MANAGEMENT PERCEPTIONS REGARDING SKILLS SHORTAGES IN GOLD MINES

BY
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December 2012

Promoter: Prof EE Smith
Co-promoter: Prof NE Mazibuko
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DECLARATION

I, Lumkwana Andreas Xingwana, hereby declare that this thesis entitled: “Management perceptions regarding skill shortages in gold mines” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

SIGNATURE

DATE: 10 December 2012
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ABSTRACT

The skills shortages in mining and mineral sector had existed for a decade and had a widespread effect on South Africa economy. It affects the level of economic productivity and reduces the country’s capacity to develop a knowledge society. This, in turn, affects the country’s functioning in the global economy. Despite the sector’s best efforts, the shortages continue to grow and threaten the delivery of projects and growth plans. Some researchers contend with the view that the persistence of skills shortages in mining and mineral sector is largely due to entrenched attitudes among both the industry and the community. They claim that employers have the means to change the educational profile of the subsectors by appointing recruits with higher levels of schooling. However, owing to the limited number of higher educated people living in the communities surrounding the mining operations and lack of interest in mining of people with higher levels of education, to name but few, employers are perceived to have a habit of employing people with little skills. The current study was aimed at investigating the impact of skills shortage on organisational performance, propensity to leave, competitive advantage and sustainability, from the management perceptive.

The main objective of this study was to incorporate and embed previous research findings and theories into a comprehensive hypothetical model. A hypothetical model showed various factors that may influence skills shortage. Four independent variables (working environment, employment conditions, resources and education and training) were identified as variables that may influence skills shortage; and mediating variable (skills shortage) was also identified as a variable that have potential to affect dependent variables (organisational performance, propensity to leave, competitive advantage and sustainability) of gold mining sector. Furthermore, eight hypotheses were developed to test the relationship between independent, mediating and dependent variables. All these variables were clearly defined and operationalized with various items obtained from measuring instruments used in other similar studies.

A purposive sample of 343 respondents was drawn from the population. A seven-point Likert scale and structured questionnaire were administered in person to the
respondents and of which 300 were usable and subjected further to several statistical analyses. The validity and reliability of the measuring instrument was evaluated using significant effect $p \leq 0.001$ and Pearson’s correlation test ($\alpha = 0.05$). Data gathered were fed to and analysed by STATISTICA (version 10) and factor analysis and regression analyses were the statistical procedures used to test the significance of the relationships between the various independent and dependent variables. Consequently, working environment, resources and education and training were three independent variables that were identified as having ability to predict propensity to leave, competitive advantage and sustainability.

An attempt was made to establish whether various demographic variables have an influence on mediating and dependent variables through the introduction of gender and position in the organisation while conducting an Analysis of Variance and Multiple linear regressions, but they obtained negative values. The conclusion is that demographic variables do not have over mediating and depended variables. The findings of this study states that with conducive working environment, availability of resources, the high levels of education and training, the country could produce skills that would reduce propensity to leave, drive competitive advantage and sustainability, innovation and entrepreneurship, create competitive advantages and boost employment sustainability.

KEY WORDS: Management perception, skills shortage, propensity to leave, competitive advantage and sustainability
CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

Skills shortage in South African mining industry had its origin in the discovery of diamond in 1867 and gold in 1886 (Rembe 2005:1) as well as the subsequent industrialisation of the country and development of the mining industry. The discovery of the commercial quantities of these commodities led to the influx of labour from the neighbouring countries and abroad, a pattern that still exist even today (Harington, McGlashan & Chelkowska 2004:65). In the beginning, South Africa did not have sufficient skilled labour force and had to import workers to do skilled jobs from European countries. The development of the South African mining industry was instrumental to the development of the country’s infrastructure, establishment of other businesses that support the mining community, generation of wealth and employment opportunities on a large scale (Budeli 2009:58). However, the benefits of the extraction of minerals and coal continues to provide the foundation for local economies in some parts of the country due to geological factors, legal restrictions, and the rate of demand from local industries, amongst other issues (Chindo 2011:5).

According to Swidorsky (2011), products of the mining industry are used as inputs of consumer goods, processes, services provided by all other industries, including agriculture, manufacturing and transportation, utilities, communication and construction. Coal, for example, is used for energy, copper for wiring, gold for satellites and sophisticated electronic components, and a variety of other minerals as ingredients of medicines and household products. Many towns and cities such as Barberton, Johannesburg, Klerksdorp, Rustenburg, Welkom, and Witbank, have come about through mining operations. Most of the infrastructural development of roads, electricity generation, water reticulation and housing in and near these towns, were meant to support the growth and operations of the mining industry (Development Bank of Southern Africa 2012:12). In order to build this capacity it was necessary to have a
thorough, rational and explicable knowledge of the nature and vision of this industry; the vision that considers the impact of the external environmental forces (Armstrong 2000:248-249; Smit & Morgan 1996:245-246).

Mining is a process of delving into the earth to extract naturally occurring minerals, either on surface or underground, and quarrying for construction companies. Surface mining is undertaken to extract the mineral deposit which are near the earth surface, while underground mining is the extraction of ore below the earth’s surface (Amponsah-Tawiah & Dartey-Baah 2011:62). Underground working conditions are unusual and more hazardous than surface mining. In addition to formal training that employees go through before placement underground, a maximum proficiency in a particular skill is a requirement. That means an employee would have to spend more time practicing that particular skill in order to be able to know commodity rock formation, identify unsafe conditions and internalise the ‘unwritten rules’ of working underground (Nel & Pienaar 2006: 184). The depth and physical properties of rock being mined are few factors that would determine whether mining can be carried out using labour intensive or capital-intensive methods. When comparing them with similar operations in other countries, South African mining houses are categorised as labour intensive. This means that a greater number of people employed in South African mines are more exposed to health and safety risks than their counterparts in other parts of the mining world (Department of Minerals and Energy 2008:12).

The risks of working in a mine are associated with the possibility of fire caused by electrical, combustible material, explosives and arson, occupational illness caused by exposure to heat, dust, noise, radiations, vibration and harmful gases, environmental incidents such as slime dams collapsing, cyanide or other chemicals spillage and water, air or ground water pollution, as well as operational incidents such as material handling, logistics and track related accidents (Marcus 2001). Although mine health and safety conditions have improved dramatically, fugitive dust and fumes generated during drilling and blasting operations and mine tailing facilities, places people at risks of developing either pneumoconiosis or silicosis (Burger 1999: 97-103; Ololade 2012:9). Table 1.1
shows diseases of significance that were compiled from the submitted annual medical reports for the period 2007-2008, by 493 mines in terms of Section 16 of the Health and Safety Act.

Table 1.1: Occupational diseases captured per commodity from annual medical reports 2007.

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<th>SLCS</th>
<th>PTB</th>
<th>NHL</th>
<th>CWP</th>
<th>Asbestos</th>
<th>Silica</th>
<th>Other</th>
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<tr>
<td>Gold</td>
<td>1620</td>
<td>3812</td>
<td>626</td>
<td>0</td>
<td>0</td>
<td>518</td>
<td>185</td>
</tr>
<tr>
<td>Platinum</td>
<td>24</td>
<td>358</td>
<td>926</td>
<td>4</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coal</td>
<td>9</td>
<td>127</td>
<td>73</td>
<td>22</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Diamond</td>
<td>9</td>
<td>9</td>
<td>23</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>176</td>
<td>172</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: Adapted from Mine Health and Safety Audits (2008:33)

SLCS: Silicosis  PTB: Pulmonary Tuberculosis  TB: Tuberculosis
NIHL: Noise Induces Hearing Loss CWP: Coal Workers Pneumoconiosis

Table 1.1 shows that the gold mines have the highest incidence of silicosis (1620), PTB (3812) and Silica (518) in the mining industry when compared to platinum and other mines. Overall, PTB cases are higher since silicosis disposes its patients to TB while HIV infection is always associated with TB. Platinum mines have the highest incidence of NIHL (926).

Due to the recent spate of fatal mine accidents, the Department of Minerals and Energy (DME) has vowed to shut the mines until there are strict safety improvements in place and to prosecute employers for negligence (Phillis & Gumede 2011:565). According to Viljoen (2010) employers are entrusted with certain functions and responsibilities in terms of either the Occupational Health and Safety Act, 85 of 1993 (OHSA) or the Mine Health and Safety Act, 29 of 1996 (MHSA). Employers, therefore rely on a legal appointment of managers and other people, to perform the functions and responsibilities on behalf of them. Health and safety regulations demand that some legally appointed persons must be able to competently supervise the safe operation of the mine.
(Research Focus 2007:8). Fourie (2004:498) defined competence as the blend of knowledge, skills, behaviour and aptitude that a person can apply in the work environment. Brandon (2012: 2) posited that it is unlikely that there will be sufficient skilled workers to satisfy this demand over the next 20 years. This scenario does not mean the vacancies would not be filled.

The focus point of this study is to determine the influence of working environment, employment conditions, resources and education and training on organisational performance, propensity to leave, competitive advantage and sustainability amongst various levels of management that were identified in the South African gold mines. The rationale for choosing South African gold mines as the study area is that they are intensive and have no flexibility. Therefore, skills shortage would be used as a mediating variable while assessing the nature and extend of its relationship with both independent and dependent variables.

This chapter would cover aspects such as background to skills shortages in the mining industry; addressing skills shortages; problem statement; research objectives; literature review, proposed conceptual model; hypotheses; research methodology and an overview of the structure of the research.

1.2 BACKGROUND TO SKILLS SHORTAGES IN THE MINING INDUSTRY
Research Focus (2007:1) reported that Mining Qualifications Authority (MQA) was established in terms of the Mine Health and Safety Act (No. 29 of 1996) and subsequently registered as one of 23 Sector Education and Training Authority (SETAs) in terms of the Skills Development Act (No. 97 of 1998). The MQA is a statutory body that is aimed at facilitating the skills development in the mining industry in order to eliminate illiteracy and set a standard of education in the mining sector. Based on the study done by CSIR and Fraunhofer Gesellschaft of Germany on South African automotive industry, skills development needs were categorised into four main levels: (AIDC 2002) training at worker’s level (37%); technical skills (14%); training at engineering level (30%) and management skills (19%).
Internationally, the mining industry is facing critical skills shortage, as mining companies in developed countries like Australia, Canada, Great Britain, New Zealand and the United States of America (USA) recruits highly skilled South Africans (Rasool & Botha, 2011:4). On the other hand, AngloGold Ashanti (2008) claimed that local mining companies were not only losing workers to other mining companies, but also to major engineering and construction projects in South Africa. It further stated that the high turnover of artisans and a loss of engineers have forced the mining industry to do a comprehensive review of training materials and programmes, job grading and conditions of employment. In this respect, Mlambo-Ngcuka (2006) cautioned that, unless this skills shortage is tackled at all levels of the economy, it could "undo" all the gains of the past years. However, Nkosi (2003) further stated that “People are emigrating. We develop them and they go. This is real. It is facing us as a country. We need to deal with it” (Mlambo-Ngcuka 2006).

The impact of skills shortages in the mining industry can be felt by recipients of by-products of minerals, mining employment agencies as well as various bodies representing these groups. For instance, as a result of load shedding at the beginning of 2008 by Eskom some operational processes of businesses including mining were interrupted. As a result, expansion plans for the mines, smelters in the country, housing projects and new ventures were curtailed (Phillips 2008). Furthermore, regular turnover amongst senior management to pursue personal business interests, created instability within the mining industry leading to poor oversight, performance management and policy implementation (Bernstein 2010). Lourens (2009) believed that the loss of skills at all levels throughout the industry necessitated the implementation of automated control as far as possible to reduce variability of production in times of this crisis and increased control expertise. Autor, Levy and Murnane (2003) held the view that there are two main arguments in favour of the introduction of new technologies to address the relative demand of skilled labour (Dupuy & Marey 2007:3) at all levels of the organisation namely:
• The direct effect whereby technology replaces workers performing non-routine tasks to address the skills shortage; and

• The case of indirect effect, whereby management acknowledges that automation complements skilled (Bresnahan, Brynjolfsson & Hitt 2002, and Van Reenen & Caroli 2001).

Meyer and Botha (2004:172-173) believed that the current problem relating to skills development in the mining industry can be summarised as follows:

• There is a high level of unskilled workers who lack the skills base for meaningful employment, apart from menial jobs they are doing. Most skill occupations have a significant proportion of workers who do not possess formal qualifications. Can South African mining industry maximise its potential with such high numbers of skilled workers without formal qualifications?

• Productivity levels are low as a result of poor or inadequate training due to low levels of investment in training workers. There is a need for all skills training to be developed continually to meet the now very rapidly changing skill requirements in the workplace arising from new technologies (Hofmeyer 2000:7); and

• While apprenticeships are a major source of skills in the traditional skilled trades, there has been an increase in other pathways involving vocational education outside of the apprenticeship system.

1.3 ADDRESSING SHORTAGES IN BUSINESS AND THE MINING INDUSTRY

Businesses and industries can work towards addressing current and future skill needs through a variety of approaches (International Labour Organisation 2012:6) including:

• Undertaking strategic workforce profiling and planning of the current and future skills shortage; and

• Incorporating flexible models of skills shortage and workplace practices in order to meet future skills development needs for the industry to remain productive and competitive, as well as socially responsible for retaining its skilled workers.
These two approaches are discussed briefly in this section and in-depth in Chapter three, four and five of the current study.

In the context of the above discussions on MQA, one can distinguish between scarce and critical skills. According to Daniels (2007:2) and Department of Labour (2007:6) scarce skills may be referred to those occupations that are characterised by a scarcity of qualified and experienced people, currently or anticipated in the future. Scarce skills are further differentiated as either because such skilled people are not available, known as absolute scarcity, or they are available but do not meet employment criteria, known as relative scarcity (Food and Beverage SETA 2005:42). Critical skills in this study refers to specific skills within occupations and categorised as generic skills, such as problem solving, conflict resolution, numeracy, or teamwork and particular occupational skills that is required for performance within that occupation such as management and leadership skills or basic computer literacy (Mining Qualifications Authority 2009 and Erasmus & Breier 2009: 4).

