contracts between 1991 and 1999 was a decline of approximately 58%.

Table 4. New apprenticeship contracts, 1990–99.

Industry						**Percentage of change:**
	1995	**1996**	**1997**	**1998**	**1999**	**1991–99**
Mining	1644	840	1476	815	366	−58.41

Source, extracted from: (Kraak, 2008)

This feeds directly into the decline in the number of qualifying artisans from 13500 in 1985 to approximately 2500 in 2004. It is this drastic decline which constitutes a major crisis according to both government and business (Kraak,

2008).The knock-on effect of this is the lower number of artisans and hence technicians and engineers as traditionally, competent career-driven artisans proceeded through the ranks to become technicians and ultimately engineers.

2.2.2 Learnership approach

This approach was undertaken as a means to change from being supply-led (where colleges offered courses due to increase interest from students) to being demand-led (programmes closely aligned to employer's actual skill requirements).However, Kraak (2008, p. 209) argues, "Almost a decade later it is questionable whether such a pragmatic shift has taken place – from a supply to a demand-led system".

Furthermore, Kraak (2008, p. 212) states, "This problem of poor-quality education and training accentuates the crisis around the demise of structured labour markets. This double burden stands in sharp contrast to the labour market conditions which faced young white graduates in the 1970's – beneficiaries of both a good college education and a structured pathway into work".

2.3 Stakeholder theory

Phillips, Freeman & Wicks (2003, p.480) has defined this concept as follows, “Stakeholder theory is a theory of organizational management and ethics”. Furthermore, Phillips et al (2003, p.481) states, “Managing for stakeholders involves attention to more than simply maximizing shareholder wealth. Attention to the interests and well-being of those who can assist or hinder the achievement of the organization’s objectives is the central admonition of the theory. However, for stakeholder theory, attention to the interests and well-being of some non-shareholders is obligatory for more than the prudential and instrumental purposes of wealth maximization of equity shareholders”.

The necessity for this stakeholder interaction is highlighted by Strand (2008, p.25) statements as follows:

- “The very survival of the firm depended on the crucial task of the management in taking care of the stakeholder balance”;
- “Industry is increasingly recognizing the need for improved stakeholder engagement, seeing it as a means to reduce risks and increase opportunity”; and
- “Through increased stakeholder engagement and participation, the corporation can realise greater opportunity with increased global development”.

Building on the importance of stakeholder engagement and mindset change in business, Andriof, Waddock, Husted, Sutherland & Sheffield (2002, p.486) has stated, “The notion of partnerships across various governmental, social and economic sectors was a marked contrast from traditional outcomes of United Nations (UN) summits”.

In terms of building relationships and facilitating communication between stakeholders, Keown, Van Eerd & Irvin (2008) proposes a process called Knowledge Transfer and Exchange (KTE).There are certain steps involved before and after actively engaging with stakeholders. A useful tool in this regard is the stakeholder circle method proposed by Walker, Bourne & Shelley (2007). This approach involves five steps namely:

1. Identify stakeholders;
2. Prioritise stakeholders;
3. Visualise stakeholders;
4. Engage stakeholders; and
5. Monitor effectiveness of communication.

In terms of step 4, the application of stakeholder engagement, Brown & Flynn (2008, p.50) states, “Some mining companies have used stakeholder engagement with great success – expediting the ability to acquire permits,

entering communities and finding support and access to the local workforce. In addition, stakeholder engagement has been used by mining to mitigate negative social and environmental impacts of mining".

It is envisaged that effective transparent engagement between the three stakeholders identified below is required to mitigate the current shortage of critical technical skills.

2.3.1 Expectations of the three stakeholders about education and the labour market

1. Higher education

Kruss (2004) divides this into two elements, namely, Universities and Technikons, regarding the labour market. In terms hereof, Kruss (2004, p.678) states, "the two dominant models that have linked Universities with the labour market are:

- To teach people to think and explore the unknown, and
- Deferred employment pending professional education and training".

Furthermore, in terms of Technikons and the labour market, Kruss (2004, p.678) states, "Technikons were mandated to prepare graduates directly for employment".

2. Public sector (Regulatory bodies)

Kruss (2004, p.680) states, " the explicit claim was made that higher education institutions are responsible for ensuring that graduates are ready to operate as skilled employees in the workplace, rather than employers being required to invest in the requisite tacit knowledge, skills and dispositions".

3. Private sector (Mining companies)

Kruss (2004, p.682) states, "Private sector leaders espoused a direct link between higher education and the job-market, expecting higher education to directly prepare young people with skills to make them employable".

From the above it is clear that there's a misalignment in the expectations about education between the three stakeholders.

2.4 Co-operation vs. Competition for sustainability

Almost two decades ago, Hill, Hitt & Hoshisson (1992, p.501) stated, "Firms attempting to realise economies of scope need organizational arrangements that stress cooperation between business units. Firms attempting to realize economic benefits from efficient internal governance need organizational arrangements that stress competition between business units". In light of this paper one could view the different mines producing a commodity as the firms. Hence, the strategy of the players in the mining industry must be well understood.

Charlesworth (1996, p. 25) stated that, “Competition and co-operation are major features of social interaction. Human beings are inherently competitive by their very nature”. In this regard, a mind-set change is required as Charlesworth (1996, p. 28) has stated, “Acquiring the ability to engage in such co-operation constitutes a major developmental task which children must learn in order to compete successfully against others for resources without alienating them”.

Hannah & Walsh (2004, p. 29) has stated, “A competitive firm evolves with advances in knowledge and technology, developing new products and / or services for the market”. As one can deduce from this statement, this is not easy to achieve within the mining industry as competitors produce the same product / commodity, that is, gold, platinum, diamonds, coal etcetera. Therefore, the challenge is not on differentiation and alternative products but rather on reducing the cost per ton.

Water and electricity, being the two primary requirements for any mining operation, are in serious short supply in the South African mining context. Eskom, being the sole supplier of electricity in South Africa will be escalating the electricity rates astronomically over the next three years. In support hereof, Hansen (2000, p.342) states, “Eskom currently controls a near monopoly of generation and transmission with more than 95 percent of market share, 98 percent of generating capacity and virtually 100 percent of transmission

assets". The result thereof to the mining industry as a whole is increased operational costs for no increase in production. Therefore, a different approach (co-operation instead of the traditional competition) is required in terms of the sustainability of the industry as a whole.

Malcolm & Colin (2008) proposes that engineering educators collaborates with employers in an effort to develop the appropriate competencies required by engineers in this ever changing world.

There are several reasons as to why co-operative arrangements have been avoided in the past (Hannah et al, 2004) namely:

- Lack of trust;
- Mismatch of resources or learning;
- Inappropriate organizational structures or processes; and
- Inability to manage complexity.

However, to mitigate these challenges (Hannah et al, 2004) proposes the following requiring an industry mind-set change:

- Commitment by all parties due to the compelling business need each party has for the mutual benefits;

- The elimination of competition from within the alliances in the value chain relationship;
- Each co-operative arrangement to have a clear purpose with definite limits on the parameters of the relationship; and
- Ensure all arrangements are secured by some form of monetary assurance.

In so doing, the viability and sustainability of the entire industry can be realised and achieved.

2.5 Conclusion

In terms of the labour market, the literature has pointed out that due to globalisation, the elimination of the structured labour market of the “old” South Africa replaced by the learnership approach, there is a general consensus that the supply of technical persons possessing certain competencies within the engineering discipline are in short supply.

Furthermore, there is evidence that the expectations on who is responsible to educate these persons in terms of acquiring those specific skills vary amongst the three stakeholders. In terms of the demand-side, some organisations are committed to training and development while others adopt an “identify and poach” strategy.

There is evidence from the literature that stakeholders acknowledge the benefits of co-operation and engagement in mitigating these challenges. However, resistance to change seems to be the major inhibiter in exploring this option.

There has been acknowledgement by the various stakeholders in the past as to their specific challenges in terms of the skills shortage. However, to date an all-inclusive approach in addressing the challenges have not been presented. This research aims to do just that in presenting empirical evidence of the challenges and proposing solutions presented by the entire industry to the benefit of all stakeholders concerned.

3. CHAPTER 3: Research Questions

From the themes in the literature review, the following three research questions were developed:

3.1 Question 1

What are the solutions to the insufficient supply of competent technical skills within the South African mining industry?

This question seeks to address the mismatch in supply and demand of the technical skills dilemma in the market.

3.2 Question 2

What is contributing to the lack of readiness in the workplace in terms of artisans, graduate technicians and engineers within the South African mining industry?

This question seeks to uncover factors leading to the gap between what the individual can offer and the industries wants and needs.

3.3 Question 3

To what extent can co-operation instead of the current competition amongst the various stakeholders mitigate the shortage of technical skills within the South African mining industry?

This question aims to take a different approach in addressing the technical skills problem as the approaches of yester-year is not working in today's globalised world.

4. CHAPTER 4: Research Methodology

4.1 Research method and design

The approach to this research was qualitative as it sought to explore and gain a deep insight into the root causes / challenges and hence propose solutions pertaining to the technical skills gap in supply and demand within the South African Mining Industry. This is in line with Zikmund's (2003) explanation as to the purpose of exploratory research being the need for a clear and precise statement of the recognised problem.

4.2 Population

In order to gain a deep insight into answering the three main research questions, in-depth interviews were conducted with key individual's representative of all stakeholders impacting the South African Mining Industry namely:

1. Regulatory bodies:

- DMR (Department of Minerals Resources);
- MQA (Mining Qualifications Authority) being the respective SETA (Skills education training authority);

- ECSA (Engineering council of South Africa);
- AMRE (Association of mine resident engineers); and
- NBI (National Business Initiative).

2. Tertiary educational institutions (Supply side):

- Further education and training (FET) colleges;
- University of Technologies; and
- Universities.

3. Mining companies (Demand side):

The population of relevance for this specific study entailed three entities namely:

- Representatives from the DMR, MQA, ECSA, NBI and AMRE;
- Representatives from the FET's, University of Technologies and Universities; and
- Management within the following disciplines; Mining, Engineering and / or training and development within that specific mining organisation.

The specific unit of analysis was the perception of stakeholders regarding the challenges and hence the proposed solutions pertaining the technical talent within the South African Mining Industry.

4.3 Sampling

A non-probability judgment sample was employed (Zikmund, 2003). The respondents of the interviews were selected to fulfill the purpose of the research and were experts (with relevant experience) in their respective fields (Zikmund, 2003).The non-probability snowball technique (Zikmund, 2003) was applied to the respondent at that time of interview to disclose any additional information.