While the skills level could be measured by means of formal education and experience, the Mining Qualifications Authority (2012:3-4) strive to provide a reliable set of skills shortage signals to the mining sector and direct strategic interventions and activities to address these shortage. The Sector Skills Research conducted by the Mining Qualifications Authority (2007) is an example of how MQA provided a signal of relevant critical and scarce skills to the mining sector. The data provided in Table 1.2 are weighted data and extrapolated to gold mining sector in the Free State province and differentiated according to absolute and relative scarcity of skills.
### Table 1.2 Scarcity and critical skills in Free State mines

<table>
<thead>
<tr>
<th>Code</th>
<th>Occupation</th>
<th>Absolute Scarcity</th>
<th>Relative Scarcity</th>
<th>Total Scarcity</th>
</tr>
</thead>
<tbody>
<tr>
<td>132201</td>
<td>Finance Manager</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>133201</td>
<td>Engineering Manager</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>133503</td>
<td>Production or Operations Manager</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>133504</td>
<td>Operations Manager</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>136304</td>
<td>Foreman</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>139902</td>
<td>Environmental manager</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>232202</td>
<td>Surveyor</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>233201</td>
<td>Civil Engineer</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>233301</td>
<td>Electrical Engineer</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>233502</td>
<td>Mechanical Engineer</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>234401</td>
<td>Geologist</td>
<td>4</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>251301</td>
<td>Environmental Health Officer</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>311903</td>
<td>Environmental Science Technician</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>312301</td>
<td>Electrical Engineering Draftsperson</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>312302</td>
<td>Electrical Engineering Technician</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>312502</td>
<td>Mechanical Engineering Technician</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>312903</td>
<td>Mining Technician</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>321202</td>
<td>Diesel Motor Mechanic</td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>322303</td>
<td>Welder</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>323201</td>
<td>Fitter</td>
<td>2</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>323502</td>
<td>Fitter and Turner</td>
<td>8</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>323501</td>
<td>Millwright</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>334101</td>
<td>Plumber</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>341101</td>
<td>Electrician</td>
<td>8</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>342101</td>
<td>Air-conditioning &amp; Refrigeration Mechanic</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>411401</td>
<td>Enrolled Nurse</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>712201</td>
<td>Driller</td>
<td>119</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>712202</td>
<td>Miner</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>821701</td>
<td>Construction Rigger</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>72</strong></td>
<td><strong>273</strong></td>
<td><strong>345</strong></td>
</tr>
</tbody>
</table>

**Source:** Adapted from Mining Qualifications Authority (2009)

Table 1.2 shows drillers and miners are the most needed in the relative scarcity column basically because they do not need any formal training except shop-floor training such as Blasting Certificate of Competency. Therefore, as one of the country’s largest private employers, the mining sector needs people from across the board and anybody could...
find a place in mining. In high demand at the moment, both absolute and relative, are artisans and engineers from all disciplines including metallurgy, geology, mechanical, electrical, civil and industrial.

In acknowledgement of these skills imbalances the government had to develop direct strategic interventions and activities to address these shortages (Mining Qualifications Authority 2012:3-4). The strategies and activities are embedded in the:

- The National Skills Development Strategy of 2001,
- The Human Resources Development Strategy of 2001, and
- Numerous policies and regulations emanating from these legislations such as Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and the Joint Initiative on Priority Skills Acquisition (JIPSA 2007).

JIPSA (2007) and AsgiSA were set up as government intervention tools, whose primary role was to identify the clusters of scarce and critical skills and come up with sets of necessary interventions, highlight the bottleneck and recommend solutions (Amos, Ristow & Ristow 2006:98, and Mlambo-Ngcuka 2006). On the other hand, MQA stipulation is that all mining companies should submit a training report on an annual basis. Table 1.3 is AngloGold Ashanti’s (2008) Training Report.
Table 1.3: The racial breakdown of the training beneficiaries

<table>
<thead>
<tr>
<th>Racial groups</th>
<th>Number trained</th>
<th>Per centage</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>17 139</td>
<td>87.6</td>
</tr>
<tr>
<td>Coloured</td>
<td>96</td>
<td>0.49</td>
</tr>
<tr>
<td>Indian</td>
<td>24</td>
<td>0.12</td>
</tr>
<tr>
<td>White</td>
<td>2 307</td>
<td>11.79</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>19 566</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Adapted from AngloGold Ashanti (2008:2)

Table 1.3 shows that out of 19,566 employees that were trained, 87.6 per cent of them were African and that employees from Coloured and Indian communities have the lowest number of trainees in that period. The reason might be that most people from these communities were not willing to work or venture in the mining vocations probably due to the risks associated with working at the mines and exposure to health and safety risks (Nel & Pienaar 2006). The other issue is management’s perception that the lack of skills was exacerbated by the necessary government intervention such as Black Economic Empowerment (BEE) or Mining Charter, which requires amongst other things, that:

- 40% labour of mining company management must be historically disadvantaged South Africans (HDSAs);
- 10% labour of women representation; and
- As a condition for being granted a mining license, to contribute to the sustainable socio-economic development of mining communities and sending areas (Rogerson 2011:5408).

In anticipation of the Mining Charter implementation review in 2009 by the government, employers and unions, the Chamber of Mines assessed the progress of the mining industry on its charter commitments (see Table 1.4).
Table 1.4: Percentage target and actual for HDSA in South Africa

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior management</td>
<td>33</td>
<td>26</td>
<td>26</td>
<td>15</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Professionals</td>
<td>55</td>
<td>54</td>
<td>50</td>
<td>57</td>
<td>56</td>
<td>56</td>
<td>47</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Technicians and associated professionals</td>
<td>49</td>
<td>48</td>
<td>48</td>
<td>50</td>
<td>48</td>
<td>45</td>
<td>37</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Clerks</td>
<td>84</td>
<td>86</td>
<td>97</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>96</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Services and sales</td>
<td>82</td>
<td>82</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>99</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Craft and related trades</td>
<td>44</td>
<td>40</td>
<td>50</td>
<td>57</td>
<td>55</td>
<td>53</td>
<td>44</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Plant and machine operators</td>
<td>58</td>
<td>50</td>
<td>97</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
<td>97</td>
<td>97</td>
</tr>
</tbody>
</table>

Source: Adapted from Department of Labour (2008)

Overall on the positive side, there is slight improvement toward reaching the HDSA target. On the contrary, there is still a very small pool of African, Indians and Coloured matriculants with subjects and grades to access these programmes. This has caused a severe limitation at trying to minimise the risks associated with mining and at a time when programmes like these are necessary to achieve a more representative workforce and to meet employment equity criteria (Adler & Reed 2002:7-8). It is important to understand the main aim of the Mining Charter and how it correlates with employees’ advancement to managerial positions, leading to skills development and unemployment and poverty alleviation. According to the Mining Charter, there is a need to advance mining employees who are most effective to higher positions, especially from HDSA. A lack of performance and commitment in this regard, thought to be less than 50 labours (Kotter 1996) amongst organisational leaders contributed to business failure. The ways to advance to the higher positions in a contemporary business organisation, currently, differ profoundly from those of two decades ago due to the fact that:

- There is strong reliance on career paths, based on skills and experience;
Currently, managerial positions are fewer, organisational structures are flatter and more decentralised and many mining houses are downsizing (Acutt, Hyland & Windeknecht 2004:1); and

There have been changes in Human Resource Management (HRM) practices regarding the selection and promotion of employees, being structured and less subjective, in order to meet affirmative action and equal employment opportunity criteria (Oosthuizen & Naidoo 2010).

1.4 PURPOSE OF STUDY
The main purpose of this study is to:

- Identify the specific sets of skills shortages in the gold mining industry;
- Understand the drivers that influence skills shortage in the gold mining industry;
- Determine management’s perception regarding skills shortage to attract skilled employees in the gold mining industry; and
- Develop a range of recommendations that may be used to address skills shortage in the gold mining industry.

Due to management’s perceptions, skills shortage cannot be separated from the context of the mining profession, educational settings, broader skills development and market environment of the country. Therefore, the qualitative context of the current skills shortage will also be discussed. Finally, taking literature, quantitative and qualitative information into account this study will conclude by outlining the absolute and relative nature of the skills shortage of mineworkers in South Africa, before highlighting the recommendations out of the range of findings emerging from this research study, for successful implementation.

1.5 PROBLEM STATEMENT
According to JIPSA (2007), the business sector has shown more robustness in livening the skills debate than any other stakeholders and states that:
Managerial positions are often filled by skilled personnel and thus increasing the shortages of professionals such as engineers; and

Legislation requires that the Mining Sector comply with strict health and safety regulations, therefore, operations can only be performed by specific personnel with specific qualifications (Research Focus 2007:8).

The vacancies reported by employers and debate thus far about skills shortage are typically for highly skilled personnel who have gone through a formal education system (JIPSA 2007 and Mining Qualifications Authority 2007). As a result of this, the purpose of this study would be to pay special attention to the lower- and semi-skilled categories.

Although most employers may be unable to define and quantify skills shortage, the severity of the skills shortage is when it acts as impediment to technology adoption, effectiveness and efficiency. The urgency to address skills shortage in the South African mining industry is hampered by two main schools of thought on skills, namely perceptions relating to management decisions and business growth or expansion, which articulate views at variance with each other (Erasmus & Breier 2009). For example, there is a perception that:

- Employers report skills shortage because they have the means to deal with it, whiles others may not be able to do so due to financial constraints. Those that have the means, always argue that they would never meet affirmative action quotas (Momberg 2008) since training of unskilled workers and retaining of skilled workers have become expensive; and
- The South African mining industry faces no skills shortage but is inhibited by the underutilisation of the available skills. The mining industry used to generate millions of unskilled jobs, but this sector has now become more capital and knowledge intensive (Runge 2012:3). According to the opinion Laszlo and Laszlo (2002), knowledge has become a key factor in gaining and sustaining the competitive advantage of the mining organisations.
The other problem relating to skills shortage is that South African mining companies face an acute shortage of highly skilled workers especially if the current socio-economic goals of the public sector are taken into consideration (Economic Analysis Directorate 2009:5). Factors contributing to this scenario are:

- Increased machinery sophistication and automation used in mining requires high levels of technical skills for many positions;
- Quarrying and brick works have increased substantially due to major construction projects, such as renovations of stadia, Gauteng Rapid Rail Link (Gautrain) and as well as government operations of upgrading roads, harbours, electricity and telecommunications which would extend this shortage for the next fifteen to twenty years (Economic Analysis Directorate 2009:5). These projects demand much of South Africa’s pool of qualified and experienced people;
- When prices of the commodities increase, resulting in the projects that were dormant becoming viable, re-opened and new ones being developed.

It has been fourteen years since the introduction of the Skills Development Act 97 of 1998 and South Africa is still struggling to produce and retain the critical skills needed to drive the economy (Loynes 2009). Consequently, due to perception that the pool of skilled and experienced people is nearly empty and raising ‘eyebrows’, Dlamini-Zuma (2009) stated that the government is forced to consider extending the work permits of foreigners with scarce skills by up to five years, instead of the current one-year period (Dlamini-Zuma 2009). Subsequently, objections are often raised about foreigners taking positions that could be occupied by locals and therefore not solving the skills shortage but are responsible for the ‘perpetual brain drain plaguing’.

In summary the study attempts to investigate the following problems:

- The first research problem is based on the replacement demand, that is, the demand for skills arising from growth of the company, decline in occupational
employment or people leaving the mining company through retirement and study, sick and maternity leave.

- The second problem deals with the effectiveness of management in addressing the problem of skills shortages in the gold mining industry. The urgency to address skills shortage in South African mining industry is hampered by two main schools of thought on skills, namely perceptions relating to management decisions and business growth or expansion.

- The third problem deals with the surge of global competition in the labour markets, introduction of technology in the workplace, and impending shifts in the demographic mix of force, which calls for a partnership of stakeholders to improve the skills and professionalism of the South African workforce.

Even though there is widespread recognition that South Africa has severe skills shortages in certain key sectors, there is still no consensus as to the nature, extent and existence of this shortage (Erasmus & Breier 2009:2). For example, it is not known what the current skills shortage would be like without migrant workers. In addition to that, the monitoring series currently available in South Africa are incomplete, not always comparable overtime, and seldom available in detail at industrial level (OECD 2003: 103). It is against this background that this study reviewed management perceptions of skills shortages in gold mines.

1.6 RESEARCH OBJECTIVES
Considering the problem statement discussed above the primary objective and secondary goals are identified below.

1.6.1 Primary objective
The primary objective and motivation for conducting this study is to determine management’s perception regarding skills shortages in gold mines.
1.6.2 Secondary goals
To assist and achieve the main objective above, the secondary goals of this study are to:

- provide a theoretical overview of skills shortages and capacity building initiatives;
- develop a hypothetical model of skills shortages in gold mines;
- empirically test the conceptual model and hypotheses; and
- statistically analyse and interpret data collected with a view to arriving at an empirical solution to the problem.

1.7 RESEARCH QUESTIONS AND HYPOTHESES
When considering the hypothetical model of this study, the following research questions and hypotheses are identified.

1.7.1 Research questions
On the basis of the objectives of the research, the following are the research questions:

- Is the work environment provided with efficient facilities to control skills shortages in the gold mines?
- How does management control employment conditions in the gold mines to improve skills development?
- Which resources in the gold mine’s management need to improve so as to sustain skills development?
- What dimensions of education and training do management need to achieve so as to control skills shortages in the gold mines?
- What capacity building initiatives do management need to perform to control skills shortages and improve productivity in the gold mines?
- How does management control skills shortages so as to improve sustainability, competitive advantage and productivity in the gold mines?
- How does management improve skills development so as to control the propensity to leave and turnover in the gold mines?
1.7.2 Research hypotheses

A hypothesis is a preliminary untested theory that may be advanced as a possible answer to or explanation of a particular problem. This theory then forms the basis of an inquiry. The importance of these hypotheses lies in the fact that they would bring direction, specificity and focus to this research study (Kumar 1999:64-65). The null hypotheses that would be tested in this research study are stated as follows:

First set of hypotheses: Influence of independent variables on skills shortages.

*H0¹* The working environment does not influence perceptions regarding skills shortages in gold mines.

*H0²* Employment conditions do not influence perceptions regarding skills shortages in gold mines.

*H0³* Availability of resources does not influence perceptions regarding skills shortages in gold mines.

*H0⁴* Education and training do not influence perceptions regarding skills shortages in gold mines.

Second set of hypotheses: Impact of management perceptions regarding skills shortages on outcomes.

*H0⁵* Management perceptions of skills shortages do not influence organisational performance in gold mines.

*H0⁶* Management perceptions of skills shortages do not influence propensity to leave in gold mines.

*H0⁷* Management perceptions of skills shortages do not influence the competitive advantage of gold mines.
H08  Management perceptions of skills shortages do not influence sustainability of gold mines.

The descriptions above of the null hypotheses will be treated as valid unless the actual behaviour of the data contradicts these assumptions and are rejected (Rachad 2003: 177).