Given the nature of this study a total sample size of twenty-one experts was secured as follows:

1. Regulatory bodies – 6 representatives in total, as follows:

- DMR (Department of Minerals Resources) – 1 representative;
- MQA (Mining Qualifications Authority) being the respective SETA (Skills education training authority) – 1 representative;
- ECSA (Engineering council of South Africa) – 1 representative;
- AMRE (Association of mine resident engineers) – 2 representatives; and
- NBI (National Business Initiative) – 1 representative.

2. Tertiary educational institutions (Supply side) – 6 representatives in total, as follows:

- Further education and training (FET) colleges – 2 representatives;
- University of Technologies – 2 representatives; and
- Universities – 2 representatives.

3. Mining companies (Demand side) – 9 representatives in total, as follows:

- Gold company – 6 representatives;
- Platinum company – 1 representative;
- Coal company – 1 representative; and
- Diamond company – 1 representative.

An inclusive sample of this nature sought to gather a holistic understanding of the issues within the South African Mining industry and embarked on resolving them accordingly.

4.4 Data collection

This was achieved by in-depth expert interviews (as per appendix 1, interview schedule). The list of and sequence of interviews were conducted as per appendix 2. In terms of this research paper, data collection unfolded as follows:

4.4.1 Method

Primary data was obtained from in-depth expert interviews. The interviews were structured in such a way for the respondent to speak freely and openly for maximum benefit to the researcher. The confidentiality of the process was emphasized and explained. In this regard, the actual name of the individual and company has not been disclosed in the final research paper. Furthermore, prior to the interview, an informed consent letter (see appendix 1) was signed and dated by the participant and researcher. In so doing, it was envisaged that the respondents openly disclosed in-depth knowledge regarding the research questions as per the abovementioned appendix, that is, Interview schedule. This was achieved by conducting the interviews at the respondents' place of convenience.

Zikmund (2003, p.199) states the following, “The face-to-face interaction between interviewer and respondent has several characteristics that help researchers obtain complete and precise information”, namely:

- The opportunity for feedback;
- Probing complex answers;
- Length of interview can be controlled more accurately;
- Props and visual aids; and
- High participation.

In this regard, the desired outcome of the research was very likely to be realised.

4.4.2 Interview schedule design

The design of the interview was structured around the various themes identified by the three research questions. After putting a draft interview schedule together, my supervisor was contacted for input and after much refinement the interview schedule was finalised as per appendix 1.

Thereafter, companies, tertiary institutions and regulatory bodies within a 150 kilometer radius of Johannesburg were identified as potential targets in terms of the research. Making use of professional networks, key individuals were

contacted within those companies, tertiary institutions and regulatory bodies telephonically and / or via e-mail to schedule the 1 hour interview. Simultaneously, names and contact numbers were obtained of key individuals who could add value to the research from those persons. The positive respondents were scheduled accordingly as per appendix 2.

The following steps were applied during the actual interview process per organisation:

1. Introduction (at least 5 minutes), that is, the purpose hereof was for both researcher and respondent to relax by getting to know each other and encourage open and honest interaction.

2. Explanation, that is, the purpose hereof was for researcher to explain the aim of research and to ensure confidentiality of any disclosed information. An important activity during this time was the signing of the consent letter.

3. Questioning, that is, researcher questioned the respondents' as per interview schedule (see appendix 1).

Following the first interview, continuous engagement between mentor and researcher in terms of the quality as well as quantity of information occurred

before commencing with the rest of the interviews. The first interview was therefore used as a pilot interview in this regard.

4.5 Data analysis

Mouton (2009, p.108) states that, “Ultimately all fieldwork culminates in the analysis and interpretation of some set of data, be it quantitative survey data, experimental recordings, historical and literary texts, qualitative transcripts or discursive data. Analysis involves breaking up the data into manageable themes, patterns, trends and relationships. The aim of analysis is to understand the various constitutive elements of one’s data through an inspection of the relationships between concepts, constructs or variables, and to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data”.

Furthermore, Mouton (2009, p.109) states, “One interprets (and explains) observations or data by formulating hypothesis or theories that account for observed patterns and trends in the data. Interpretation means relating ones results and findings to existing theoretical frameworks or models, and showing whether these are supported or falsified by the new interpretation”.

Therefore, as one can see, the actual analysis was an interactive process where one substantiated ones conclusions in terms of existing information. In

this regard, Mouton (2009, p.109) concludes with, “Interpretation also means taking into account rival expectations or interpretations of one’s data and showing what levels of support the data provide for the preferred interpretations”.

In terms of this actual analysis, data obtained and plotted in the tables in Chapter 6 was compared with the literature in Chapters 1 and 2. The similarities and / or differences were then discussed, interpreted and conclusions deduced.

4.6 Research limitations

Due to time as well as accessibility constraints, as depicted in section 4.4.2, only respondents within a 150 kilometer radius were chosen. Therefore, not all key companies, tertiary institutions and regulatory bodies could be targeted.

During certain interviews, although prior scheduling, interviews were rushed due to unforeseen circumstances. This resulted in the quality of the data obtained not meeting the expectations of researcher. Due to the caliber of persons interviewed, a re-schedule was virtually impossible.

5. CHAPTER 5: Results

In addressing the three research questions derived at in Chapter 3, the following tables (in response to the interview schedule, that is, appendix 1) were compiled from the 21 interviews conducted. Of the 21 interviews, 6 were from the regulatory bodies, 6 interviews were from the tertiary educational institutions and a total of 9 interviews from the mining companies. In all the tables presented, the hash symbol (#) depicts “number”.

5.1 What are solutions to the insufficient supply of competent technical skills within the South African mining industry?

The approach undertaken in response to the first research question was to firstly assess the perception in the market regarding the supply of competent technical skills before commencing with the in-depth questioning. The number of responses was plotted on a 5 point Likert scale.

Table 5. Complete sample’s response to question: Do you agree there’s a critical shortage in supply of competent technical skills in the mining industry?

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans			1	5	15
Technicians		1		6	14
Engineers		1	2	2	14

Table 6. Regulatory bodies' response regarding the critical supply shortage in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans					6
Technicians		1			5
Engineers				1	5

Table 7. Tertiary educational institutions' response regarding the critical supply shortage in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans			1		5
Technicians				2	4
Engineers		1	1		4

Table 8. Mining companies' response regarding the critical supply shortage in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans				3	4
Technicians				2	5
Engineers			1	1	5

Question 1.1 from the interview schedule was an open ended question which focused on ascertaining practical solutions from the industry, and allowed respondents to elaborate on their answers to the question: *"What practical solutions do you propose in mitigating the current supply shortage"?* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented in the rank order table below:

Table 9. Ranked order table regarding the practical solutions in mitigating the supply shortage

Practical solutions proposed in mitigating the current supply shortage?					
Ranking	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies	Total responses
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	3	1	2	6
2	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.	1	2	2	5
3	Government incentives to be more attractive to facilitate training by the mines.	2		2	4
3	More apprentices and bursars to be employed.			4	4
3	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	2	2		4
3	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.	1	3		4
4	Ensure feedstock of artisans by maintaining a ratio for example 1:4 i.e. 1 apprentice: 4 artisans.	1		2	3
4	Promote persons up the corporate ladder due to their competence and not as a result of BEE to ensure the persons can deliver the results at that level.		1	2	3

5	Companies to target individuals with potential and direct on specific career paths.	1		1	2
5	Recruitment of technical skills from abroad.	1		1	2
5	The quality of the teachers/ training facilitators to be addressed to improve the standard of the training providers.	1	1		2
6	Re-classification of work pertaining to artisans, technicians and engineers.			1	1
6	FET colleges to have accredited workshops to hone certain skills i.e. electrical, fitter and turner ect.		1		1
6	Market related salaries to be paid to retain skills.			1	1

From the table above, the top three themes per stakeholder group were:

Table 10. Regulatory bodies' top three responses

Practical solutions proposed in mitigating the current supply shortage		
#	**Stakeholder 1: Regulatory bodies**	**Total responses**
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	3
2	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	2
3	Government incentives to be more attractive to facilitate training by the mines.	2

Table 11. Tertiary educational institutions' top three responses

Practical solutions proposed in mitigating the current supply shortage		
#	**Stakeholder 2: Tertiary educational institutions**	**Total responses**
1	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.	3
2	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	2
3	Experienced persons must be incentivised to impart their knowledge to the younger generation.	2

Table 12. Mining companies' top three responses

Practical solutions proposed in mitigating the current supply shortage		
#	**Stakeholder 3: Mining companies**	**Total responses**
1	More apprentices and bursarers to be employed.	4
2	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	2
3	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching / mentoring.	2

Question 1.2 from the interview schedule was an open ended question which focused on ascertaining from the industry whether or not their proposed solutions has worked elsewhere before, and allowed respondents to elaborate on their answers to the question: "*Has it worked anywhere else locally and/or internationally before"?* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented as per legend and depicted in table overleaf:

Table 13. All stakeholder groups' responses

Legend	1 = seldom	2-3 = somewhat	4+ = most definitely

Has proposed solutions worked anywhere else locally and/or internationally before?				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	Most definitely	Seldom	Somewhat
2	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.	Seldom	Somewhat	Somewhat
3	Government incentives to be more attractive to facilitate training by the mines.	Somewhat		Somewhat
4	More apprentices and bursars to be employed.			Most definitely
5	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	Seldom	Seldom	
6	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.	Seldom	Most definitely	
7	Ensure feedstock of artisans by maintaining a ratio for example 1:4 i.e. 1 apprentice: 4 artisans.	Seldom		Somewhat
8	Promote persons up the corporate ladder due to their competence and not as a result of BEE to ensure the persons can deliver the results at that level.		Seldom	Somewhat
9	Companies to target individuals with potential and direct on specific career paths.	Seldom		Seldom
10	Recruitment of technical skills from abroad.	Seldom		Seldom

11	The quality of the teachers/ training facilitators to be addressed to improve the standard of the training providers.	Seldom	Seldom	
12	Re-classification of work pertaining to artisans, technicians and engineers.			Seldom
13	FET colleges to have accredited workshops to hone certain skills i.e. electrical, fitter and turner etcetera.		Seldom	
14	Market related salaries to be paid to retain skills.			Seldom

From the table above, the top three themes per stakeholder group were:

Table 14. Regulatory bodies' responses

Has proposed solutions worked anywhere else locally and/or internationally before?		
#	**Stakeholder 1: Regulatory bodies**	**Total responses**
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	Most definitely
2	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	Somewhat
3	Government incentives to be more attractive to facilitate training by the mines.	Somewhat

Table 15. Tertiary educational institutions' responses

Has proposed solutions worked anywhere else locally and/or internationally before?		
#	**Stakeholder 2: Tertiary educational institutions**	**Total responses**
1	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.	Most definitely
2	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	Somewhat

3	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.	Somewhat

Table 16. Mining companies' responses

Has proposed solutions worked anywhere else locally and/or internationally before?		
#	**Stakeholder 3: Mining companies**	**Total responses**
1	More apprentices and bursarers to be employed.	Most definitely
2	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	Somewhat
3	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.	Somewhat

Question 1.3 from the interview schedule was an open ended question which focused on the industry providing evidence in terms of whether or not their proposed solutions has worked elsewhere before, and allowed respondents to elaborate on their answers to the question: "*What evidence do you have to support your view"?* The answers given were then plotted per stakeholder in table overleaf:

Table 17. All stakeholder groups' responses

Evidence to support views?				
#	**Constructs**	Stakeholder 1: Regulatory Bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.		Up until now the minimum theoretical requirement for an artisan is N2 and not NCV2 which indicates the DOL and DOE is operating in silos creating confusion in the industry.	
2	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.	Poor pass rates with the GCC exams.		Poor quality of technical persons at the mines.
3	Government incentives to be more attractive to facilitate training by the mines.	Companies only train as and when required.		
4	More sustainable number of apprentices and bursars to be employed.			Companies only train as and when required leading to no trainees being signed on during certain years.

5	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.	Dismal matriculants pass rates.	No sense of clear direction in terms of curriculum which the DOE wants to go.	Dismal matriculants pass rates.
6	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.	The N courses worked well in the previous Government regime in that it aligned itself well with industry expectations and was thereby recognised.	Companies unfamiliar with the quality and applicability of NCV (National certificate vocational) as opposed to the N6 technical certificate.	The N courses worked well in the previous Government regime in that it aligned itself well with industry expectations and was thereby recognised.
7	Ensure feedstock of artisans by maintaining a ratio for example 1:4 i.e. 1 apprentice: 4 artisans.			Increased turnover rates.
8	Promote persons up the corporate ladder due to their competence and not as a result of BEE to ensure the persons can deliver the results at that level.	Increased turnover rates especially amongst BEE candidates.		Increased turnover rates especially amongst BEE candidates.
9	Companies to target individuals with potential and direct on specific career paths.			Frustration builds up with motivated, career-driven orientated individuals with no specific career path leading to unhappiness and

				ultimately resignation.
10	Recruitment of technical skills from abroad.			Increased foreigners in terms of technical talent.
11	The quality of the teachers/ training facilitators to be addressed to improve the standard of the training providers.		Facilitators themselves are incompetent.	Limited practical exposure after receiving the FET qualification.
12	Re-classification of work pertaining to artisans, technicians and engineers.			Overlap of expectations from the 3 engineering categories.
13	FET colleges to have accredited workshops to hone certain skills i.e. electrical, fitter and turner ect.	Limited practical exposure after receiving the FET qualification.	Limited practical exposure after receiving the FET qualification.	Limited practical exposure after receiving the FET qualification.
14	Market related salaries to be paid to retain skills.			Increased turnover rates as a result of better offers.

Question 1.4 from the interview schedule was an open ended question which focused on the industry giving reasons as to why their proposed solutions have not been implemented yet, and allowed respondents to elaborate on their answers to the question: "*Why has it not been proposed / implemented as yet"?* The answers given were then plotted per stakeholder in table below:

Table 18. All stakeholder groups' responses

Why has not been implemented as yet?				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	More collaboration and consistency between Government, FETcolleges, Universities of technology, Universities and employers required.	Political bureaucracy and red-tape.		
2	Experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring.			Reactive instead of pro-active environment.
3	Government incentives to be more attractive to facilitate training by the mines.	Due to financial constraints.		Government believes training to be done by companies.
4	More apprentices and bursars to be employed.			Due to financial constraints.
5	Quality of secondary schooling to improve to facilitate better Mathematics and Science results.		No clear direction in terms of curriculum at schooling.	

6	Re-instatement of the N course programme which was successful in terms of churning quality artisans under the previous Government regime.		Currently being re-instated due to increased demand and industry recognition.	
7	Ensure feedstock of artisans by maintaining a ratio for example 1:4, that is, 1 apprentice: 4 artisans.			Companies only train as and when required.
8	Promote persons up the corporate ladder due to their competence and not as a result of BEE to ensure the persons can deliver the results at that level.			Due to political / legislative pressures, companies forced to fill vacancies with specific candidates.
9	Companies to target individuals with potential and direct on specific career paths.			Good performers are often left in positions as they performing their required duties better than expected.
10	Recruitment of technical skills from abroad.	Due to financial constraints.		Short term not a sustainable solution.
11	The quality of the teachers/ training facilitators to be addressed to improve the standard of the training providers.	Due to lack of focus.	Due to financial constraints.	
12	Re-classification of work pertaining to artisans, technicians and engineers.			Companies became too fixated on qualification instead of a specific skill set.
13	FET colleges to have accredited workshops to hone certain skills i.e. electrical, fitter and turner ect.			

14	Market related salaries to be paid to retain skills.			

5.2 What is contributing to the lack of readiness in the workplace in terms of artisans, graduate technicians and engineers within the South African mining industry?

The approach undertaken in response to the second research question was to firstly access the perception in the market regarding the lack of readiness in the workplace of the technical skills before commencing with the in-depth questioning. The number of responses were plotted on a 5 point Likert scale.

Table 19. Complete samples response to question: Do you agree there's a lack of readiness for the workplace in terms of artisans, graduate technicians and engineers in the mining industry?

					
	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans		1	4	9	7
Technicians		1	2	8	10
Engineers			4	7	10

Table 20. Regulatory bodies' response regarding the lack of readiness in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans			1	4	1
Technicians			1	4	1
Engineers			2	3	1

Table 21. Tertiary educational institutions' response regarding the lack of readiness in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans			3		3
Technicians			1	2	3
Engineers			1	1	4

Table 22. Mining companies' response regarding the lack of readiness in terms of technical skills

	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans		1		4	3
Technicians		1		2	5
Engineers			1	3	4

Question 2.1 from the interview schedule was an open ended question which focused on ascertaining contributing factors from the industry, and allowed respondents to elaborate on their answers to the question: *"What is contributing to the lack of readiness in the workplace in terms of artisans, graduate technicians and engineers in the mining industry?"* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented in the rank order table below:

Table 23. Ranked order table regarding the contributing factors to lack of readiness

Contributing factors to lack of readiness in the workplace in terms of artisans, graduate technicians and engineers?					
Ranking	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies	Total responses
1	Insufficient / Inappropriate practical exposure for students and graduates.	1	2	5	8
2	Persons from rural background entering the industry and not adjusting to culture.	2	1	1	4
2	Graduates want to be placed in management positions almost immediately without spending the required time at various levels.			4	4
3	Lack of role models / mentors within the industry.	1	1	1	3
3	Companies not giving employees the time to be trained, due to job demands.	2		1	3

3	Governments failed intervention by "fast tracking" training e.g. section 28 artisans.	2		1	3
3	Secondary schooling system failure in equipping matriculants with the necessary qualities.	1	1	1	3
4	Insufficient capacity with current training institutions.	1		1	2
4	Working at a company other than where practical exposure obtained.		2		2
4	Disconnect between industry and the tertiary institutions.		2		2
5	The lack of and/or poor quality of teachers within any practical exposure themselves.		1		1
5	Poor attitude of graduates in that they want / expect to be spoon-fed.	1			1
5	Governments attempt at pushing numbers and not quality of graduates especially at the FET colleges.	1			1

From the table above, the top three themes per stakeholder group were:

Table 24. Regulatory bodies' top three responses

Contributing factors to lack of readiness in the workplace in terms of artisans, graduate technicians and engineers		
#	**Stakeholder 1: Regulatory bodies**	**Total responses**
1	Persons from rural background entering the industry and not adjusting to culture.	2
2	Companies not giving employees the time to be trained, due to job demands.	2
3	Governments failed intervention by "fast tracking" training e.g. section 28 artisans.	2

Table 25. Tertiary educational institutions' top three responses

Contributing factors to lack of readiness in the workplace in terms of artisans, graduate technicians and engineers		
#	**Stakeholder 2: Tertiary educational institutions**	**Total responses**
1	Insufficient / Inappropriate practical exposure for students and graduates.	2
2	Working at a company other than where practical exposure obtained.	2
3	Disconnect between industry and the tertiary institutions.	2

Table 26. Mining companies' top three responses

Contributing factors to lack of readiness in the workplace in terms of artisans, graduate technicians and engineers		
#	**Stakeholder 3: Mining companies**	**Total responses**
1	Insufficient / Inappropriate practical exposure for students and graduates.	5
2	Graduates want to be placed in management positions almost immediately without spending the required time at various levels.	4
3	Persons from rural background entering the industry and not adjusting to culture.	1

Question 2.2 from the interview schedule was an open ended question which focused on ascertaining from the industry specific perceptions in terms of what the technical talent lacks in the workplace, and allowed respondents to elaborate on their answers to the question: "*What specifically does the technical talent lack in terms of readiness?"* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented in table overleaf:

Table 27. Ranked order table regarding the specifics in what the technical talent lacks

Specifics in terms of what the technical talent lacks					
Ranking	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies	Total responses
1	Exposure to specific machinery within the mining industry.	2	1	5	8
1	Practical understanding and application of theoretical concepts.	2	2	3	7
2	Practical exposure and/or experience.	3	3	1	7
3	Exposure to the mining industry from schooling level.			4	4
3	Enough time on proper training courses			4	4
3	Life skills and understanding oneself strengths and weaknesses.		3	1	4
3	Coaching, supervision and mentoring on the job.	1	2	1	4
4	Safety, health and environmental management concepts.			1	1
4	Managerial, supervision and HR skills.			1	1
4	How a business operates, the big picture.	1			1
4	Patience to hone technical expertise in a position before climbing the ladder.	1			1
4	Self-confidence.		1		1
4	Work ethic.		1		1

From the table above, the top three themes per stakeholder group were:

Table 28. Regulatory bodies' top three responses

Specifics in terms of what the technical talent lacks		
#	**Stakeholder 1: Regulatory bodies**	**Total responses**
1	Practical exposure and/or experience.	3
2	Practical understanding and application of theoretical concepts.	2
3	Exposure to specific machinery within the mining industry.	2

Table 29. Tertiary educational institutions' top three responses

Specifics in terms of what the technical talent lacks		
#	**Stakeholder 2: Tertiary educational institutions**	**Total responses**
1	Life skills and understanding oneself strengths and weaknesses.	3
2	Practical exposure and/or experience.	3
3	Practical understanding and application of theoretical concepts.	2

Table 30. Mining companies' top three responses

Specifics in terms of what the technical talent lacks		
#	**Stakeholder 3: Mining companies**	**Total responses**
1	Exposure to specific machinery within the mining industry.	5
2	Exposure to the mining industry from schooling level.	4
3	Enough time on proper training courses.	4

Question 2.3 from the interview schedule was an open ended question which focused on the industry providing evidence in support of their view, and allowed respondents to elaborate on their answers to the question: "*What evidence do you have to support your view?"* The answers given were then plotted per stakeholder in table below:

Table 31. Responses by all stakeholders

Evidence to support views				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	Practical understanding and application of theoretical concepts.	Poor pass rate of GCC exam.	General observations.	Increased MTTR (mean time to repair.
2	Exposure to specific machinery within the mining industry.		Negative feedback from industry as to quality of persons.	1. The limited number of GCC persons in the industry. 2. Negative feedback from industry as to quality of persons.
3	Practical exposure and/or experience.	Increased number, frequency and severity of accidents. Poor exposure depicted on professional registration applications.	Negative feedback from industry as to quality of persons.	Increased number, frequency and severity of accidents.
4	Exposure to the mining industry from schooling level.	Reporting of graduate numbers to DOL.	General observations.	Exit interviews from technicians and engineers.

5	Enough time on proper training courses.			Poor pass rate of GCC exam.
6	Life skills and understanding oneself strengths and weaknesses.		General observations.	
7	Coaching, supervision and mentoring on the job.			Exit interviews from technicians and engineers.
8	Safety, health and environmental management concepts.			Exit interviews from technicians and engineers.
9	Managerial, supervision and HR skills.		Poor quality of module completion documentation.	
10	How a business operates, the big picture.	The short-sightedness of the person on the way the work is conducted.		
11	Patience to hone technical expertise in a position before climbing the ladder.			Impatience in expecting a promotion.
12	Self-confidence.		Negative feedback from industry as to quality of persons.	
13	Work ethic.		Negative feedback from industry as to quality of persons.	

Question 2.4 from the interview schedule was an open ended question which focused on the industry providing possible explanations in terms of the skills dilemma, and allowed respondents to elaborate on their answers to the question*: "What are the causes that have led to this situation"?* The answers given were then plotted per stakeholder in table overleaf:

Table 32. Responses by all stakeholders

Possible explanations as to why the technical skills are in this dire situation				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	Lack of practical understanding and application of theoretical concepts.	Political decisions by Government to facilitate quantity, rather than quality of graduates.		Lack of professional networks between graduates.
2	Lack of exposure to specific machinery within the mining industry.		Work availability within a specific industry.	Increased sophistication of machinery.
3	Lack of practical exposure and/or experience.		Work availability within a specific industry.	Critical shortages had resulted in persons being fast tracked too quickly.
4	Lack of exposure to the mining industry from schooling level.			
5	Not enough time on proper training courses.	1. Companies unrealistic immediate expectations from graduates. 2. Companies utilisation of trainees as cheap labour to fill certain vacancies. 3. Disparity between training material and unit standard.		

6	Inadequate life skills and understanding of oneself strengths and weaknesses.			
7	Lack of coaching, supervision and mentoring on the job.	Lack of time from experienced persons to train younger persons in the workplace due to production demands.		Unwilling to impart knowledge to younger generation.
8	Insufficient knowledge of safety, health and environmental management concepts.			Increased expectations from Government by imposed SHE legislative changes/ amendments.
9	Insufficient managerial, supervision and HR skills.			
10	Inadequate knowledge as to how a business operates the big picture.			
11	Impatience to hone technical expertise in a position before climbing the ladder.		Financial, social situation.	

5.3 To what extent can co-operation instead of the current competition amongst the various stakeholders mitigate the shortage of technical skills within the South African mining industry?

The approach undertaken in response to the final research question was to access the perception in the market regarding co-operation versus competition amongst the stakeholders within the industry. The number of responses were plotted on a 5 point Likert scale.

Table 33. Complete samples response to question: Do you think there's co-operation or competition amongst the various stakeholders for developing technical skills for the mining industry?

					
	Complete co-operation	Slight co-operation	Neutral	Slight competition	Complete competition
Artisans		7	3	5	7
Technicians		4	7	1	9
Engineers		5	2	2	12

Table 34. Regulatory bodies' response regarding co-operation versus competition in market in the industry

					
	Complete co-operation	Slight co-operation	Neutral	Slight competition	Complete competition
Artisans		2	1	3	
Technicians		3	2		1
Engineers		3	1	1	1

Table 35. Tertiary educational institutions' response regarding co-operation versus competition in market in the industry

	← →				
	Complete co-operation	Slight co-operation	Neutral	Slight competition	Complete competition
Artisans			2		4
Technicians			2		4
Engineers			1	1	4

Table 36. Mining companies' response regarding co-operation versus competition in market in the industry

	← →				
	Complete co-operation	Slight co-operation	Neutral	Slight competition	Complete competition
Artisans		4		2	3
Technicians		1	3	1	4
Engineers		2			7

Question 3.1 from the interview schedule was an open ended question which focused on ascertaining joint initiatives proposed by the industry, and allowed respondents to elaborate on their answers to the question: *"What joint initiatives could be implemented to pro-actively address the skills requirement head-on"?* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented in the rank order table overleaf:

Table 37. Ranked order table regarding joint initiatives to pro-actively address the skills requirements

Joint initiatives to pro-actively address the skills requirements					
Ranking	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies	Total responses
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	3	4	5	12
2	More active interaction driven by MQA, NBI and chamber of mines.	2	1	3	6
3	Centralised accredited testing of artisans and training of technicians (industry specific training).	2	2	1	5
4	Schooling system to be addressed to facilitate more mathematics and science matriculants.			3	3
5	All mining houses to develop skills.			2	2
6	Joint agreements between mining houses in terms of market salary to mitigate poaching.			1	1
6	Develop specific engineers for specific roles.			1	1
6	Engineers to be encouraged to join associations, that is the AMRE (association of mine resident engineers)and SACEA (South African Colliery Engineers Association) to encourage networking and hence knowledge sharing.			1	1
6	Initiatives to be put in place like Bateman and Denel aviation.	1			1

From the table above, the top three themes per stakeholder group were:

Table 38. Regulatory bodies' top three responses

Joint initiatives to pro-actively address the skills requirements		
#	**Stakeholder 1: Regulatory bodies**	**Total responses**
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	3
2	More active interaction driven by MQA, NBI and chamber of mines.	2
3	Centralised accredited testing of artisans and training of technicians (industry specific training).	2

Table 39. Tertiary educational institutions' top three responses

Joint initiatives to pro-actively address the skills requirements		
#	**Stakeholder 2: Tertiary educational institutions**	**Total responses**
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	4
2	Centralised accredited testing of artisans and training of technicians (industry specific training).	2
3	More active interaction driven by MQA, NBI and chamber of mines.	1

Table 40. Mining companies' top three responses

Joint initiatives to pro-actively address the skills requirements		
#	**Stakeholder 3: Mining companies**	**Total responses**
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	5
2	More active interaction driven by MQA, NBI and chamber of mines.	3
3	Schooling system to be addressed to facilitate more mathematics and science matriculants.	3

Question 3.2 from the interview schedule was an open ended question which focused on ascertaining from the industry the feasibility of success with proposals, and allowed respondents to elaborate on their answers to the question: "*What is the feasibility of success with your proposed initiative"?* From the answers given, themes were identified through content analysis and the frequency of these themes tallied using frequency analysis. These frequencies are presented as per legend and depicted in table overleaf:

Table 41. Responses by all stakeholders

Legend	1 = Poor	2-3 = Moderate	4+ = Excellent

Feasibility of success with proposed solutions				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	Moderate	Excellent	Excellent
2	More active interaction driven by MQA, NBI and chamber of mines.	Poor	Poor	Moderate
3	Centralised accredited testing of artisans and training of technicians (industry specific training).	Excellent	Excellent	Excellent
4	Schooling system to be addressed to facilitate more mathematics and science matriculants.	Moderate	Excellent	Moderate
5	All mining houses to develop skills.	Excellent	Moderate	Excellent
6	Joint agreements between mining houses in terms of market salary to mitigate poaching.	Poor	Poor	Poor
7	Develop specific engineers for specific roles.	Poor	Poor	Moderate
8	Engineers to be encouraged to join associations i.e. AMRE (association of mine resident engineers), SACEA (South African Colliery Engineers Association) to encourage networking and hence knowledge sharing.	Moderate	Moderate	Excellent
9	Initiatives to be put in place like Bateman and Denel aviation.	Poor	Poor	Poor

Question 3.3 from the interview schedule was an open ended question which focused on the industry providing evidence in feasibility of success, and allowed respondents to elaborate on their answers to the question: "*What evidence can you present in this regard"?* The answers given were then plotted per stakeholder in table below:

Table 42. Responses by all stakeholders

Evidence to support views				
#	**Constructs**	Stakeholder 1: Regulatory bodies	Stakeholder 2: Tertiary educational institutions	Stakeholder 3: Mining companies
1	More collaboration and synergy between mining companies, Government Departments themselves (DOL, DMR and DOE) and tertiary institutions required.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.
2	More active interaction driven by MQA, NBI and chamber of mines.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.	History has proven that challenges can only be resolved there positive engagement between all stakeholders.
3	Centralised accredited testing of artisans and training of technicians (industry specific training).		Prior to new Government, centralised training facilities like the one in Oilfantsfontein yielded industry-wide recognised artisans.	