In the light of the above questions and hypotheses, the researcher would undertake an investigation to ascertain the nature of skills shortages in the South African gold mining industry. The next section highlights the proposed hypothetical model of the study.

1.8  PROPOSED HYPOTHETICAL MODEL
Based on the analysis of various secondary sources, it is now possible to construct a model of skills shortages in gold mines. Four independent variables have been identified, namely working environment, employment conditions, availability of resources and training and development; and four dependent variables have been identified, namely organisational performance, propensity to leave, competitive advantage and sustainability. The proposed conceptual model is depicted in Figure1.1.
Figure 1.1: Hypothetical model of perceptions regarding skills shortages in gold mines

INFLUENCES

Working Environment
- Safety
- Health
- Occupational fatalities
- Physical

Employment conditions
- Retirement
- Recruitment
- Contracts
- Rewards
- Fringe benefits
- Placements

Resources
- Funds/costs to hire
- Educational qualifications
- Labour
- Competency level
- Infrastructure

Education and Training
- Technical/engineering skills
- Experience
- Training
- Institutions
- Literacy levels

Management perceptions of skills shortages in gold mines

OUTCOMES

Organisational Performance

Propensity to leave

Competitive advantage

Sustainability

Independent variables

Source: Researcher’s own construct

Dependent variables
The outcomes resulting from the influence of management perceptions and the impact of capacity building initiatives can be classified as performance, turnover, propensity to leave, competitive advantage and sustainability.

- **Organisational performance**: Organisational performance is the organisation’s capability to attain its mission, objectives and goals by using resources in an efficient and effective manner to satisfy the desired expectations of owners, employees and customers (Aluko 2003:172 and Abu-Jarad, Yusof & Nikbin 2010:28). The measurement of organisational performance is normally in the form of productivity, effectiveness, efficiency, profitability or return on investment but in this study it is widened further with the inclusion of social and environmental factors. The organisation should measure its performance in relation to owners, employees, customers, local community and governments (Hubbard 2009:179).

- **Propensity to leave**: This concept may be defined as the employees’ intention to quit their jobs due to possible antecedents such as lack of job involvement, autonomy, skills variety and organisational commitment. Firth, Mellor, Moore and Loquet (2004) claimed that there are several reasons why people leave the organisation, such as insufficient information of how to perform the job adequately; extensive job pressures; and dissatisfaction regarding the working environment or employment conditions.

- **Competitive advantage**: Competitive advantage refers to those resources that allow a mining organisation to develop and maintain an edge over competitors who produce similar products and services. Such an edge is created by offering the same products/services at a lower cost, offering superior products/services at the same price as the competitors do or concentrating on a market niche (Diugwu 2011:102). According to Van Den Berg (2008:415) the mining competitive advantage includes:
  - producing at the lowest cost sustainably;
  - building a premier brand name;
  - harnessing a high performance culture;
pursuing innovation and mechanisation;
- purchasing effectively;
- financing ventures and pursuing opportunities;
- providing competitive barriers using mineral rights, processing and refining methods.
- managing the ore mix of current operations; and
- keeping costs in line on deeper and mechanised mines

Allard (2002:14) linked the success of the business with competitive advantage only if the business is managed effectively.

- **Sustainability**: Sustainability is a business concept that builds long-term value amongst all stakeholders to meet short-term profitable targets and protect its social license to operate (Lins & Horwitz 2007:3). In this study, sustainability measures the commitment of the mines to maintain profitable business performance and corporate responsibility such as to maximise efficiency and effectiveness while protecting the environment, building social equity and increasing long-term financial growth (Raza 2012:6). The most pressing challenge for the mining organisation is to improve the quality of life of its employees and the community in which they are situated by supporting the local community beyond the life of the mine (Lins & Horwitz 2007:14).

### 1.9 RESEARCH METHODOLOGY

**1.9.1 Research paradigm**

There are two main paradigms that can be identified in research, namely qualitative and quantitative research. The qualitative approach is a method used to discover the meanings that participants attach to a certain phenomenon (Flick 2002:17 and Zikmund 2000:108). Quantitative research is a method used to quantify patterns that the researcher encounters within the empirical study (Heppner & Heppner 2004:93). This study adopted the quantitative research approach, by means of descriptive research, whereby the perceptions of management regarding skills shortage in gold mines, would be addressed.
1.9.2 Population
Collis and Hussey (2003:155) defined population as any precisely defined set of people or collection of items which is known to have similar characteristics and from which the samples would be drawn. The population of interest in this study are all managers in South African gold mines.

1.9.3 Sampling
The study was conducted in the North West and Free State Provinces, where the three largest gold mines, AngloGold Ashanti, Goldfields and Harmony, are found. The sampling frame was restricted to management (lower, middle, top and professionals). Purposeful sampling method was used to select samples for the current study. Permission to conduct the empirical study was requested from the mine management. All the proceedings was treated as confidential and also communicated to the participants before completion of the questionnaire could take place. Participation was voluntary and the purpose of the study would be explained verbally and in writing to management and union leaders.

1.9.4 Data collection
The data collection process would be highlighted in the subsequent paragraphs.

1.9.4.1 Secondary data
The rationale for employing a literature study was to incorporate and embed the findings of the current study into the body of knowledge that was relevant to the research problem being addressed (Oliver 2004:106-107). To accomplish this, a thorough literature review on skills shortages and capacity building was conducted. Various secondary sources such as books, journal articles and the Internet would be used.

1.9.4.2 Primary data
Zikmund, Babin, Carr and Griffin (2012:185) defined primary data as data gathered and assembled specifically for the current study. Primary data was collected by means of a survey using self-administered questionnaires. The main aim was to identify the
management perceptions regarding skills shortages, as to identify capacity building initiatives in the gold mines.

1.9.5 Questionnaire design

Questionnaires were completed by respondents themselves, or if necessary, by means of a personal interview. The questionnaire will consist of the following four sections:

- Section A covers general perceptions regarding factors influencing skills shortage, that is: workplace environment, employment condition, resources and education of the mining industry (seven-point ordinal Likert scale).
- Section B was designed to obtain information relating to management perceptions regarding skills shortages in the mining industry (seven-point ordinal Likert scale).
- Section C focuses on skills levels in mining occupations (nominal scale).
- Section D concentrates on the impact of skills shortages on performance outcomes (seven-point ordinal Likert scale).
- Section E covers the biographical information of the respondents (nominal scale).

1.9.6 Pilot study

A pilot study was conducted at a mine in the Theunissen district. Initial samples of 31 managers were requested to complete questionnaires. A pilot study is a smaller version of a larger study that would be used to ensure that the ideas or methods behind a research idea are “sound” and prepares for the project study by pre-testing the research instrument that will be used for data collection (Kumar 1999:9-10).

1.9.7 Validity and reliability of the measuring instrument

The evaluation of the strengths and weaknesses of the research instrument would be done through reliability and validity (Payne & Payne 2004: 28).

1.9.7.1 Validity

Validity describes and assesses a measurement or a criterion that accurately reflects the concept it is intended to measure (Heppner & Heppner 2004:118). Some of the aspects of assessing validity includes: the content, appropriateness of the questionnaire
for the sample population, extent to which the questionnaire is detailed to collect all the information needed to address the research goals and objectives, format of the questionnaire and design. External validity refers to the extent to which the findings of the research study could be generalised across or to the population from which the sample was drawn. It provides clear guidelines of how reporting of the findings of the study should be done (Taylor & Asmundson 2007:30). Internal validity refers to the degree to which the observed change in independent variable can be confirmed with confidence that it is the cause of the change in an dependent variable (Taylor & Asmundson 2007:24).

Face validity would be ensured through the assistance of experts in the field of human resource, Business Management and statistician to scrutinise the questionnaire. Content validity is ensured by means of a pilot study conducted among a convenient sample of managers in the selected gold mines of the Free State. Construct validity would be assessed through discriminant and convergent validity.

1.9.7.2 Reliability
Reliability determines whether the obtained score is a stable, dependable, consistent, accurate and predictable indication of employees’ performance on the administered test or criteria (Flick 2002:220). To ensure reliability, codes from the questionnaires will be given to a statistical analyst to independently code them along the same dimensions. The statistical software package, STATISTICA (version 10) and AMOS would be used to determine the Cronbach’s alpha values for the factors that would be tested in this study. A Cronbach’s alpha values that are equal to or greater than 0.7 would be considered as having acceptable internal validity.

1.9.8 Data analysis
Data analysis is a continuous process of making sense of the collected data through descriptive statistics and exploratory factor analysisist (Ritchie & Lewis 2005:219). In this study, data analysis would involve reduction of data into manageable themes, patterns, trends and relationships. According to Partington (2002:101-102) quantitative research
involves the numerical analysis of data through simple production of tables, charts and
graphs to more advanced multivariate statistics. Firstly, a simplified description of some
phenomenon would be facilitated by using descriptive numerical values such as the
mean, standard deviation and frequencies. Secondly, statistical significance would be
used to identify a correlation between the dependent and independent variables. Lastly,
multiple regressions would be used to estimate the degree to which an independent
variable would be able to predict the value of the dependent variable. Tests of
significance will be designed in order to apply theory to sample data and then make
judgements as to whether characteristics, differences or relationships found in the
sample can be expected to have occurred naturally or by chance in the population from
which the sample was drawn (Blaikie 2001:207).

1.10 LITERATURE REVIEW: CLARIFICATION OF CONCEPTS

1.10.1 Strategic management
Strategic management may be defined as the process whereby management formulate
long-term direction, implement specific performance objectives, and develop strategies
that would enable an organisation to achieve these objectives despite all relevant
internal and external factors. From this definition, the purpose of strategic management
is to address the impact of skills shortage in order to exploit and create new and
different opportunities and optimise current trends for the future (David 2005:5). Ireland,
Hoskisson and Hitt (2009:6) viewed strategic management as a process consisting of a
full set of commitments, decisions and actions required to achieve strategic
competitiveness. Daft (2008:239) concurred with the statement above, in that strategic
management is a set of decisions and actions that would be used to formulate and
implement strategies that would provide a superior fit between the organisation and its
environment.

1.10.2 Skills
The skills concept may be defined as the process of enabling individuals to assume new
roles and implement systems effectively in order to successfully achieve stated
performance outcomes (Harrison 1993:264). Jackson (1997:121-122) defined skills as
technical and personal capabilities that are required for completing a task. The National Skills Task Force (2000) distinguishes skills into four types. Firstly, basic skill is an ability to understand and perform mathematics calculations, numeracy and recently, computer literacy. Secondly, generic skills are a range of skills including finding solutions to a problem, working as a team and the ability to improve personal learning and performance. Thirdly, vocational skills are technical skills needed to carry out tasks within an occupation or an occupational group (Robbins 2001:314). Lastly, “distinct personal attributes” are often defined in terms of motivation, judgement, leadership and initiative, but some authors contrast these as not really skills (Keep & Mahew 1999).

1.10.3 Occupational competency
Competency is a range of standards linked to occupational performance that can be based on having the necessary ability, authority, skills and knowledge that would amount to a person having the capability to execute the task and mandate assigned to him/her (Cowie 1998:234). Occupational competence may be defined as the ability to apply knowledge, understanding, practical and thinking skills to achieve effective performance to the standards required in employment (Bartram 2011:4). Hence mine management believed that with competency, mine accidents and hazards may be reduced, while developing competency frameworks would improve performance and ensure that only competent people are allowed to work underground. The competencies needed are high personal productivity, motivating subordinates, time and stress management, effective communication, and conflict management (Schwella & Rossouw 2005:769).

1.10.4 Skills shortage
A skills shortage can be defined as a situation in which employers are unable to fill vacancies in a specific occupation or specialisation due to an insufficient number of workers with the required qualifications and experience (Green, Machin & Wilkinson 1998:165-187, and Learning and Skills Council 2006). When considering the definitional ambiguity regarding skills shortage above, the following four definitions (Greig, Glancey & Wilson 2008:117) constitute the term “skills shortage”: 
• Current skills gap: there exist a gap between supply of skills currently available and demand for skills that the organisation needs to achieve its business objectives;
• Hard-to-fill vacancy (HTFV): the organisation found it hard to recruit the staff it needs;
• Anticipated skill problem: an organisation anticipates that the skills shortages in future would affect the organisation; and
• Emerging skill problems: management’s perception that the organisation does not have a current skills shortage, but anticipate that the skills problem of some kind would emerge in the future.

1.10.5 Capacity building
Broadly, capacity building is viewed as a long-term process that focuses on the capacities of organisations, infrastructure and communities to influence the performance of an organisation through the provision of technical support activities, such as human, physical and knowledge resources (Matachi 2006:4). Organisational capacity building for example, is directed towards developing the internal competence such as employee and management development. Secondly, infrastructure capacity refers to all organisations that provide general support at national (for instance, Eskom providing electricity to the whole of South Africa), regional (for example, Sedibeng Water Board providing water to Goldfields region) and local (municipality, for example, providing services to the town concerned) level in order to build the capacity of this organisation. Lastly, community capacity refers to the ability of an organisation to take a leading role in the development and regeneration of its community (Research capacity building 2008).

In this study capacity building is defined as an assistance provided to an organisation for the development of its core skills and capabilities in order to seek ways to improve or build the organisation’s effectiveness and sustainability as well as to be better equipped to respond to the changing contexts. Capacity building for an organisation, would relate to a variety of activities such as, improved governance, leadership, mission and
strategy, administration, fundraising and income generation and business positioning. Furthermore, for an individual, capacity building would relate to leadership development, advocacy skill, technical skills and organising skills. It is therefore important that an organisation retain its capacity to generate this skill level at every stage of this development (David 2005:139 and Byars & Rue 2008:92).

According to Letts, Ryan and Grossman (1998), capacity building:

- relates to a range of activities by which individuals, groups and organisations improve their capacity to achieve sustainable natural resource management;
- taking an in depth look at where an organisation stands in comparison to where it hopes to be in the future, and develops the skills and resources to get there (Senge, Kleiner, Roberts, Ross & Smith 1999); and
- includes awareness, skills, knowledge, motivation, commitment and confidence. Capacity building requires an emphasis on a combination of human qualities, material resources and a favourable environment (Letts, et al. 1998).

Subsequently, a need exists to strengthen this capacity to meet the projected higher needs for organisational resources and productivity, associated with future development, attracting investment and population growth, as well as the mines’ conservation and rehabilitation of the environment for future generations. Accepting this huge demand for capacity building, the researcher feels that there is a need to focus on strategies that build on the experiences of the past and give hope for a realistic and sustained future (Rethinking capacity building 2008).

1.10.6 Perception

Individuals respond to a situation based on their perception. Perception can be defined as a process by which individuals organise and interpret available information or their sensory impressions in order to give meaning to their environment (Robbins, Odendaal & Roodt 2001:107). As expected, the views of unions on skills shortage, in terms of quality and quantity, would be at variance with those of the employer. Unions generally want to improve the skill level of their members because higher skills increase their
bargaining power in wage negotiations. On the other hand, employers may consider themselves as facing a shortage at the original wage, and unwilling to employ additional workers at the higher wage (Shah & Burke 2003: 10).

1.11 PREVIOUS RESEARCH
The importance of capacity strengthening programmes in skills development is reflected in substantial research efforts amongst post-graduate students and researchers regarding the approaches and models of skills shortage or deficiency (Rossouw, Le Roux & Groenewald 2003:2-4). There have been a number of theories that have traditionally been forthcoming, explaining that there is a positive relationship between skills shortage and the type of production the organisation undertake, commitment required on investment on training and development, as well as the growth of the organisation (Hogarth & Wilson 2001). Yet, these research studies were uncoordinated, disparate and therefore fails to give a holistic picture of the true state of skills shortage in the country and specifically, mining industry. In addition to that, the monitoring series currently available in South Africa are incomplete, not always comparable overtime, and seldom available in detail at industrial level (OECD 2003:103).

1.12 SCOPE AND DELIMITATION OF THE STUDY
This study reviewed the literature and empirical survey study on skills shortages in the gold mining industry. As it is the key contributor to the safe production of mining products, it is imperative that the mining industry ensures competent human (technical and managerial skills) capacity building in order to manage skills shortages in the gold mines. The focus of the study was on the impact of skills shortages on various variables as identified in the proposed conceptual model. The focus of this study was therefore directed toward these concepts and their interrelationship in order to contribute to the existing body of knowledge in the field of strategic management research.
1.13 STRUCTURE OF THE RESEARCH

This section comprises a brief outline of the eight chapters in this study as shown in the table below, followed by a brief summary of its content.

Table 1.5 Outlay of the study

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
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<tbody>
<tr>
<td>One</td>
<td>Introduction and background of the study</td>
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<tr>
<td>Two</td>
<td>Overview of the mining business environment</td>
</tr>
<tr>
<td>Three</td>
<td>Conceptualising skills shortage in gold mines</td>
</tr>
<tr>
<td>Four</td>
<td>Skills development in the mining industry</td>
</tr>
<tr>
<td>Five</td>
<td>A model for management perceptions of skills shortage in gold mines</td>
</tr>
<tr>
<td>Six</td>
<td>Research methodology of this study</td>
</tr>
<tr>
<td>Seven</td>
<td>Data analysis and interpretation of the empirical results</td>
</tr>
<tr>
<td>Eight</td>
<td>Summary of findings, conclusions and recommendations</td>
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</table>

- **Chapter One - Introduction and background of the study**
  This chapter would introduce the study by providing a background to the study; the problem statement and outlining the research objectives. A brief overview of the research methodology will also be provided. Clarification of key concepts to be used in this study will be highlighted.

- **Chapter Two - Overview of mining business environment**
  In this chapter, the nature of the mining business environment would be outlined with specific reference to aspects regarding skills shortages.

- **Chapter Three - Conceptualising skills shortage in gold mines**
  This chapter would present the nature and extent of skills shortage in gold mining sector.
• **Chapter Four - Skills development in the mining industry**

Chapter four would highlight some of the skills development initiatives that are available, as well as the impact and outcomes of skills shortages, and capacity building initiatives in gold mines.

• **Chapter Five - A model for management perceptions of skills shortage in gold mines**

This chapter would present the proposed conceptual model to be used in this study, research hypotheses and the operationalisation of the variables.

• **Chapter Six – Research methodology of this study**

Chapter six would provide a brief overview of the research methodology followed in this study. Aspects to be covered include: research paradigms, sampling, data collection, questionnaire construction and data analysis.

• **Chapter Seven - Data analysis and interpretation of empirical results**

Responses would be analysed and interpreted through discussion regarding the main trends, patterns, similarities and differences that may have emerged. Results would be illustrated by means of graphs, figures and tables.

• **Chapter Eight - Summary of findings, conclusions and recommendations**

Chapter 8 would provide a summary of the study, draw main conclusions and highlight important recommendations and managerial implications.


1.14 CONCLUSION
This chapter provided an introduction and background to this study. In understanding the role and impact of management perceptions regarding skills shortages on organisational performance, propensity to leave, competitive advantage and sustainability and therefore, achieving the desired output in the mining industry, the various mining organisations or units need to understand different attributes of various variables best suited to promoting desired outcomes. The quantitative method was used to collect data in this regard and would be discussed in detail in chapter six.

Chapter two clarifies the business environment in which the mining organisation operates in detail, taking previous studies into consideration.
CHAPTER TWO

OVERVIEW OF THE MINING BUSINESS ENVIRONMENT

2.1 INTRODUCTION

Chapter one provided an introductory statement, problem statement and hypotheses of the study and indicated the manner in which this study was going to be conducted. Chapter two sets out to highlight the primary factors of the business environment in which the mine operates that drives mining organisations to focus on attracting, developing and retaining skilled employees in order to attain high performance, low employee turnover, competitive advantage and sustainability. The internal and external factors that influence organisational performance range from the level of the skills of the force to the nature of the mining business environment. However, what must be noted is that these factors are complex and dynamic in nature because they not only influence the organisational performance but affect how mining business would strive for optimum and sustainable performance. Therefore, it is important to discuss the business and regulatory environment of the mining organisation.

The discussion in this chapter is based on the six AsgiSA' constraints (Rasool & Botha 2011:2) that prevent South African mining industry from achieving its desired growth rate, which includes:

- the relative volatility of the currency;
- the cost, efficiency and capacity of the national logistics system;
- shortages of suitably skilled workers and the spatial distortions of apartheid that affect unskilled costs;
- barriers to entry, limits to competition and limited new investment opportunities;
- the regulatory environment and the burden on small and medium enterprises (SMEs); and
- deficiencies in state organisations’ capacity and leadership.
This study analyses the nature of business environment from the perspective of its complexity and dynamics. According to Platzek (2012:51), the business environment is fundamentally complex, as it is very difficult to predict future happenings, especially when environmental changes are taking place too frequently as in the case of mining, information technology or fashion industries. On the other side, the business environment is dynamic in that it keeps on changing whether in terms of technological improvement, shifts in consumer preferences or entry of new competition in the market (Reino, Kask & Vadi 2007:124). Garg (2007:3-4) argued that the ability of an organisation to adapt to changing environmental circumstances is a key to organisational survival while effectiveness of the adaptive response is dependent on aligning the response to the environmental circumstances faced by the organisation.

Like other industries, the mining industry also operates within an industry-related environment. Its performance is being affected by the increasingly complex geological conditions, demands, and local and global competition. In addition, skills shortages, increasing social commitments, rising input costs, inadequate infrastructural development, unreliable electricity generation and water reticulation further aggravate the situation (Stone & Van der Merwe 2010: 457).

This chapter is structured as follows; the first part presents an overview of the mining business environment’s impact on the mining industry; the second part provides how mining can have significant impacts on the environment both during the mining operations and for years after the mine is closed, so it must be managed in a way to minimise those impacts through well-designed, well-operated, and well-regulated mining operations, and ensure environmental sustainability. The last section endeavours to ascertain the future global challenges facing the mining industry.

2.2 BUSINESS ENVIRONMENT OF THE MINING INDUSTRY
Business environment may be defined as the study of the business in relation to its environment and a set of external and internal factors which may influence the continued and successful existence of the business organisation. Organisations are open systems and have to interact with the environment (Kaifi & Noori 2011:89) to
survive and grow; organisations must make sound judgment of their surroundings and avoid costly errors (Bosch, Tait & Venter 2011:40). While there are multiple characteristics of the environment, one fundamental dimension that can affect how mining organisations respond has always been the degree of uncertainty (Lin 2006:439).

2.2.1 Conceptualising the business environment uncertainty

Mining is a very risky business venture compared to other businesses because it depends entirely on ore-body estimations; as such decision makers must consider many uncertain input factors in the mining industry. The main sources of uncertainties are reserve amount, ore grade distribution, recovery processes, selling price of the product and density of in-situ reserve. Uncertainties begin with exploration and continue up to the closure of the mine (Erdem 2008:24-25). These uncertainties have an important impact on project investment decisions and profitability of the mining projects. Knowledge management and competitive intelligence have become two important strategy concepts for mining decision makers to ease the complexities of uncertainty. A number of authors have strong views on the role and boundaries of each of these concepts (Liebowitz 2006:16-22, and Rothberg & Erickson 2006:6).

Uncertainty means that decision makers do not have sufficient information about environmental factors, and they have a difficult time predicting external changes (Daft 2007:600). Uncertainty increases the risk of failure for organisational response and makes it difficult to compute costs and probabilities associated with decision alternatives (Bosch et al. 2011:43). The awarding of mining licences and reforming of the labour market are some issues that the mining organisations are uncertain of. As a result, this uncertainty would continue to discourage both domestic and foreign investors and further affects the risk assessment of global ratings. South African comparative position as a mining destination has, according to the Fraser Institute's influential global survey, fallen once again due to, for instance, SA's dysfunctional mining bureaucracy and political interventions. The miners, for years, had complained about the policies aimed at driving skills away, making mining difficult with rigid regulation and making
unaffordable, and the underhand dealings at the Department of Mineral Resources (Cohen 2011). The uncertainty concerning the administration, interpretation, and enforcement of existing regulations was illustrated by the extraction from Fraser’s Annual Survey of mining companies 2010/2011 presented in Table 2.1.

**Table 2.1: Survey of mining jurisdictions by the Fraser Institute 2010/2011**

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<tr>
<td>Total jurisdictions</td>
<td>79</td>
<td>72</td>
<td>71</td>
<td>68</td>
<td>65</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Policy Potential Index</td>
<td>67</td>
<td>61</td>
<td>49</td>
<td>50</td>
<td>53</td>
<td>37</td>
<td>53</td>
</tr>
<tr>
<td>Mineral potential</td>
<td>66</td>
<td>45</td>
<td>44</td>
<td>45</td>
<td>57</td>
<td>27</td>
<td>37</td>
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Source: Adapted from McMahon and Cervantes (2011:24-30)

Fraser’s Annual Survey of mining companies, a survey that includes data on 79 jurisdictions, shows that South Africa’s ranking has plummeted 30 places from 37 to 67 in five years, while Africa's average score has not improved in the past 4 years. South Africa is ranked 71 for growing uncertainty in mining policy and implementation, and 70 for trade barriers, which includes currency restrictions. The number of transactions in the mining sector has also declined by 77,8 labour from US$ 13 billion in 2003 to US$ 2.9 billion in 2010 (Sergeant 2011, and McMahon & Cervantes 2011:24-30).

Clinton, Woollard and Thomas (2012:5) reported 50% increase in uncertainty about the business environment within which mining organisations are operating, over the last two years, and this continues to affect the wellbeing of the workforce. Those people who are working in organisations with higher levels of uncertainty are more likely to experience higher levels of stress, employment relations problems and absenteeism. Gupta (2009) pointed out that the characteristics of the business environment that is particularly relevant to the understanding of mining environmental uncertainty, considers how simple or complex and stable or variable the environment is.
• **Complexity of environment**: According to Elliot (2010:6), the volatility of the commodity prices, mining risks appetite and availability of capital during the recent global financial crisis, have all made the mining operational decisions more complex. In the case of skills shortage, Healy, Mavromaras and Sloane (2012:13) reported that there are considerable differences in the complexity of skill shortages by industry. Agriculture, Construction and mining industries are most likely to report skills shortages with complex causes while businesses in the wholesale and retail industry are less likely to report multiple skills shortages. Mining, like any other business operating in a more competitive environment is more likely to encounter formidable skills shortages. The execution of complex operations requires more skilful, thoughtful and experience decision making and is more prone to error than a simple one. There are three environmental levels to be analysed in this study, namely, macro, industry and internal environments. This study will identify, categorise, explore, describe and analyse the complexity existing in these environments (Gupta 2009, and Leach 2011:14-15).

• **Stability of environment**: It is the frequency at which the environmental elements change and how predictable are the changes. The stable and unstable dimension refers to whether elements in the environment are dynamic. An environmental domain is stable if it remains the same over a period of months or years and only few elements change in a predictable fashion. It is a known fact that South African mining houses are multinational companies and as such must examine several key factors, (1) political environment, (2) economic growth prospects, (3) local labour supply, and (4) financial stability, when conducting a feasibility study for possible mining destinations (Tanoos 2012:74). Mining organisations may prosper under a stable and conducive political climate. On the other hand, skills shortages in the mining industry occurs due to the cyclical nature of the industry, with its periods of expansion and contraction employees are not sure whether to stay or not (Phillimore, Curtain & Algie 2000:5). Safe, healthy, stable and enjoyable working conditions are the best way to attract and retain talented skilled employees. Under
unstable conditions, environmental elements are dynamic and shift abruptly, and it is hard to anticipate the changes (Gupta 2009 and Leach 2011:14-15).

It is imperative to understand the environment in which the business has to operate and to learn more about various components of the business environment in order to conceive better, more informed and likely more competitive business models (Koh, Gunasekaran & Saad 2005:385). The striking feature of business environment review is the wide range of perceptual environmental characteristics measured in uncertainty studies. The characteristics of the business environment of mining industry may be classified into; (1) impact of external factors on organisational performance; (2) impact of industry factors on sustainable competitive advantage; and (3) impact of internal factors on overall research outcomes of the study. The lack of knowledge of these various components can have severe effects on the performance and future survival of the organisation (Daniels, Radebaugh & Sullivan 2007).

2.2.2 Impact of external factors on organisational performance
The external environment is a relatively remote environment with factors that have an indirect and uncontrollable influence on the organisation (Rossouw et al. 2003:35). These factors are categorised as global and macro environments.

2.2.2.1 The state of the global mining industry
Globalisation has established new dynamics (political and strategic risks) in many entrenched industries, such as automotive, communications, clothing, electronic, and even in the mining industry, as it has seen some of the greatest changes in its history. Amidst this complex environment, the mining organisation has to face the reality of global involvement (markets, production and competition) and the struggle to create a sustainable competitive advantage, and these two issues have become common denominators of many mining organisations (Elliott 2010:2, and Skirrow 2000:1).
Global involvement of the mining industry

The global involvement of the mining industry occurred due to the trend of increasing international trade across national boundaries and the conduct of business activities in more than one country (Brooks, Wheatherston & Wilkinson 2004: 308). The AngloGold Ashanti Company has operations in ten countries around the globe; Goldfields Company has operations in South Africa, Ghana and Australia; Harmony Company has operations and projects in South Africa, Australia and Papua New Guinea (Virtual Metals Research 2006:28-30).