4	Schooling system to be addressed to facilitate more mathematics and science matriculants.		The dismal pass-rate and number of matriculants with mathematics and science on higher grade results is not conducive to yield the required entry number of students into the Engineering filed.	The dismal pass-rate and number of matriculants with mathematics and science on higher grade results is not conducive to yield the required entry number of students into the Engineering filed.
5	All mining houses to develop skills.		Poaching between the mining houses only shifts the problem from one to the other and is a short term solution to that specific company.	
6	Joint agreements between mining houses in terms of market salary to mitigate poaching.			If the market salary can be standardised, this will mitigate the problem of persons, in particular artisans moving for better salaries.
7	Develop specific engineers for specific roles.			Group category positions have been abandoned in specific company.
8	Engineers to be encouraged to join associations that is the AMRE (association of mine resident engineers)and SACEA (South African Colliery Engineers Association) to encourage networking and hence knowledge sharing.	Networking between professionals is key to succeed in the industry, so as not to “re-invent the wheel”.	Networking between professionals is key to succeed in the industry, so as not to “re-invent the wheel”.	Networking between professionals is key to succeed in the industry, so as not to “re-invent the wheel”.

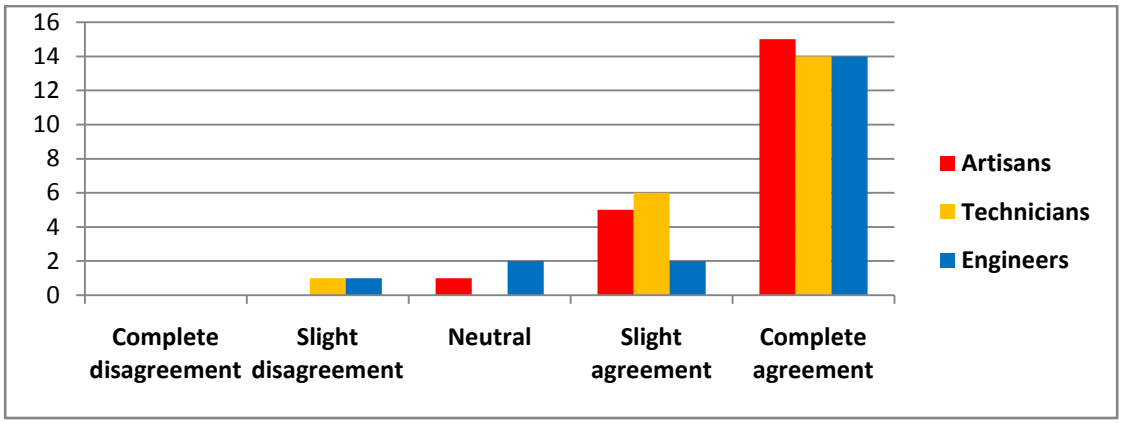
6. CHAPTER 6: Discussion of Results

In this Chapter, the findings tabled in Chapter 5 are discussed in relation to the three research questions developed in Chapter 3 and aligned with the literature discussed in Chapters 1 and 2. Within this Chapter, it is shown that the research objectives have been achieved.

6.1 What are solutions to the insufficient supply of competent technical skills within the South African mining industry?

According to the captured data from table 5 to table 8, the overall perception in the market amongst all three stakeholders is skewed heavily in complete agreement that there is a critical supply shortage in terms of artisans, technicians and engineers, see figure 1 below. Artisans seem to be slightly more of a concern in this regard. This is in agreement with Kraak (2008) in that the availability of technically skilled labour has become a critical issue in South Africa.

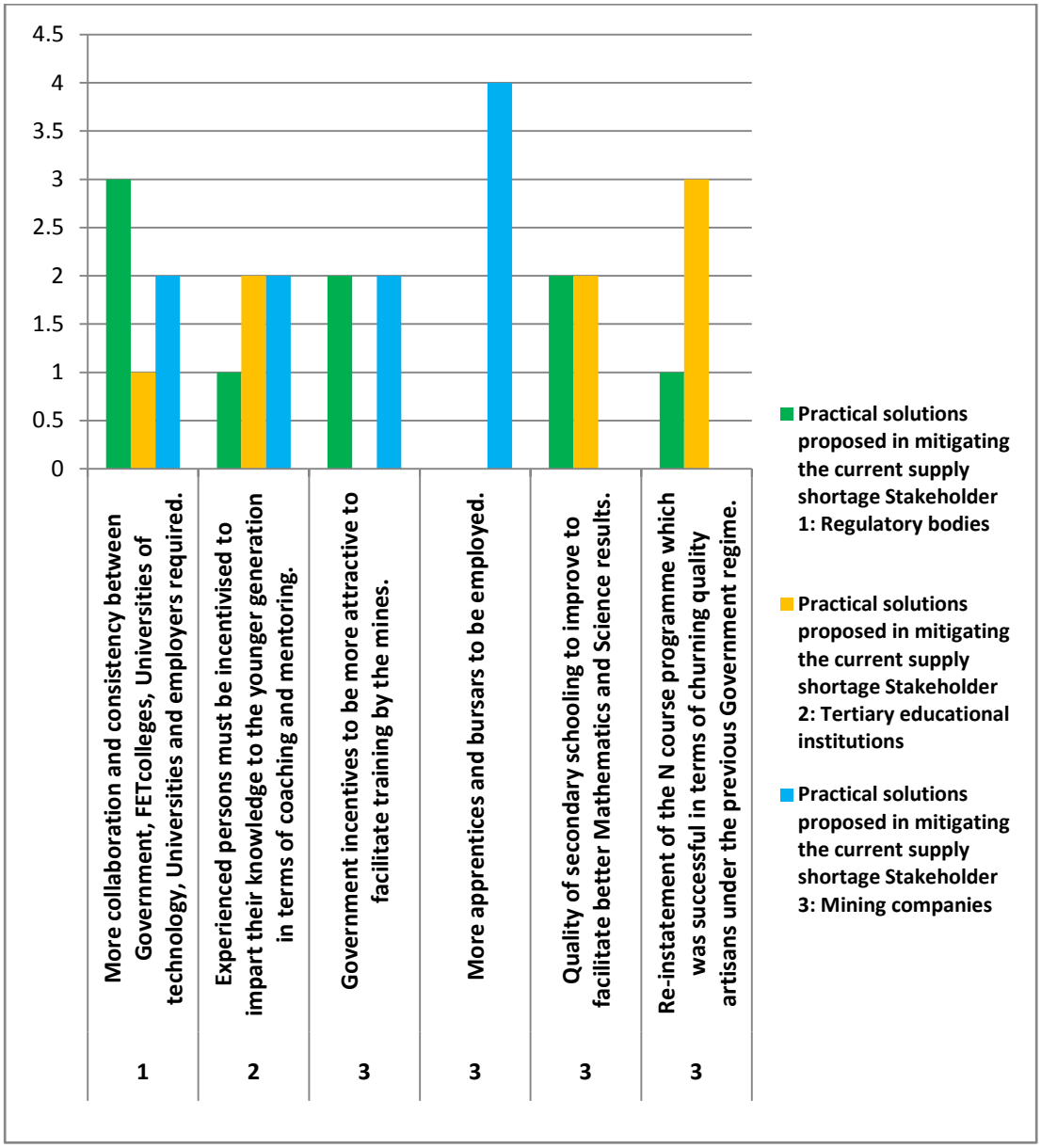
Figure 1. Industry responses



Practical solutions, see figure 2 overleaf, proposed by the industry is disclosed and ranked in table 9.

The top response, concurred with the regulatory bodies' response, table 10, in that more collaboration and consistency between Government, FET colleges, Universities of technology, Universities and employers is required. In terms hereof, Kruss (2004) mentioned in the literature the differences in expectations of education between the various stakeholders. Furthermore, the importance of stakeholder interaction to the very survival of the firm was pointed out by Strand (2008). Although acknowledged by all stakeholders as the number one solution in mitigating the supply shortage, active implementation hereof is not forthcoming. This siloed approach amongst the stakeholders is not conducive in yielding the desired results in terms of meeting the supply of the technical skills.

Figure 2. Top 5 practical solutions proposed by the industry i.e. ranked 1- 3



In table 11, the top proposal by the tertiary educational institutions was the re-instatement of the N course programme as opposed to the NCV learnership programme in churning out quality artisans as the programme aligned itself well with industry expectations and was thus well recognised. This concurs

with Kraak's (2008, p.200) preference for the structured labour market of prior the 1994 democratic elections as stated, "South Africa developed a highly structured and racially exclusive occupational labour market for artisans and technically trained para-professionals such as technicians and technologists. Key role players in these arrangements were the large mining and manufacturing employers and the large state-owned enterprises, the white trade unions, the white technical colleges and white learners. It was these institutions that produced large numbers of artisans for both their own needs, but also for those small firms reliant on poaching to meet their artisanal needs". In this regard, Lawless (2005) has mentioned that structured workplace training is few and far between within companies.

Table 4 yielded the 58.41% decline in new apprenticeship contracts between 1990 and 1999. This is very interesting considering that the mining company's top solution in table 12 being, more apprentices and bursars are to be employed to mitigate the technical supply shortage.

An important solution mentioned (although ranked surprisingly low in table 9) was that of the quality of teachers / training facilitators to be addressed to improve the standard of the training providers. In this regard, Kraak (2008, p.212) stated, "This problem of poor-quality education and training accentuates the crisis around the demise of structured labour markets".

As indicated in table 13, and more specifically in tables 14 to 16, there is consistency amongst regulatory bodies and tertiary educational institutions in that there is “somewhat” agreement regarding the following construct namely, quality of secondary schooling to improve to facilitate better Mathematics and Science results. Consistency is also evident between tertiary educational institutions and mining companies in that, experienced persons must be incentivised to impart their knowledge to the younger generation in terms of coaching and mentoring. However, the most striking finding amongst all three stakeholders is the notable differences amongst their top three responses and the rank order thereof. These differences are once again an indication of the lack of stakeholder engagement and the importance hereof as mentioned by Strand (2008).

The analyses of table 18 yields the following important finding: due to the financial constraints, especially during the last economic downturn, companies cut back on expenditures in an attempt to positively influence their income statement. This has led to companies only training as and when required and no trainees being signed on during certain years, last year being a casing point, table 17. This is in contradiction to what the mining companies deem, table 16, as the most definitive response in addressing the supply shortage being, more apprentices and bursars to be employed. In support hereof, Lawless (2005, p.135) states, “Owing to pressure on profit margins, and little capacity or time to train young staff, all wish for instantly trained or fast-tracked

staff, that is, they want the product but are not prepared to take responsibility for the process".