Traditionally, mining countries such as the USA, Canada, Australia, South Africa and UK (mining finance) dominated the global mining scene (Humphreys 2012:1). These countries have become the traditional leaders in mining and exploration methods and technology. Exploration and development funding has changed over the past few years with emphasis shifting to areas that have been poorly explored or have had poor access for reasons of politics, infrastructure or legislation (Mbendi information Source 2011). The rise of China had an important implication for Africa. China’s trade with Africa is growing rapidly because of its need for commodities and being a major player in the oil sectors of the Sudan, Nigeria, Algeria, Angola, and Gabon (Hale 2006:9). The investment on projects located in Africa has fairly been constant over the first years of the 21st century indicating that the attractiveness of Africa as an investment target has at least not declined during the recent boom (Ericsson & Elof 2009:10). However, it should be noted that it has not improved either. Prinsloo (2010) believed that an increasing number of global investors are focusing on Africa for investment returns. India has set its sights on South Africa’s mineral resources and is keen to form partnerships with local organisations. Consequently, most of South African mining organisations are in foreign control.

Dzebu (2010:5) suggested that the South African mining industry had, for a very long period, been one of the leaders in the global mining business, but has dropped to the fifth place, as shown in Figure 2.1.
Baxter (2010:109) pointed out that China’s rise as a great economic power has become one of the dominant issues of our time. The global commodities boom, which commenced in October 2001, was driven by a flowing together of two positive factors (Baxter 2010:109) applicable to mining industry, namely:

- materials intensive growth in developing countries and emerging economies with a fast growing population, such as Brazil, Russia, India and China, that are driven by significant urbanisation and industrialisation processes; and
- constraints in supply from mining companies. Mineral supply was relatively constrained as the mining industry grappled with the six ‘Ps’: constraints in the form of (1) people, (2) procurement, (3) power, (4) permits, (5) projects and (6) politics, resulting in declining stock piles for various minerals
Dzebu (2010) and Baxter (2010:109) pointed out that the Chinese economy has enjoyed nearly two decades of 8–9% output growth. In 2010, it was estimated that the contribution of the Chinese to the Mining GDP is now about US$182 billion and ranked first in the top ten mineral producing countries in the world. Its influence in world markets is demonstrated by the fact that it is now a larger consumer of most industrial raw materials than the United States (Hale 2006:2). Resource-rich countries such as South Africa have benefited from China’s new role in the globalisation of manufacturing and trade (Hale 2006:8). The Chinese treat Africa differently than does the Western countries, which see instability on the continent as a potential threat. The Chinese, on the other hand, see Africa as a long-term business opportunity.

(b) Mining businesses in Africa
According to the Economic Commission for Africa (2009:2), Africa is a poor continent, well endowed with mineral resources and one of the few regions remaining in the world which is largely unexplored. The world’s largest mineral reserves of platinum, gold, diamonds, chromite, manganese, and vanadium are situated in this continent. Most of these minerals are exported as ores, concentrates or metals without significant downstream processing to add value (Economic Commission for Africa 2009: 2). During the period of colonisation, African resources supported industrial development of the mother country, while industrial development in the continent was deteriorating. African people have not benefited in any significant way from the resources which have been extracted from their land and have little to show for the exploitation of their mineral resources (Kabemba & Southall 2010:13). The increase in exploration and mine development in Africa primarily focused on gold and diamond exploration (Davis 2007). South Africa, Ghana, Zimbabwe, Tanzania, Zambia and the DRC dominated the African Mining industry, whilst countries such as Angola, Sierra Leone, Namibia, Zambia and Botswana rely heavily on the mining industry as a major foreign currency earner. Nevertheless, several African civil wars are funded by some of these commodities, in particular diamonds (Davis 2007). In its Programme of Action, the New Partnership for Africa’s Development (NEPAD) expresses the belief that the minerals sector is important in the development of Africa in the 21st century. NEPAD proposed a range of
objectives and actions which would result in more efficient extraction, harmonisation of policies, information sharing, beneficiation and skills training (Limpitlaw 2004:8).

The South African mining environment is vastly different arena than the one previously controlled by the big mining houses, having undergone a series of significant changes in the past years (Taplin, Tétrault & Snyman 2003). These changes include the introduction of the Mineral and Petroleum Resources Development Act, 2002 (known as the Mineral Development Act) and the Broad-Based Socio-Economic Empowerment Charter (known as the Charter) for the South African Mining Industry, published in draft form in October 2002 and the related check-list (known as the Scorecard) document released in February 2003 (Taplin et al. 2003:1).

According to Malherbe (2000: 1), the development of South Africa from an essentially agricultural to a modern industrial economy can be linked to the discovery of world class diamond and gold deposits in the latter part of the 19th century. The combination of the two minerals with others like coal, platinum, iron ore etc. played and continue to play a significant role in South Africa's economy in terms of job opportunities, contribution to the GDP and its social investment.

(c) Importance of South African mining industry globally
Leon and Wentzel (2010:1) stated that South Africa’s mining industry’s position as the largest gold producer in the world was lost to China in 2007. Table 2.2 illustrates South Africa’s mineral potential and production in global terms. Nationally mining industries now contribute over five labour of South Africa’s GDP. However, precious metals account for 65% of the country’s mineral export earnings and 21% of total exports of goods. The industry employs some 500 000 people directly and a further 500 000 indirectly through suppliers and services.
Table 2.2: South Africa’s share of the world’s reserves and production

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Africa’s % of World Production</th>
<th>Africa’s Rank Production</th>
<th>Africa’s % of World Reserves</th>
<th>Africa’s Rank Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum</td>
<td>78%</td>
<td>1</td>
<td>88%</td>
<td>1</td>
</tr>
<tr>
<td>Gold</td>
<td>18%</td>
<td>3</td>
<td>55%+</td>
<td>1</td>
</tr>
<tr>
<td>Chrome</td>
<td>51%</td>
<td>1</td>
<td>95%</td>
<td>1</td>
</tr>
<tr>
<td>Manganese</td>
<td>28%</td>
<td>2</td>
<td>82%</td>
<td>1</td>
</tr>
<tr>
<td>Vanadium</td>
<td>40%</td>
<td>1</td>
<td>44%</td>
<td>1</td>
</tr>
<tr>
<td>Cobalt</td>
<td>18%</td>
<td>1</td>
<td>42%</td>
<td>1</td>
</tr>
<tr>
<td>Diamonds</td>
<td>54%</td>
<td>1</td>
<td>60%+</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Adapted from Swiss Business Hub South Africa (2009)

Table 2.2 illustrates that South Africa holds an abundance of mineral resources and is currently a leading producer of metals, such as above 55% of gold, about 90% of platinum metals, about 80% of manganese, above 90% of chrome, about 42% of cobalt, about 45% of vanadium, diamonds and coal. In addition, the mining industry plays a fundamental role in the South African economy as mining and quarrying exports constitute approximately forty per cent of total exports. The demand for the many commodities that South Africa possesses has played a major role in helping the economic recovery of the country. South African mining organisations are of the most successful in the world and South African expertise in this sector is globally recognised (Swiss Business Hub South Africa 2009).

(d) Impact of the global economic crisis on the South African mining sector

The global picture is clearly important for a large mineral-producing country such as South Africa. The economic tide appears to be turning and the South African economy is beginning to mend. One industry that is crucial to monitor is the mining sector and this study examines the state of the mining industry in South Africa during this period (Van
The global financial crisis of 2008/2009 period, severely affected the mining industry and the fall in export sales and commodity prices led to massive job losses, estimated to be in the region of 50 000 (Baxter 2010:113-114). Lonmin, the world’s third-biggest platinum producer announced that they are to lay off 5,500 workers at two South African mines (Swiss Business Hub South Africa 2009). The company said that this has come about as a result of the tumbling demand from the car sector which uses platinum in catalytic converters. Similarly, Anglo American reported that they will be cutting jobs by 19,000. Gold production also dropped by 13.6%, the lowest level since 1922 making SA only the third largest gold-producing nation behind China and the US. This number could even have been bigger as analysts put estimated job losses at between 100 000 and 150 000 had the government, unions and mining organisations not implemented the Mining Industry Growth, Development and Employment Task Team (MIGDETT), which helped mitigate against those larger potential job losses (Van der Merwe 2010).

According to Global Business Reports (2008:54), the global commodities boom and a recovery in fixed investment in the mining sector did little to turn the wheel around because mining production in South Africa continued to decline and the country was unable to take full advantage of the global boom. A combination of factors is responsible, including infrastructure challenges, regulatory red tape and production disruptions due to safety related issues. The rise in global commodity prices was supposed to have boosted activities and incomes in the economy and shifted the factors of production towards the mining industry, but this is not happening (Connolly & Orsmond 2011:1). However, for the efficient mining development to continue investment into road, rail and energy infrastructure, education and skills development must be seen as the most important contribution that foreign mining companies can make in advancing the country economy and the mining industry (Global Business Reports 2008:69).
(e) Globalisation and skills shortage

One of the features of globalisation is lack of restriction on the movement of within South Africa and between South Africa and rest of the world. Lack of restriction creates opportunity for skilled people to move across the border for better job prospects. Although, globalisation might be pointed out as the reason for skilled people leaving the country, there are socio-cultural, political and economic factors that push people out of the country, such as feeling insecure with political dispensation. These people would move to the countries where they could feel safe to offer their skills (Rasool, Botha & Bisschoff 2012:11). On the other hand, the mobility of skilled workers is encouraged by multinational companies when they transfer some of their staff to abroad-based branch of the same organisation.

2.2.2.2 Macro environment

The managers may use Political, Economic, Social issues, Technological, Legal and Environmental issues (PESTLE) to analyse and describe the macro-environment that the mine faces. These variables, each on its own, may shape and directly influence the skills shortage (Lussier 2003:47-50, and Johnson & Scholes 2002).

(a) Political variables

Every organisation has both internal and external politics. The internal politics like team jealousies, cohesiveness, and personal interests occur in all departments and must be considered and managed by stakeholders (Sharan 2003:136). The external politics refer to those which the organisational stakeholders do not control. Government-oriented policies and practices tend to focus on formal rules, and therefore, the organisation is not likely to function well in a regulated or non-market-based environment. According to Rasool (2010:43), the major reasons that leads to loss of skilled South Africans include crime, decline in service delivery, poor quality of life, unhappiness with the political situation, declining education standards and inadequate government health care (Bailey 2003:235).
(b) Economic variables
Agriculture and mining, as primary sectors, have traditionally formed the backbone of the South African economy but have been experiencing a rapid decline as important contributors to the national output, lately. They are both particularly sensitive to changes in the value of the domestic currency (Doole & Lowe 2001:15-16). Mining, in particular, has to adapt to the risk of currency appreciation, declining of gold or platinum price, rapid depletion of ore reserves and increase of operational costs, resulting into retrenchments and downscaling. However, the mining industry still occupies the central position of the South African economy, evidenced by its consistent domination of national export earnings, its provision of direct employment to well over 400 000 people and the fact that it accounts for more than 40 per cent of the market capitalisation of the JSE Securities Exchange South Africa (Fauconnier 2004:11).

Rasool et al. (2012:13) believed that the state of the economy may be the reason why many skilled people intend to leave the country. The high rate of inflation and other economic factors such as of appreciation of foreign currency, interest rate and fluctuation of the exchange rate erode savings and create a considerable degree of uncertainty in the future. Rogerson and Rogerson (2000:49) reported that 74% of people who left the country were unhappy with the level of taxation, and 71% were unhappy with living costs.

(c) Social variables
South Africa is a conglomeration of different ethnic groups, each in itself with a distinct culture. Therefore, there is a growing need for the fulfilment of a culture of social responsibility by the organisation towards the community in which it is situated. Throughout its existence, the mining industry has strived for the pursuance of a quality life in the broader community by being one of the main providers of employment to illiterate workers locally and also to immigrant workers from Lesotho, Mozambique and other neighbouring countries. Unfortunately, the mining employees, like the wider South African population, have inevitably been exposed to HIV/AIDS and as a result, the
industry identified the virus as a major threat; considerably more than a decade ago (Fauconnier 2004:9-11).

Mine closures or staff reductions can negatively impact on a community’s and government’s perception of a mining organisation. Therefore, a balance needed to be struck between cost optimisation and environmental responsibility such as building houses, schools, hospitals and sports facilities for its employees as well as social investment programmes, in the form of sponsorships and bursaries for skills development (Robbins & Decenzo 2001:57-58).

A number of social factors such as the potential to increase the standard of living have a tendency to increase the flow of workers into the country of interest. Some social factors include the ageing population of workers, language barriers, access to housing and education, behaviours and cultures of workers. Most of these factors make many migrant workers feel socially excluded.

(d) Technological variables
Global markets, on-going technological change together with other rapid changes in the external business environment make the world more complex, have an impact on organisations’ products or services and require change in traditional management (Platzek, Pretorius & Winzker 2010:477). Technology is continually being developed, with an increasingly important role in the mining sector for productive processes as well as value adding activities, resulting in the need for a high level of technical skill due to increasing sophistication of equipment and machinery, changes to entry barriers in the market, and changes to financial decisions like outsourcing of critical and scarce skills. The varying technological environments of different countries affect the designing of products. In the USA, and many other countries, for example, electrical appliances are designed for 110 volts, but when these are made for India, they have to be 220 volts. In the modern competitive age, the pace of technological changes is very fast (Cronje, Du Toit, Marais & Motlatla 2003:97-99).
The changes in the shortage of skills may be caused by structural changes, new products, technology and workplace arrangements (Rasool & Botha 2011:3). Thus, according to Richardson (2007:9) these skills are specifically for those occupations and usually take years to acquire them. This explains the on-going concern of skills shortage. Sabourin (2001:5) reported that skills shortages for all professionals increase gradually with the expansion of the plant size. It follows then that technological change is positively related to the skills shortage, meaning that an increase in technology results into an increase in skills shortage.

The South African gold mining sector is faced with the cultural trend of increased automation in underground mining, where work is done by robot machines with computer guidance or even operated from the surface, because intensive operations are too costly at ultra-depths.