Therefore, in conclusion to this research question, the top findings in this regard are as follows:

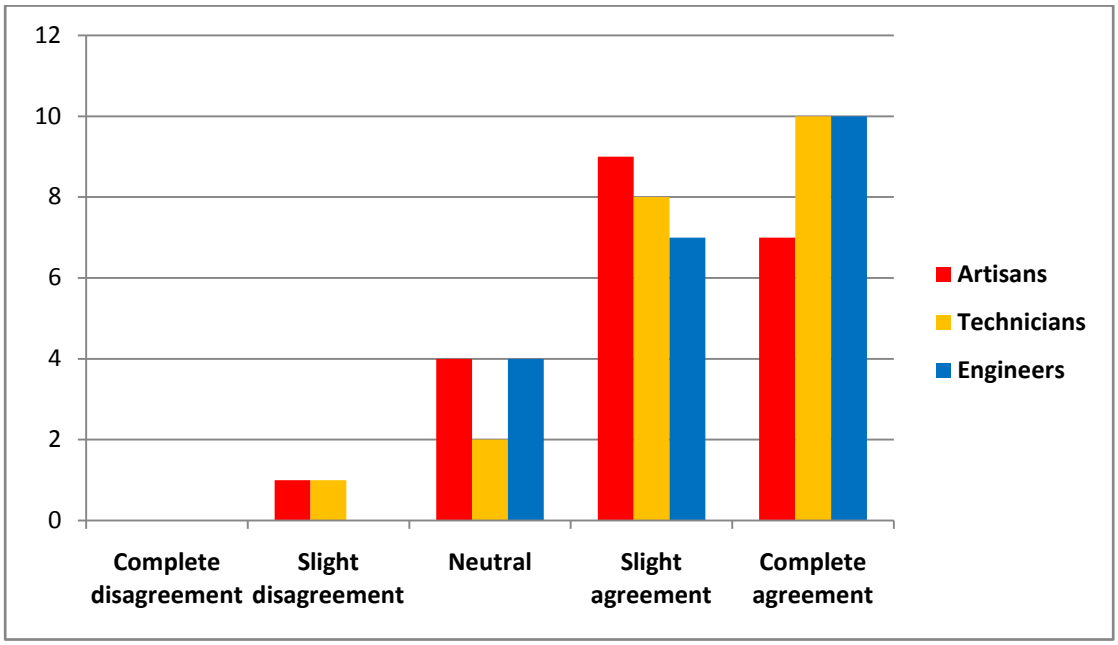
- The overall perception within the industry is complete agreement that a critical shortage exists in terms of artisans, technicians and engineers;
- In terms of solutions in mitigation of the above-mentioned shortage, the top response is more collaboration and consistency between Government, FET colleges, Universities of technology, Universities and employers;
- Collaboration between mines is highly unlikely given the competitive nature of the business, however between regulatory bodies, tertiary educational institutions and mines all acknowledge that this is the way forward. However, resistance to change seems to be the major hindrance within the industry to facilitate this much needed interaction;
- The reinstatement of previous N course as opposed to the current NCV course being the top proposed solution by the tertiary educational institutions;
- Training of apprentices and bursars to be done more consistently by the mines as the long term skills mitigation strategy as opposed to the current short term reactive strategy; and

- The quality of teachers and facilitators in terms of the knowledge and how that knowledge is conveyed to the learners must be addressed, although this point is ranked surprisingly low by the industry.

6.2 What is contributing to the lack of readiness in the workplace in terms of artisans, graduate technicians and engineers within the South African mining industry?

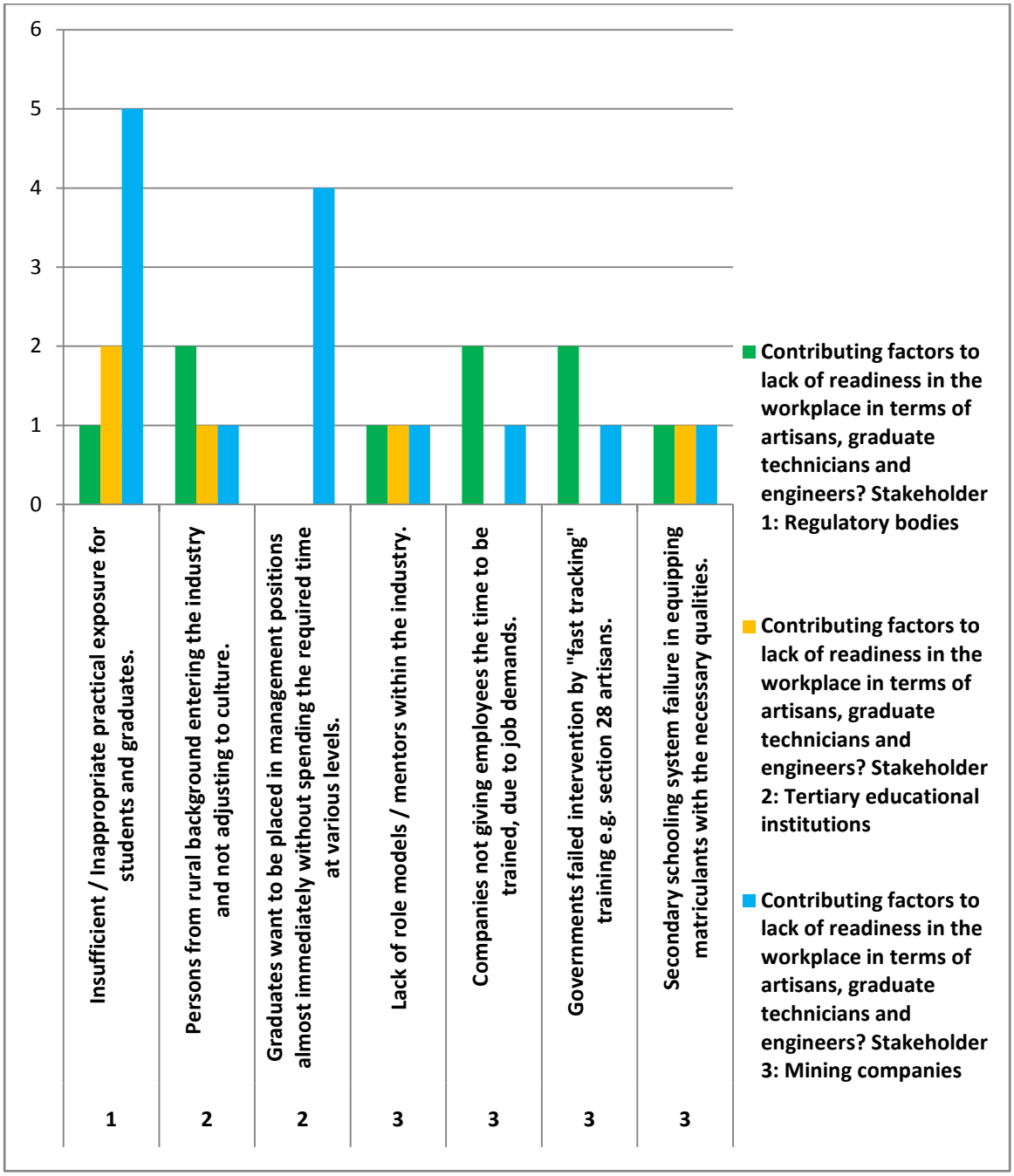
According to the captured data from table 19 to table 21 the overall perception in the market amongst all three stakeholders is skewed towards complete agreement in that there's a lack of readiness in the workplace in terms of artisans, technicians and engineers. There seems be an even spread across artisans, technicians and engineers in this regard, see figure 3 overleaf. This is in agreement with the generalist statement by Erasmus & Loedolff (2006, p.264), "It is argued that young people cannot find employment because they do not possess the specialised skills required either by employers or for successful self-employment". In further support hereof, as mentioned in the literature, Pauw, Oosthuizen & Westhuizen (2008, p.45) has stated, "There is a general consensus that unemployment is structural in the sense that there is a mismatch between the types of workers supplied and those demanded in the labour market".

Figure 3. Industry responses



Reasons disclosed by the industry are ranked accordingly in table 23.The top 7 industry responses, represented in figure 4 (overleaf) presents rank 1 to 3. In terms thereof, the top response, concurred with by the tertiary educational institutions, table 25 and mining companies, table 26, is insufficient / inappropriate practical exposure for students and graduates. In support hereof, Lawless (2005, p.135) has stated, “A great deal of effort is required to develop sound training regimes which will stimulate young graduates and grow the capacity required. Few companies carry out structured work-place training any longer”.

Figure 4. Top 7 contributing factors to the lack of readiness proposed by the industry i.e. ranked 1- 3



Furthermore, in terms of figure 4 above, persons from rural areas working at mines due to employment opportunities and not fitting in due to a clash between personal and mine environment culture was a surprising discovery

indeed. The consistency amongst all three stakeholders indicates that there is a general consensus in this regard.

The third practical solution being the impatience for promotion is an indication of the challenges imposed by generational theory. This is becoming a greater challenge as time goes on due to the skills dilemma and the fact that more and more older persons are expected to transfer their knowledge to the youth.

Specifics in terms of what the technical talent lacks are disclosed by the industry and ranked accordingly in table 27. Here the top 3 responses all related to the lack of practical exposure and application of theoretical concepts to mine specific equipment and machinery. All of these are listed in the stakeholder specific tables 28 to 30 as well. This lack of exposure and hence experience can therefore be seen as the main reason for the skills mismatch mentioned in the literature. In the literature, this was alluded to by the statement of Gordon (2009, p. 34), “if ever there was a time to get serious about helping workers acquire the right skills, this is it”.

Evidence in support of the industries views have all been listed accordingly in table 31. What stands out prominently amongst the regulatory bodies, tertiary educational institutions and mining companies is firstly, the poor pass rate of the GCC exam mentioned in the literature and secondly, the increased number, frequency and severity of mine accidents.

Explanations by the industry as to why the technical skills are in this situation are depicted in table 32. Once again there seems to be a general spread in this regard alluding to the siloed approach amongst the three stakeholders. The importance of stakeholder engagement, as mentioned by Strand (2008), cannot be overstated in obtaining agreement and thereby implementation of a viable solution within the industry.

Therefore in conclusion to this research question, the top findings in this regard are as follows:

- There is no definitive perception within the industry regarding lack of readiness amongst artisans, technicians and engineers;
- The top reason presented by industry is insufficient / inappropriate practical exposure for students and graduates;
- The mining culture is not applicable to everyone;
- Generational theory is becoming a major source of contention within the industry; and
- Evidence presented by the industry in support of the lack of applicable practical exposure all concurs with the poor GCC pass rate and increase number, frequency and severity of mine accidents.