(e) **Legal variables**

Organisations must deal with unfamiliar political systems when they go international, as well as with more government laws, policies and regulations. The changes to legislation may have impact on mining costs, general employment, access to materials, quotas, resources, imports/exports, taxation etc. The recent introduction and amendment of various legislation and regulation acts (such as the Mining Charter, the Basic Conditions of Employment Act, the Relations Act no. 66 of 1995 and the Employment Equity Act no. 55 of 1998 and others) have placed an enormous pressure on the South African mining organisations. This meant they had to conform and move towards fully representative organisational structures, in order to be granted their periodical mining licence. In an attempt to accelerate this process, for example, various organisations in South Africa are embarking on action and black empowerment programmes to develop historically disadvantaged groups and to integrate them into the existing organisational culture (Daft 2010:104-105, and Nieman & Bennett 2006: 246).
According to Hartman and Mutmansky (2002:26), the laws applicable to the mining industry may be categorised into:

- **Consumer laws**: These laws are designed to protect customers against unfair practice such as deceptive advertising of the product and distort the demand side in order to increase the share value (Leary 2005:1149).
- **Competition laws**: These laws are aimed at ensuring fair competition and the free flow of truthful information in the marketplace such as protecting small firms against bullied by larger firms and ensuring customers are not exploited by firms with monopoly power (Leary 2005:1147-1149).
- **Employment laws**: These laws are the set of rules and regulations that regulate the dismissal of workers, working hours and minimum wages. Their main aim is to protect employees against the abuse of power by managers (Kugler & Pica 2003: 3-4).
- **Health and safety legislation**: These laws are aimed at ensuring the workplace is as safe as is reasonably practical. They cover issues such as training, reporting accidents and the appropriate provision of safety equipment (Mine Health and Safety Act of 1996).

The government intervention to address inequality and skills shortage in the workplace was seen as the reason why people took early retirement and intended to leave the country. Rasool and Botha (2011:2) felt that apart from the shortage of skills, factors like affirmative action and employment equity also contributed to unemployment. With regard to Affirmative action, many skilled people were affected in particular Whites, who felt that the government did not appreciate their talents or skills. The results of a survey of the Southern Africa Migration Project reported that approximately 83% of White people and 20% of Black people opposed the government’s affirmative action policy (Rasool *et al.* 2012:13, and McDonald & Crush 2002:40). They turned to emigration.
(f) Environmental variables

A social phenomenon of the industry sometimes causes disturbances in the socio-economic prosperity levels in the community, thus creating a gap between the expectations of the masses and the economic reality of the industry. Mining by its very nature requires that land, air and water systems be disturbed, and end up becoming pollutants (Hoskin, Bird & Stanley 2000). This entails accusations of environmental damage and risk of working in a mine. The risks of working in a mine are of more concern to the workers in the industry than to the public at large. Dusts and noise for example, which are most of the time hazardous hygienically, are produced by a lot of mining activities. The challenge for the mining industry is to find, extract and process mineral resources with the least possible environmental disruption. This impact has led to most of the world's nations adopting regulations to moderate the negative effects of mining operations. For instance, certification of mines with good practices occurs through the International Organisation for Standardisation (ISO) such as ISO 9000 and ISO 14001, which certifies an auditable environmental management system.

Van Der Veen and Strongman (2003:18) said that sustainable development in the mining sector requires projects that are financially viable, environmentally sound, and socially responsible, implemented with sound governance (not only organisations but also communities and Governments) and have lasting developmental value, especially at the community level. The mining industry thus endeavours to align its operational culture with the World Bank Draft Environmental, and Health and Safety Guidelines for Precious Metals and continual impact assessment, as required by the certification process. One of the certification requirements is to adopt an expanded range of protective measures (MacLeod 2004:3) that include:

- sensitive treatment of the land during exploration;
- environmental and aesthetic management of land under development;
- environmentally sustainable production procedures during the mining and metallurgical processes; and
- decommissioning and reclamation practices aimed at restoring the land.
The greatest environmental issue associated with gold mining is the disposal of a significant amount of waste removed from the mines which end up as dust and water pollutants (Robbins & Coulter 2002:98). Therefore, organisations are social phenomena which exist within a wider social context. Treuren (2009) reported that evidence of the damage resulting from climate change was accumulating and businesses were feeling pressure to adopt environmentally friendly workplace practices. These environmental pressures created four distinct types of skills shortage challenges.

- There would be an enormous demand for research and development of environmentally friendly technologies. The world will need a generation of scientists, engineers, policy makers and managers trained to find better ways of doing things.
- Organisations would start the process of dismantling old, inefficient technologies and replacing them with new, environmentally-friendly approaches. Business will need people with the right knowledge to implement and maintain new environmentally-efficient business practices.
- Organisations’ expertise in some areas of climate-change management, such as renewable energy research, engineering and environmental management would be in great demand globally. This would increase competition for these workers, regionally and globally; a workforce already too few in number to meet local needs.
- There would be a shortage of Human Resource expertise in the management of organisational change and workforce retention.

Treuren (2009) further argued that these four shortages were workforce planning problems which needed to be faced by the business, government and education sectors working together to develop knowledge and skills needed for the future. Lastly, as a result there will be a shortage of human resource expertise in the management of organisational change and retaining of skilled workforce.

2.2.3 Impact of industry factors on sustainable competitive advantage

Industrial (marketing) environment is the closest environment of the organisation and its elements influences organisations’ competitive advantage and have a direct impact on
an organisation’s strategy. Profitability, growth and survival are the main objectives of every organisation in a competitive business environment (Cant & Van Heerden 2010:37). The mining market structure can be associated with an oligopoly market. The main characteristics of an oligopoly are that there are few mining houses in the market, mining houses produce homogenous products, and market entry barriers do exist (Carlton & Perloff 2005).

2.2.3.1 Defining competitive advantage of the mining industry

South African organisations are at the centre of global mining operations, services and technology. According to Malherbe (2000:4) the South African mining organisations have become globally prominent in three areas, namely, technology providers to the global mining industry, providers of knowledge-based mining services and specialist mining contractors. For instance, South African organisations are world-class in mining gold, platinum, diamonds, coal, ferrochrome and base metals; are among world leaders in mining explosives, drilling equipment and abrasives, metallurgical processes and plants, and delivering knowledge-based services to mines everywhere.

The fears regarding the future of the international markets have hindered consumption and exacerbated the financial status of small and medium-sized mining organisations. These organisations found it difficult and problematic to finance new exploration and mining projects (Carlton & Perloff 2005), resulting into mergers. This new breed of merging and acquisitions did not end up with small and medium-sized organisations, but also with the largest mining organisations. According to Haviv and Lieberman (2008) in 2007 the mining industry was caught by surprise with the world’s largest miner BHP Billiton’s attempting to take over its greatest competitor, Rio Tinto (third largest mining company). BHP offered Rio Tinto $138 billion in order to establish a mining giant worth $380 billion in 2007, but the bid was rejected. BHP upped its bid to $147.4 billion in 2008, but was again turned down by Rio Tinto (Haviv & Lieberman 2008). BHP’s current bid, which stands at about $175 billion, has received the green light from the US Federal Trade Commission. Nevertheless, the bid has yet to be approved by the regulators of the EU, South Africa, Australia and Canada while Chinese and Japanese
customers of steel manufacturers and German industrial players are urging the European Commission not to approve the bid. Consequently, it could be expected that only a handful of mining organisations are likely to dominate the global mining business landscape over the medium to long term (Skirrow, Binns, Albi & Souza 2001:2). Generally, this is the case, since 50% of the world’s largest mining organisations merged in 2004, representing 82% of the total market capitalisation of the global industry (Royal Bank of Canada 2004).

The understanding of the numerous and sometimes understated degrees of competition in global markets or global organisations is thus rapidly becoming a required competency in many organisations (Pearce & Robinson 2003:96). The critical issue for the mining industry is recognising that effective global competition requires meeting or exceeding global standards in terms of quality, service levels, safety and environmental concerns, among other performance criteria (Hitt, Ireland & Hoskisson 2001:47). The dramatic, transforming changes in the global mining industry are based on these performance dimensions and the realisation skill that mining is influenced by external forces and events (Clifford 2004:3). Klinger (2002) agreed with this view that in the past, global mining organisations were not that skilled to understand the competitive trends and forces affecting the industry.

2.2.3.2 Competitive advantage in mining industry
Porter’s five forces model provides an analysis of the environment in which the organisation is situated and identifies the five forces that influence competitive advantage in the marketplace (Hemmatfar, Salehi & Bayat 2010:161), as shown in Figure 2.2.
According to De Beer (2003:10) the nature of competitiveness in a given industry can be viewed as a composite of the following five forces that affect the level of competition:

(a) **Threat of potential entrants**: The barriers of entry in the South African construction and mining industries are not considerably high, by mere looking at the existence of large number of small mining organisations and organisations being unable to contain the operation of illegal miners who are draining the profits of registered organisations. Some specialised jobs require training and/or certification for higher wages and improved benefits. People will self-fund their education so that they can enter the industry in a work-ready state.

(b) **Intensity of the competition**: The competition of skilled workers in the mining industry in South Africa is characterised as diverse, based mainly on the reward, condition of employment and working environment. Industries that are intensive have no flexibility and therefore skill and shortages would directly result in the decline in production.

(c) **Pressure from substitutes**: A constant threat however for the local mining organisations is the possibility of foreign funded organisations to generate greater
deals and bids for huge infrastructure projects in South Africa, resulting in engineers and artisans leaving the mining industry to do the same tasks there.

(d) **Bargaining power of suppliers:** The workforce is aware that they have much more bargaining power in terms of wages and conditions, and they are using this to move from one mine site to another. Workers are taking advantage of the skills shortage and looking around for the best offer. All goods and services are scarce but skills shortage is purely a function of price and is available at the market price. Employees today want individualised career options. If management doesn't provide it, workers take their knowledge and skills elsewhere.

(e) **Bargaining power of customers:** The bargaining powers of the buyers in the gold mining sector are considerably high in South Africa, since there is a fluctuation of gold price, and workers are able to join any mining organisation with attractive salary packages. The force of supply and demand determines the price. The buyer can take it or leave it. However, those who choose to leave it (because of lack of funds or personal preference) must not cry skills shortage.

Porter’s five forces model is a useful framework for competitive analysis within an industry that leads to strategic planning and the development of a tailored competitive strategy that expects to exploit the situation. Al-alak and Tarabieh (2011:81) defined competitive advantage along four different generic strategies by which an organisation may set itself to address the problems posed by Porter’s five forces identified above. These strategies according to Wen-Cheng, Chien-Hung and Ying-Chien (2011:102-103) are:

- **Differentiation:** The organisation offers different and better products or services in order to charge higher prices and sell more products;
- **Cost leadership:** The intention is for the organisation to become the lowest cost producer in the industry;
- **Differentiation focus:** An organisation develops strategies aimed to differentiate itself within just one or a small number of target market segments; and
• **Cost focus**: An organisation develops strategies to serve small range of customers in an industry.

Carlton and Perloff (2005) suggested that the market environment has a strong influence on the success or failure of the business, the principal task of marketing management in this environment is therefore, to identify, evaluate and utilise any opportunities that arise in this market, and overcome threats that arise, so as to meet competition. The marketing of most precious metals from South Africa is in the hands of the State which negotiates the price of the commodity. The market environment of the mining industry is analysed below in Figure 2.3 as financial, product and market efficiency.

**Figure 2.3: Market environment of mining industry**

![Diagram of mining market context](source)

**(i) Product market efficiency**

When capital and operating costs of processing, transporting, smelting and refining the mineral ore are increasing; the mine must adjust to the declining productivity by increasing the efficiency of mine production. Product efficiency is measured by the
number of units of output that can be produced from given quantities of inputs. The product life-cycle and life of the mine approaches to the chain value of the product, service and processes are gaining momentum, in that products are no longer considered in isolation from the environment and the logistics chain supporting them (Hustrulid & Bullock 2001, and Platzek et al. 2010). According to World Economic Forum (2010) South Africa, continues to lose ground to its nearest rivals in economic competitiveness, slipping to fifty-fourth place out of 139 countries in the latest WEF global competitiveness index published on 10 September 2010.

(ii) Market efficiency
The mining industry is growing, mainly due to the expansion of the global economy and in turn places significant pressure on mining organisations to recruit workers from around the world. Internationally, the mining industry is facing critical skills shortage, with for example a third of South Africa’s artisans and engineers leaving the country over the past 40 years to markets like Canada and Australia. Locally, mining organisations are not only losing workers to other mining organisations, but also to major engineering and construction projects in South Africa. Nkosi (2003) argued that the problem facing South Africa currently is the emigration of people that were developed and must be dealt with as matter of urgency. The high turnover of artisans and the loss of engineers have forced the mining industry to do a comprehensive review of training materials and programmes, job grading and conditions of employment. In this respect Mlambo-Ngcuka (2006) cautioned that, unless this skills shortage is tackled at all levels of the economy, it could “undo” all the gains of the past years.

There are skills shortages throughout the mining industry, as well as in petroleum, electricity, construction and others. The sector that manages to provide good market prospects for all would probably be judged to be doing better than one in which there were large variations in job prospects around a high average measure of performance (Wadsworth 2002). These sectors are also looking at ways of attracting workers from other industries. According to this notion, there are several implications for the mining market (Mining Industry Human Resources Council 2007:12), such as the following:
• The employment in the production side of the mining industry has not been growing, because it takes the same number of employees to extract the ore regardless of its value as indicated by the current drop in gold production;

• The increase in capital investment means that there will be a demand for new workers in the short to medium term. It will take time, possibly up to five years, for the value of these new resources to bear fruit and make a full contribution to improving productivity;

• This will be tempered somewhat by the fact that much of the new investment is in sophisticated equipment and machinery, as demonstrated at Goldfields South Deep mine; and

• The higher profit margins arising from the higher commodity prices (e.g. Gold and platinum) make previously uneconomic deposits more attractive and enable the mining industry to compete with other industries to attract employees in a tight market. While there is little empirical evidence of an increase in mining sector wage rates at this time; there is subjective evidence of significant increases in total compensation across many occupations.

South Africa’s performance has remained stable while there was a recorded improvement in other countries. These weaknesses include market efficiency where South Africa is ranked 97th), inflexible in hiring and firing practices (135th) and a lack of flexibility in wage determination (131st) in the latest WEF global competitiveness index published on 10th September 2010. A major obstacle toward competitiveness for South Africa is the high costs to business due to the current spate of crime and violence in the country. South Africa is ranked as 137th (World Economic Forum 2010):

(iii) Financial market sophistication

Mining by its very nature is financially expensive, and has adverse environmental and social impacts, and yet many countries and organisations have successively managed to convert their mineral endowment into national wealth (Formosa 2008:11) that provides for example; the country with the economic means to address its environmental problems and social aspirations and the organisation with funds to cover
its capital and operating costs of the business as well as its social responsibility to the community in which it is situated. According to World Economic Forum (2010) South Africa claimed the number one spot for auditing and reporting standards. In 2009 it was number two and in 2008 number four in this category, which should be a comfort to businesses, financial institutions and overseas investors. Finance is critical to the health of any business, with international organisations paying particular attention to its finances. International organisations work in multiple currencies and are often taxed in multiple locations. Mining organisations in South Africa obtain their capital by issuing shares or/and trade their shares both on South Africa's JSE Securities exchange and London/New York and other international stock exchanges.

Capital investment in goods producing sectors in general and mining in particular would field long-term growth. This growth could occur if investment is in new mines, yielding an increase in production, or if investment is in new machinery and equipment, yielding higher productivity from existing mines (Baxter 2010:114-115). Directors, executives and strategic planners all have a fiduciary responsibility to forecast ahead for the mining organisation (Taylor, Leggio, van Horn & Bodde 2003). This entails identifying, evaluating and managing risks and uncertainties that the organisation may encounter. The five-year commodity boom of 2003-2008 gave organisations in the sector strong cash flows and healthy balance sheets (Humphreys 2009).

2.2.4 Impact of internal factors on overall research outcomes of the study

The internal environment is the environment in which management plans, organises, leads, controls and creates a particular culture or the productive functioning of the organisation (Platzek et al. 2010:482). The mine management activities are enacted in this environment in pursuit of synergistic conditions between organisational goals and employees’ objectives, organisational resources and extent influence, as well as alignment of employee’s interests and skills to the organisational values. Typically, some of the more significant sources of an organisation’s trends and uncertainties that are reshaping the mining industry are its mission statement, society within the organisations, and management and operating decisions (Lussier 2003:40-41).
2.2.4.1  Mission of the organisation
The organisational mission is the purpose or reason for being in business and the creation of the mission is top management’s responsibility. The cultural issues; such as history, previous achievements, abilities and environment of the organisations, serve as the basis for the mission statement rather than forming an integral part thereof. Unfortunately, it is difficult to formulate an exact organisational mission within an unstable and rapidly changing mining environment, considering the currency factor (Mullins 2004:151-152). Once goals are defined, it is also necessary to address the type of strategy that is necessary to advance these goals and objectives. According to Smith, Surujhlal and Manyuchi (2008:336) strategy involves a goal, a vision, a blueprint of the future, and a plan on how to get there. It is also important that all the employees in the organisation should be given an opportunity to provide inputs for the establishment of its strategies. Change in business goals sometimes leads to changes in the size and structure of the organisation’s work force. Therefore, any form of change increases the possibility of unproductive conflict in the organisations, unless the values inherent to that vision have been defined and communicated to all stakeholders.

2.2.4.2  Society within the organisation
People grow up and work in a particular society that shapes their basic beliefs and values, and develops out of contact between groups of individuals within an organisation like management committees and unions (Kotler & Armstrong 1997:93). In South Africa, the following are three prominent stakeholders of the mining industry:

- Department of Minerals and Resources: It is a governmental institution which represents the government’s involvement in the mineral sector.
- Chamber of Mines: It is a voluntary employers’ association of mining organisations operating in the gold, platinum, iron ore, manganese, coal, diamond, zinc, copper, lead and antimony mining sector.
- Unions: Unions are voluntary and employee organised in the mining industry.
2.2.4.3 Management decisions
Bassi and McMurrer (2006:5) stated that management and leadership are major determinants of organisational performance. Organisations with effective leadership and management are better placed to successfully employ professionals in all fields and utilise their skills by best matching staff with jobs. Competent senior managers can also improve the operating effectiveness and/or efficiency of an organisation and recognise and explore the opportunities for innovation, change and growth (Porter & Ketels 2003). The values of a particular group or society could be an important factor in the choice of leadership style adopted by managers (Robbins & Decenzo 2001:246). Briefly, this means that leadership participation is a function of cultural traditions. In contrast, the perception of people about the product, organisation and even a country’s industrial and technological competency, depends almost entirely on the leaders of industries. As a result, the leaders demonstrate the ability to direct, restructure and mould the kind of organisational practices that will promote excellence, benchmarking, capacity building, quality and development (Lussier 2003:210).

2.2.4.4 Operating decisions
An equally important basis to the success of the mining industry is firstly, its constant choice of being vigilant towards improvement of health and safety in the mining workplace.

The global mining safety record has come a long way for the past ten years, especially in South Africa, where the number of fatalities across major mining organisations has steadily declined, but still remains high in comparison to the target of zero fatalities. In figure 2.4, the high rate of fatalities in South Africa as compared to those of Australia and USA, are attributed to deep and intensive operations of the mines. On the positive note South African mines were able to halve the number of mine fatalities over the past ten years. China was not included in this analysis, considering that over 6000 mineworkers there lost their lives in 2003, approximately 18 employees per day (Cameron & Goldsmith 2004:25). Mining has one of the best industry records in protecting its employees.
Secondly, another equally important keystone to the success of the mining industry is its operation choice which carries financial risks. It is up to the organisation’s financial skill to identify and quantify the different levels of risks that separate good decisions from bad ones. A risk is a possibility that something eventually could occur. When management chooses to take risks, it also aims to lessen any negative impact and increase any positive impact that might be caused by the organisational operations (Jones 2005:8-9). Therefore, the risk analysis of this study focuses on threat frequency, vulnerability, and loss magnitude, and whether it treats the problem as a probability.

Lastly, another important base to the success of the mining industry is its operation choice which focuses on geological conditions. Almost all mineral ore-bodies are mined in complicated geological conditions. According to Drzewiecki (2007:1) such conditions are a result of highly folded layers of rock types, numerous big faults with up or down-throw reaching even fifty meters or more, hundreds of small faults within mineral reserve, fading and stratification of exploited mineral ore bodies and underground water reservoirs. The above-mentioned conditions make exploitation of mineral ore reserve extremely dangerous, therefore extraction requires specific preventative measures in both the preparatory and realisation stages. The assurance of safe working conditions is obviously an important element of production costs, especially for underground mining.

2.2.5 The environmental influence on mining organisations

The degree to which the environment influences the organisation depends largely on the types of business and the goals and objectives of the management. A mining industry decision is different from any other industry (Hoskin et al. 2000:45), in that:

- Unlike the manufacturing industry, mining organisations are restricted as to where to operate by the availability of the economic deposits or cannot choose to mine near the market place. A licence is required for opening and operating the mine;
- Unlike other primary industries which can fertilise or restock, cannot influence the prime sites for extraction since minerals are limited and irreplaceable;
• Minerals are formed at a rather slower rate (about million years) compared to maize or cotton. It takes about five to eight years from the discovery of the mine to actual or full production (Lundmark & Warell 2008); and
• Operating units are always wasting concerns. Heaps of mine waste occupy large areas of land and disfigure the landscape, which ends up as a source of dust and water pollution.

Therefore, the scanning of the mining business environment is based on attributes of external environment and availability of resources for the organisation (Aldrich 2008, and Ansoff 2007). Environmental scanning is a research process in which the organisation gathers, analyses, and dispenses information among its directors and managers, that helps it in making decisions regarding surviving, expanding or entering new markets. This process entails obtaining both factual and subjective information on the business environments in which a company is operating or considering entering (Bosch et al. 2011:44). The business environment may be scanned when initiated by a crisis or on a regular scheduled period or continuously. In the contemporary turbulent business environment, most analysts feel that the best scanning method available is continuous scanning because this allows the organisation to act quickly, take advantage of opportunities before competitors do and respond to environmental threats before significant damage is done (Babatunde & Adebisi, 2012:25).

2.3 MONITORING THE MINING ENVIRONMENT SUSTAINABILITY
The earth is a closed system. Anything that is changed on earth causes a series of changes in the land, water and air. Forest fires and even physical infrastructures cause changes in the systems on earth. When coal seams and mineral ore bodies are disturbed, changes also occur in the earth’s systems. Mining by its very nature requires that land, air and water systems be disturbed, and end up becoming pollutants (Singh 2007:1). Mining is often being associated with positive economic benefits; however, it may also create significant problems for the environment and human health. Consequently, the economic globalisation and various state institutions have made it vital for mining companies to fulfil their social responsibilities, communicate
with stakeholders, and strike a balance between economic growth and environmental protection (Fang 2011).

2.3.1 Overview of economic impact of the mining industry
According to Go (2011) mining is a profitable business that creates employment opportunities for the local communities. It benefits everyone including the government and that is why the mining industry is widely supported. However, mining by nature is inherently unsustainable in that the life of the mine depends on the availability of mineral deposits and will eventually come to a close and this has adverse consequences for economic growth and development in those areas, leaving behind ‘ghost’ towns. When old ore bodies are being depleted, mining organisations are increasingly looking to developed deposits located in less accessible regions of the country (Sumi & Thomson 2001:21). Therefore, the sustainability of the mining houses can be ensured with the linkages it forms with other sectors of the economy by exporting skills and investing capital to some parts of the world in this field (Sachs & Warner 2001, and Winde & Stoch 2010).

Minerals are only found in specific areas in South Africa and have to be mined responsibly in those places. This means that there is often no alternative site where the mining can take place, unlike most industrial operations that may consider alternative sites where their operations will cause less harm. Hence, mining operations, unlike operations in other industries, are confined to areas in which mineral ore reserves are available (Malherbe 2000:84, and Crowson 2003:1).

2.3.1.1 Importance of mining in the country’s economy
Weber-Fahr, Strongman, Kunanayagam, McMahon and Sheldon (2001) stated that large mines generate foreign exchange earnings and tax revenues and create employment directly and indirectly. The level of the tax burden carried by mining organisation, including indirect taxes, is still an important issue. However, many countries have reduced taxation levels and eased repatriation requirements in order to attract foreign investment. The extraction of minerals and coal continues to provide the
foundation for local economies in some parts of the country. Hartman (1992:123) said that virtually everything people eat, every metallic object, most building materials and car parts are all made from minerals or use metallic, non-metallic or energy minerals in some way. Primarily, products of the mining industry are used as inputs of consumer goods, processes, services provided by all other industries, including agriculture, manufacturing and transportation, utilities, communication and construction. Coal, for example, is used for energy, copper for wiring, gold for satellites and sophisticated electronic components, and a variety of other minerals as ingredients of medicines and household products (USA Department of Labour, 2008:26). Therefore, the mining industry has been a key to the development of civilisation, underpinning the iron and bronze ages, the industrial revolution and the infrastructure of information age (Yeboah 2008:36). Downstream beneficiation and minerals processing of these raw materials add further value as raw materials and products are created to serve all aspects of industry and commerce worldwide (Mbendi Information Source 2011).

South Africa’s mineral wealth as stated by Choshi (2001:4) has had a number of secondary effects such as influencing the size and location of urban centres e.g. Barberton, Johannesburg, Rustenburg, Stilfontein, Vereeniging, Virginia, Welkom and Witbank. Most of the infrastructural development of roads, electricity generation, water reticulation and housing in and near these towns, was meant to create an environment conducive to the development and operations of the mining industry. The country’s settlement patterns and economic development would have been very different if it did not have minerals or if they were distributed in a different manner, because:

- between 15% to 20% of gross domestic product (GDP) would be lost. While mining directly contributes 7% to the GDP, the industry has an indirect multiplier effect of 2.6 times on the rest of the economy; and
- about 70% of South Africa’s primary energy supplies, balance of payments and mineral supply to the international market would be lost. The mining sector accounts for a huge amount of the supply and demand for energy. It consumed 15.3% of Eskom’s local electricity sales in 2006. Coal mined for electricity generation accounted for about 93% of the electricity produced in the country.
The mining and mineral sector is central to modern life and plays a leading role in the economy of the country, but for the communities on the receiving end of industrial development, the supply of metals and minerals is not without environmental and social costs (Kuhndt, Tessema & Martin 2008).

2.3.2 Impact of mining on the physical environment
Over the past two decades, possibly no issue has absorbed more of the attention of the mining and metals industry than the natural environment. Mining activities have much more serious and wide-ranging effects on human health and ecosystems, and although environmental disturbances from mining are local and very insignificant in terms of the size of the area affected, it has a dramatic and highly visual impact on the environment (Ghose & Dhar 2000:54-55). Mine development brings with it a dramatic wide range of environmental costs such as, air and water pollution and land degradation.

2.3.2.1 Air pollution
Various activities in the minerals value chain produce gases that pollute the environment. Mineral dust is a pervasive feature of all mining areas. It is generated by wind sweeping dust from water heaps, blasting and the use of heavy machinery. Blasting also produces noxious fumes that are released into the atmosphere. According to the report published in the citizen's report by the Centre for Science and Environment, New Delhi (1984-85), the Roro asbestos is dumped into the open which has endangered not only the lives of the mine workers but also of those living in the surrounding areas (Priyadarshi 2008). Production and consumption of coal has serious effects on the environment, leading to air and water pollution, while also contributing to increasing concentrations of greenhouse gases in the atmosphere. This can result in harmful levels of pollutants in rural homes, leading to respiratory health problems and other ailments. Consequently, women and young children are exposed to high levels of indoor air pollution every day. There is consistent evidence that indoor air pollution increases the risk of chronic and of acute respiratory infections in childhood; the most important cause of death among children under the age of five years in developing countries (Masekoameng, Simalenga & Saidi 2005:7).
In addition, dust generated by drilling in mines still places miners at risk of developing either of two serious lung diseases: pneumoconiosis, also called "black lung disease," from coal dust, or silicosis from rock dust (Burger 1999:97-103). These days, dust levels in mines are closely monitored and occurrences of lung diseases are rare if proper procedures are followed. Since silica dust is an ever-present potential hazard, all drilling dust and loose rock has to be wetted down at all times to prevent silicosis, a lethal disease that attacks the lungs. Underground miners have the option to have their lungs x-rayed on a periodic basis to monitor for the development of the disease. Workers who develop black lung disease or silicosis may be eligible for Rand Mutual Federal aid.

2.3.2.2 Water pollution

According to Pulles, Banister and Van Biljon (2005), many mining sites are located in arid desert regions where precipitation is scarce and water resources are not rapidly replenished. Mines use a lot of water, although some of the water is re-usable, it is frequently in competition with other water users due to the scarcity of water. Sulphide-containing minerals, when oxidised through contact with air, via mining, form sulphuric acid, is commonly known as acid mine drainage (ACD). There is wide acceptance that this phenomenon is responsible for costly environmental, social and economic impacts. This acid, when combined with traced elements, negatively impacts groundwater. In addition, chemicals like mercury, cyanide, sulphuric acid, arsenic and methyl mercury are used in various stages of mining. Most of the chemicals are released into nearby water bodies that lead to water pollution. In spite of pipes (tailings) being used to dispose these chemicals into the water bodies, possibilities of leakage are always there (Bose 2011). According to the South African Department of Environment and Tourism the potential impact of mining on the water environment are subdivided into those associated into the phases of mining activities (Twerefou 2009:10), namely:

- The act of mining itself;
- Seepage of contaminated water from mine residue deposits resulting from mineral processing;
- Dewatering of active mining operations; and
• Flooding of closed mine voids and discharge of untreated mine water.