6.3 To what extent can co-operation instead of the current competition amongst the various stakeholders mitigate the shortage of technical skills within the South African mining industry?

According to the captured data in table 33, there is no conclusive consensus within the market as to the perception regarding whether there's complete co-operation or complete competition amongst all three stakeholders. This is depicted by the spread across figure 5 overleaf, slightly more weighted towards competition than co-operation. This degree of variation is indicative of the disconnection between the stakeholders. This is a concerning finding in that the literature has shown the importance of stakeholder engagement and hence co-operation as stated by Strand (2008, p.25), "Industry is increasingly recognizing the need for improved stakeholder engagement, seeing it as a means to reduce risks and increase opportunity. Through increased stakeholder engagement and participation, the corporation can realise greater opportunity with increased global development".

Figure 5. Industry responses

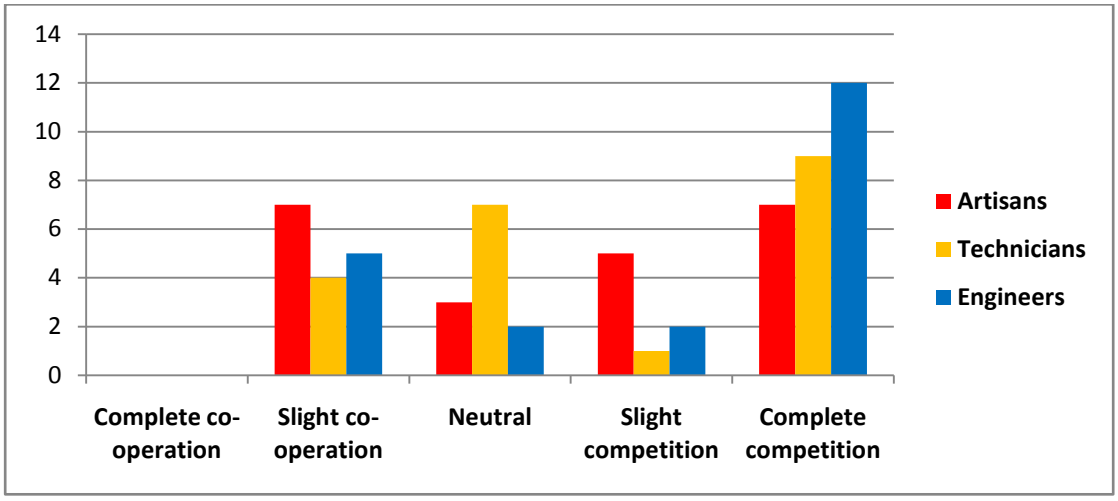
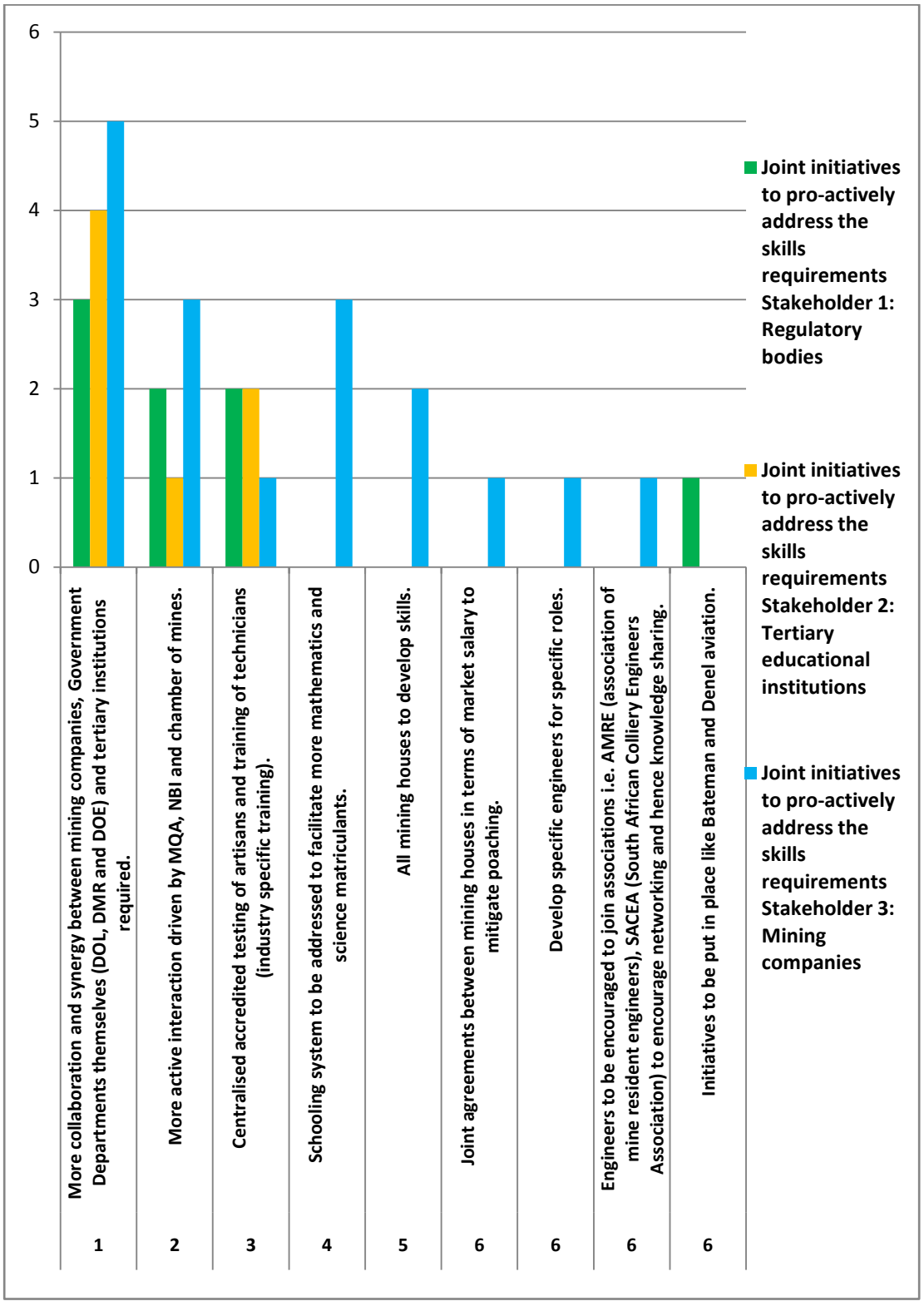


Table 34 to 36 indicates that unlike the regulatory bodies and mining companies responses, the tertiary educational institutions responses indicates a perception of complete competition amongst the various stakeholders. Again this is a concerning indication of a lack of co-operation between the tertiary educational institutions and the other stakeholders. This is contrary to what Malcolm & Colin (2008) proposed, in that engineering educators collaborates with employers in an effort to develop the appropriate competencies required by engineers in this ever changing world.

Figure 6. Joint initiatives proposed by the industry



Joint initiatives, in figure 6 above, to pro-actively address the skills requirements are disclosed by the industry and ranked in table 37. The top response by the industry as well as between the stakeholders, as depicted in tables 38 to 40 being, more collaboration and synergy between mining companies, Government departments themselves (DOL, DMR and DOE) and tertiary educational institutions required. This indicates consistency in agreement and acknowledgement of the importance of breaking down barriers between the stakeholders. However, acting in response to this amongst the stakeholders is yet to be realised to a large extent. Hannah et al (2004) has given reasons in the literature as to why co-operative arrangements have being avoided in the past.

In table 40, one of the top three responses to the mining companies' responses was that the schooling system is to be addressed to facilitate more mathematics and science matriculants. The literature concurred with this in that Gordon (2009, p. 34) mentioned, "The dawning of a new industrial age, a period characterized by a growing need for highly skilled technical workers" is upon us. Furthermore, the education-to-employment system will have to be re-looked at as the current system has created an ever increasing skills gap".

The feasibility of success with proposed solutions is listed in table 41. Excellent responses across all stakeholder groups were achieved in terms of a centralised accredited testing of artisans and training of technicians (industry specific training) initiative. This finding again points in favour for a structured

labour market eluded to in the literature by Kraak (2008). Poor responses were obtained across all stakeholder groups in terms of joint agreements between mining houses in terms of market salary to mitigate poaching. A plausible explanation to this could be the fact that the industries main source of competitive advantage is its human capital. Hence, the best talent is sort after in an attempt to obtain that advantage.

Supporting evidence from the industry is listed in table 42. What stands out in this table is the importance of networking between professionals as a means to succeed in this industry. Strand (2008) alluded to this importance in the literature.

Therefore, in conclusion to this research question, the top findings in this regard are as follows:

- Perception within the industry leans towards competition as opposed to co-operation;
- The competitive perception from the tertiary educational institutions is contrary to what is proposed in the literature;
- The standard of the schooling system to be addressed as a means of churning out more matriculants with the fundamentals in Mathematics and Science; and
- The three initiatives proposed (Figure 6) in which all three stakeholders already agree should be implemented as a matter of urgency.

7. CHAPTER 7: Conclusion

7.1 Introduction

In this Chapter, the research findings are summarised and recommendations proposed by the industry are presented pertaining to the challenges and proposed solutions to the technical skills based within the mining industry. By understanding these issues, management within all three stakeholders, directly and / or indirectly affected, will be better equipped to deal with the critical skills dilemma, particularly within the South African context. The solutions presented are practical within the mining context thereby entailing a greater probability of success.

7.2 Main findings

The findings from Chapter 6 are collated and discussed per stakeholder overleaf:

7.2.1 Regulatory bodies and Tertiary educational institutions

- *In terms of the practical solutions proposed in mitigating the current supply shortage, the most significant findings are as follows:*

The consistent theme is the importance and need for active engagement between the demand side (companies), the supply side (tertiary educational institutions) and regulatory bodies in co-coordinating this interaction.

With the acknowledgement by the industry as to the skills crisis, the need for persons nearing retirement age to remain within the industry is crucial. The need is twofold; firstly, in that they are required to affect the necessary maintenance and repairs and secondly, to impart their acquired knowledge and experience obtained over a lifetime to the next generation.

The current incentives by government to the industry are not enough in setting an environment conducive to companies to intensify the required training by the industry. Furthermore the quality of secondary schooling needs to be addressed as a matter of urgency. These matriculants are the feedstock into tertiary institutions and without the basics and fundamentals in the Sciences are destined for failure. Current programmes and curriculums not yielding the desired results must be abolished and replaced with those which have proven itself in the past.

- *In terms of the contributing factors to the lack of readiness in the workplace, the most significant findings are as follows:*

Within the industry, graduates and apprentices must be afforded the opportunity to relevant practical exposure to specific equipment and machinery over a minimum time period. This exposure must be facilitated by a mentor who takes charge of the process to ensure that after the said period, the person is well equipped to deal with the inevitable challenges within the industry. Unfortunately, this is not forthcoming. Production demands on employees and financial pressures within companies results in persons not been afforded the training time, instead in certain instances those trainees are temporarily placed in positions thereby saving the company costs.

Due to unemployment within South African, migration to the cities is and has become common place. The South African mines are still very labour intensive when compared to world standards and hence have been a Mecca for active job seekers. The persons have to either adapt or die to the “mining culture”. In an attempt to “fast-track” the apprenticeship training, the Government initiated the “section 28” programme where eligible persons spent several weeks exposed to a task and then tested accordingly. Unfortunately, due to the vastness of the engineering discipline within a mining context, these persons are far from being equipped with the tools to be effective and add value to the industry.

- *In terms of the contributing factors to the lack of readiness in the workplace, the most significant findings are as follows:*

Due to the breakdown in communication between the Government departments themselves as indicated by the statement made by a representative of a FET college, “The minimum theoretical qualification depicted still today by the Department of Labour (DOL) is an N2 certificate even though the NCV certificate has been in place for the past several years already”. This statement is an indication to the silo’s within the Government Department themselves. The implication of this is that confusion has arose amongst current apprentices as well as persons aspiring to be artisans in that no person wants to pursue a qualification if it could be terminated and / or be unrecognised in the future.

There is a lack of centralised accredited testing facilities of artisans and training of technicians to insure industry specific training. The result is doubt as to the quality of the persons’ education by the industry even in terms of qualified persons.

7.2.2 Mining companies

Companies recognise that training of more apprentices and bursars is a means for the industry to rise above the skills challenge. However, due to a number of factors, in particular the global financial crisis experienced of late, margins have all but eroded away. In this regard, training of persons and

signing of new apprentices and bursars have been put on the side. This short term reactive strategy is seen as a means to alleviate some of the financial pressures on the companies. However, in the long term the indirect impact of not having sufficient numbers due to a lack of training can be far more detrimental to the industry.

7.3 Recommendations to stakeholders

Following the main findings presented above, recommendations per stakeholder are given as follows:

7.3.1 Regulatory bodies

Acknowledgement of the importance of active engagement between the stakeholders is one thing; however, acting on this is most important in shaping the way forward. The time for talking about this is over, implementation of this point is key.

More thought must be given around creating an environment to make it more conducive for companies to train the future generation. Continuous assistance is required throughout the training of those learners / apprentices.

The fast-tracking initiatives to be stopped and the correct programmes implemented to ensure the quality of persons are up to the task at hand. This will aid in reducing and stopping machinery related mine accidents as well.

7.3.2 Tertiary educational institutions

The quality of the secondary education and facilitators must be addressed urgently. A needs-analysis is required to identify the gaps / shortcomings and a roadmap drawn up on how to bridge those gaps.

Programmes aligned with industry needs, such of the N course programme, to be implemented immediately.

7.3.3 Mining companies

With the skills base within the mining industry aging, it is in the interest of each company to incentivise those persons to remain actively employed for as long as possible. Furthermore, a knowledge management system must be implemented to capture as much information on a data base to ensure that knowledge remains at the disposal of current and future employees.

Companies must realise that trainees are on the premises for exactly that, to be trained. The common practice of utilising those persons to temporary fill certain positions can be detrimental to both parties concerned. Mentors are to be identified and equipped accordingly to ensure the desired outcome of trainees on mines within the specified timeframe. The mines are to have a

sustainable input of new bursars and apprentices annually to ensure a constant supply to the industry.

7.4 Recommendations for future research

Building on this research, an interesting approach could be to develop a template of what workplace readiness implies for technical skills in the mining industry. This template would add tremendous value to the industry as a means of assessing potential and future employees and matching them accordingly to the specific job.

A second proposal could be assessing what collaborative bodies' exits within the mining industry and proposals on improvements and other collaborative initiatives for effective engagement between the relevant stakeholders.

The final proposal being, a case study on a major player within the mining industry disclosing its challenges, initiatives proposed and implemented in terms of its technical skills base and the post-implementation results. This type of research could be valuable for the entire industry as a whole so as not to re-invent the wheel but rather to implement proven systems.

7.5 Conclusion

Although the mining industry has reached a plateau in terms of its contribution to the country's GDP of late, the social benefits to the communities in which it operates cannot be quantified. The ongoing viability of the industry is directly dependent on the availability of the technical skills discussed in this research. If the industry fails, all stakeholders fail to the detriment of the country as a whole.

The mitigation of the acknowledged technical skills crisis will not be resolved overnight. However, finding the problem is the most difficult task in solving any problem. This research has presented the disclosed problems with solutions for the industry. The task now is to actively implement these initiatives to ensure the sustainability of the South African mining industry for future generations.

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9. APPENDICES

1. Interview schedule

Informed consent letter

I am conducting research on the technical skills base in terms of artisans, technicians and engineers within the South African Mining Industry. More specifically, the challenges (what is currently the situation and how the industry ended up here) and the proposed solutions in mitigating these challenges. The interview is expected to last no longer than an hour during which time valuable insights into addressing this dilemma in which the South African Mining industry finds itself can be raised.

Your participation is voluntary and you can withdraw at any time without penalty. It goes without saying that all data will be kept confidential. If you have any concerns, please do not hesitate to either contact my supervisor or myself. Our details are provided below in table 1:

Researcher name: Rustum Norman	**Supervisor name**: Prof Margie Sutherland
E-mail: rustum.norman@gmail.com	**E-mail:** sutherlandm@gibs.co.za
Phone: 082 317 3047	**Phone: 073 170 6917**

Table 1:

The particulars of actual interview are depicted in table 2 below.

Name of company:	
Name of representative:	
Designation:	
Signature of representative:	
Signature of researcher	
Date:	

Table 2:

Interview questions

1. Do you agree there's a <u>critical</u> shortage in supply of competent technical skills in the mining industry?

					
	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans					
Technicians					
Engineers					

1.1 What practical solutions do you propose in mitigating the current supply shortage?

1.2 Has it worked anywhere else locally and/or internationally before?

1.3 What evidence do you have to support your view?

1.4 Why has it not been proposed / implemented as yet?

2. Do you agree there's a lack of readiness for the workplace in terms of artisans, graduate technicians and engineers in the mining industry?

					
	Complete disagreement	Slight disagreement	Neutral	Slight agreement	Complete agreement
Artisans					
Technicians					
Engineers					

2.1 What is contributing to the lack of readiness in the workplace in terms of artisans, graduate technicians and engineers in the mining industry?

2.2 What specifically does the technical talent lack in terms of readiness?

2.3 What evidence do you have to support your view?

2.4 What are the causes that have led to this situation?

3. Do you think there's co-operation or competition amongst the various stakeholders for developing technical skills for the mining industry?

	← →				
	Complete co-operation	Slight co-operation	Neutral	Slight competition	Complete competition
Artisans					
Technicians					
Engineers					

3.1 What joint initiatives could be implemented to pro-actively address the skills requirement head-on?

3.2 What is the feasibility of success with your proposed initiative?

3.3 What evidence can you present in this regard?

Additional comments

Is there anything else you'd like to add?

Closure

I'd like to take this opportunity to thank you for your co-operation in conducting this research.

2. Interviews conducted

Interviews conducted, sequence, date & time						
#	**Company**	**Representative**	**Designation**	**Venue**	**Date**	**Time**
1	De Beers	Mr. Jaco Hugo	Group Lead: Projects & Engineering	CHQ	14/07/2010	16H00
2	Anglo American Thermal Coal	Mr. Johnny Coetzee	Head of Engineering	Anglo American Head Quarters	20/07/2010	11H00
3	Gold Fields	Mr. Ben Potgieter	Senior Manager Engineering	Gold Fields - Kloof	27/07/2010	14h00
4	AMRE	Mr. Ben Potgieter	AMRE - Vice President	Gold Fields – Kloof	27/07/2010	15H00
5	Anglo Platinum	Mr. Brian O'Connar	Senior Principal Engineer	OSD	28/07/2010	15h00
6	NBI	Mrs. Marianne Scott	Director	NBI	03/08/2010	11h00
7	ECSA	Mr. Johan Pienaar	Manager: Registration	ECSA	04/08/2010	11h00
8	Simmer & Jack Mines Ltd	Mr. Nico Schoeman	CEO	Head Office	05/08/2010	09h00
9	Simmer & Jack Mines Ltd	Mr. Paul Krause	Group Engineer	Head Office	05/08/2010	09h00
10	Simmer & Jack Mines Ltd	Mr. Vic Hoops	HR Executive	Head Office	05/08/2010	09h00
11	South West Gauteng College	Mr. Lekhotla Ginya	HOD Engineering	Molapo, Dobsonville	06/08/2010	10h00
12	DMR	Mr. Anthony Couthino	Manager: Safety	Pretoria	10/08/2010	14H00
13	Tshwane University of Technology(TUT)	Mr. Malan	Section Head:Elec Eng	Pretoria	11/08/2010	07h30
14	Gold Fields	Mr. Vishnu Pillay	Executive Vice President	Constantia Head Office	11/08/2010	11h30
15	MQA	Mrs. Sonwablle Xaba	Learning Programmes Manager	MQA offices	11/08/2010	15h00
16	University of Johannesburg (UJ)	Mr. P.J Knottenbelt	HOD Mining	Johannesburg	16/08/2010	15h00
17	Vaal University of Technology (VUT)	Mr. L. M. Masu	Executive Dean	Vanderbijlpark	17/08/2010	09h00
18	Western College for FET (WESTCOL)	Mr. Chris Smith	Senior Lecturer	Carletonville	17/08/2010	12h00
19	Gold Fields	Mr. Wayne Allen	Engineering Manager	Gold Fields - Kloof	24/08/2010	12h00
20	AMRE	Mr. Gary Bullen	AMRE - President	Johannesburg	30/08/2010	13h00
21	University of Witwatersrand (WITS)	Mrs. Beatrys. M. Lacquet	Dean Faculty of Engineering and Built Environment	Johannesburg	31/08/2010	16h15