Many mining companies practice the heap leach method of gold beneficiation which could contaminate ground water while the use of mercury by small-scale miners contaminates surface water. A study by Naicker, Cukrowska and McCarthy (2003) revealed that the groundwater in the mining district of Johannesburg, South Africa, is heavily contaminated and acidified as a result of oxidation of pyrite contained in the mine tailings dumps, and has elevated concentrations of heavy metals. Sometimes the liquid waste that is generated after the metals or minerals have been extracted is disposed of in a mining pit. When the pit gets filled up by the mine tailings, they become a stagnant pool of water. This becomes the breeding ground for water-borne diseases causing insects and organisms like mosquitoes to flourish (Oelofse, Hobbs, Rascher & Cobbing 2007).

2.3.2.3 Land degradation
There are many environmental concerns about the effects mining has on the land. Trees need to be cut down in order to have a mine built and whole forests could be destroyed. Africa covers an area of about 2,978 million square miles, about 21.8 labour of which is made up of forest that makes about 16.8 labour of the global forest. With a net loss of about 4.0 million hectares a year, Africa is the continent with the second largest net loss in forest cover (FAO 2007). Evidently, a vast majority of the rural poor in Africa earn their livelihood directly from the rich natural resources, land and forests, through farming, hunting and related activities. Mining, both small and large scale degrades lands and forests and destroys the vegetation, including economic timber species and the ability of natural forest to regenerate. It also renders the land unproductive by removing the top soil and doing other damage. In terms of land degradation (Twerefou 2009:12), mining activities cover vast areas through:

• Prospecting/exploration activities, including pits and trenches;
• Mine site surface facilities, including mine surface excavations and amenity buildings;
• Processing plants, storage sheds, dumps and dams, and residential/commercial areas;
• Water and sewage treatment plants;
• Refuse disposal sites;
• Power line access ways; and
• Access roads and railways.

Mining involves moving large quantities of rocks, and in surface mining, overburden land impacts are immense.

2.4 SOCIAL IMPACTS OF MINING
The mining industry perhaps has greater immediate pressure to address the issue of sustainability as a result of its dependency on maintaining a social license to operate. The ‘social license to operate’ is maintained through good community relations and being good stewards of the resources impacted by the mining operation (Ernst & Young’s Global Mining (EYGM) 2010:15). Watson (2008) stressed the point that these challenges have fuelled the concept of corporate social responsibility, and the organisations are beginning to focus on the abundance of opportunities for improvement.

It is encouraging to note that many of the Chamber of Mine’s members voluntarily subscribe to a variety of sustainable development (SD) ideals and do not need legislation to honour their commitments. Sustainability is a powerful and defining idea for the business. A sustainable business stands an excellent chance of being more successful tomorrow than it is today, and remaining successful, not just for months or even years, but for decades or generations. A sustainable organisation is one that creates profit for its shareholders, while, protecting the environment and improving the lives of those with whom it interacts. Therefore, it must operate in such a way that its business interests and the interests of the environment and society intersect (Quinn & Baltes 2007:4). This is often referred to as the 'Triple bottom Line'. The triple bottom line
(TBL) is shorthand for environmental protection, economic development and social progress. Figure 2.4 illustrates the drivers of sustainability.

**Figure 2.4: Drivers of sustainability (or Triple Bottom Line)**

![Venn diagram showing the interrelationship of social, economic, and environmental dimensions.]

**Source:** Adapted from Wilkinson and Reed (2007:5)

Figure 2.4 shows that sustainable development is often represented by showing these three dimensions in a Venn diagram, with sustainable development as the overlapping segment in the middle. This indicates that a balance between the three elements is required in order to produce a system that contains socially bearable progress, economically equitable growth, and environmentally viable protection (Angus-Leppan, Benn & Young 2010:231). This means an organisation must appreciate the interdependence of the environment, economy and society.

Emery (2005:28) stated that the danger of working in a mine are associated with the possibility of fire caused by electrical, combustible material, explosives and arson, occupational illness caused by exposure to heat, dust, noise, radiations, vibration and harmful gases, environmental incidents such as slime dams collapsing, cyanide or other chemicals spillage and water, air or ground water pollution, as well as operational incidents such as material handling, logistics and track related accidents. Potential negative health impacts associated with mining generally receive most of the attention.
Due to the recent spate of fatal mine accidents, the Department of Minerals and Resources (DMR) vowed to shut the mines until there are strict safety improvements in place and to prosecute employers for negligence. Employers are in charge with certain functions and responsibilities in terms of either the Occupational Health and Safety Act, 85 of 1993 (OHSA) or the Mine Health and Safety Act, 29 of 1996 (MHSA). Employers, therefore rely on a legal appointment of managers and other people, to perform the functions and responsibilities on behalf of them. Strict health and safety regulations demand certain competencies from workers before they can operate underground. Mining can have a significant impact on the environment both during the mining operations and for years after the mine is closed (Griffith 2010).

2.5 REGULATING THE MINING ENVIRONMENT

According to Hönke, Kranz, Börzel and Hérítier (2008:3), there has been ample evidence of organisations taking advantage of situations of weak environmental regulations and the devastating effects thereof. Weak environmental regulations mean firstly, the non-existence and minimal national regulation of negative external effects of industrial production, and lastly, the non-existence or minimal administrative capacity to enforce existing regulation (Börzel & Hérítier 2005:9). Burger (2010) stated that environmental impact laws must be well defined so that mining organisations can operate within these legal boundaries on a range of issues, such as the impact on the environment, how they must try to reduce this impact and how they must rehabilitate the area after mining is completed. However, it is obvious that certain mining houses' efforts to off-set such tendencies have emerged with voluntary standards in the context of transnational norms of corporate social responsibility (Hönke et al. 2008:3). Otherwise, it is the responsibility of Government to establish environmental, health and safety guidelines and ensuring compliance; to collect taxes, duties, royalties, fees and rental payments arising from mining operations without imposing excessive cost burdens on the industry and thereby jeopardising its economic viability.

Governments are responsible for setting the conditions under which investments and operations take place through their influence on the establishment of legal/regulatory frameworks through the formulation of a comprehensive approach to mining sector
development. It would be remiss for this study to discuss South Africa's mining industry without mentioning the recent proposals regarding the nationalisation of South Africa's mines, in passing. According to Leon and Wentzel (2010:11), the subject of nationalisation of mines is not a new debate in South Africa. However, with the renewed energy of the ANC Youth League behind this issue, it has become the subject of legitimate concern and may lead to even greater groundswell of regulatory activity for the South African mining industry from 2011 onwards. South Africa has seen substantial changes in its tax regime and legislative environment over the past twelve months (e.g. Revised Mining Charter), inviting the question of how other countries and investors around the world would respond. Richards (2010) emphasised that while regulatory change in Australia has been widely debated, the “Tracking the Trends 2011” report showed that other countries that have recently, quietly imposed new levies of their own include Chile, South Africa, Zambia, Tanzania and Burkina Faso.

The approach of this study from an emphasis on regulatory framework to promoting sustainable development in the mining industry is illustrated by the extractive industries (EI) value chain in Figure 2.5
Figure 2.5: Value chain for extractive industries

2.5.1 Legal and institutional frameworks
The relevant provision of MPRDA, according to Chapter 4, covers the process of application and granting of prospecting rights, mining rights or reconnaissance permits which state that the applicants for a mining right are required to conduct an environmental impact assessment and submit an environmental management program, while applicants for a prospecting right, mining or reconnaissance permit have to submit an environmental management plan. Rights on prospecting and mining only become effective under the MPRDA on the date that the corresponding environmental management plan or program has been approved (Kidd 2008:187). Alternatively, requirements for making financial provision for the remediation of environmental damage as well as for the issuing of a closure certificate are included in the MPRDA. Furthermore, financial provision must be in place as a requirement before approval of the environmental management plan or program.

Sources: Adapted from Alba (2009:3)
2.5.2 Regulatory framework
The mineral industries and mining activities, in general, cause extensive environmental damage, but dealing with them is in many cases technically possible, but the cost is often prohibitive in an industry. The mining rights to own and exploit mineral reserves and deposits, for example, are governed by the laws and regulations of the countries or provinces in which the mineral properties are situated. Therefore, there are certain restrictions on the mines’ ability to independently move assets out of these countries or provinces without prior consent of the local government. According to Marshall (2001: 10-11) the mining industry is more highly regulated than any other industry. The reasons being:

- **Nationalism of minerals**: Minerals are national treasures that belong to the people and should be exploited for the benefit of the people. In these circumstances, people expect that the government will protect their treasure and ensure that it is developed properly and benefits flow to them.

- **Financial impact**: The fact that the mining industry is a capital intensive operation means that the huge amount of money is involved and sometimes out of proportion to the overall wealth of the country in which the mine is situated. That is, it may be foreign owned. Naturally, the host government would like to have a share of the wealth through taxes, royalties and perhaps a direct interest in the mine.

- **Environmental impact**: While the environmental impact of prospecting is minimal compared to that of an operating mine. The impact does cover an extensive area, some of which have some values that the society wants protected. The environmental effect of a mine can pose a hazard to the environment or to human health in local areas, if adequate precautions are not taken. The government must ensure the impact on the ecosystem is as predicted.

- **Social impact**: Mines are often located in remote or rural areas where a traditional way of life prevails. The impact of bringing in numerous outsiders to work at the mine is bound to affect the local community. Local people in the surrounding community or region around the mine sites often feel that they are entitled to something from the project. The government for political reasons may want to
ensure, through regulations, that adequate consultation has taken place and that the approvals they are asked to give are consistent with broad-based consensus.

- **Safety impact:** Mines, particularly underground mines, are inherently dangerous places. Ground stability and use of explosives and large equipment make safety a priority. A history of major fatal accidents in the mining industry has resulted in strict government regulations governing safety and a need for union representation in safety-related decisions.

A regulatory framework allows countries to set standards that companies must follow and must be strong enough to enforce compliance. Some experts contend that a more flexible regulatory framework is preferable than the more traditional command-and-control approach (Otto & Cordes 2002:8-16). Others acknowledge that a minimum set of rules by which companies must operate is necessary (Warhurst 1999:46).

### 2.5.3 Fiscal policies

Although companies generally are driven by the pursuit of profits, the goals and objectives of the sovereign governments that control the terms and conditions under which private interests have access to mineral deposits are quite different. Moreover, their actions and policies include the taxes they impose on the mineral sector. However, the taxes are designed to promote various social goals and economic development as determined through the prevailing political processes. Governments have many options to choose from when designing fiscal systems, and various types and forms of taxation methods can be used (Otto, Andrews, Cawood, Doggett, Guj, Stermole, Stermole & Tilton 2006:7). According to Otto *et al.* (2006: 30) the form of taxation methods applied to the mining sector usually fall into one or two of the following main categories of tax: *in rem* or *in personam*:

- **In rem taxes** are charges assessed against the mineral deposit or against the inputs and actions needed to exploit it. An action *in rem* is directed towards some specific piece of property. These charges can be divided into two groups: taxes that affect the variable costs of the project (such as unit-based royalties, ad
valorem–based royalties, sales taxes, and excise taxes) and taxes that affect the fixed costs of the project (such as certain types of property taxes, import duties, registration fees, land rents, value-added tax, some types of stamp duties, and withholding taxes on loan interest and services).

- **In personam taxes** are charges against some definition of net revenues, that is, revenues less qualifying costs. An action in personam is like a claim for, say, monetary compensation against a person or personal action. The example of this kind of tax system includes income tax, progressive or additional profits tax, and withholding tax on remitted dividends, royalty based on some measure of profit, and royalty based on some measure of income.

The measure of whether or not environmental legislation and policies take sustainable development into account needs an understanding of the concept of sustainable development.

### 2.5.4 Sustainable development

According to BHP Billiton (2011), the mining organisations are only temporary users of the land, they have a responsibility to look after the land so others can use it in the future once mining has finished. Furthermore, the work that ensures the area is returned to a stable and self-sustaining condition is referred to as rehabilitation. Mining organisations take time to rehabilitate the land in order to return it to a stable condition so that it can be used by others in the future. Sustainability is a more useful term in the mining industry since it affects all areas or units in the mining industry, and one that increasingly has some legal and political weight to it, as governments at all levels move to incorporate SD frameworks into their planning and regulatory frameworks.

Although the term sustainable development was used as early as 1972 at the United Nations (UN) Conference on the Human Environment in Stockholm, Sweden, it was in 1987, with a UN report entitled "Our Common Future," that the term was fully defined and translated into policy options. The 1987 Brundtland Report defined sustainable development as development that meets “the needs of the present without
compromising the ability of future generations to meet their own needs’ (Drexhage & Murphy 2010:2).

The question of sustainability in respect of mining has its origins not in the environmental field, but in the social and economic impacts the primary extractive industries have had on the communities in which they operate. Munasinghe (2008) suggested that the environmental change affects people in the following three key dimensions of poverty:

- **Livelihoods**: People tend to be most directly dependent on natural resources, and are therefore the first to suffer when these resources are degraded.
- **Health**: People suffer most when water and air are polluted because pollution sources are often placed in or near the communities, and
- **Vulnerability**: People are most often exposed to environmental hazards and environment-related conflict, and are least capable of coping when they occur.

While wealthier people are able to afford medical care for pollution related sicknesses like asthma and are able to move out of congested and polluted areas, poor people cannot.

Moreover, organisations have noted an advantage in recruiting and retaining talent when they have a viable sustainability stance, while various studies, according to Rigby (2008:1-3) also show that economic-friendly policies help to increase employee productivity. Wilkinson and Reed (2007:5) described interactions between the environment, society and the economy as three “shear zones” that produce a variety of opportunities and challenges for organisations. However, this can also imply that some aspects are beyond sustainable development considerations. The actions to improve conditions in a sustainable community take these connections into account. For example, if an enterprise is not able to maintain its competitiveness then its long-term viability is doubtful as is the quantity and quality of jobs it provides. Conversely, workplaces that provide decent work build the human and social capital essential for
sustained productivity improvement. Thus, a two way relationship between competitiveness and decent work exists (International Labour Organisation 2007:22).

2.6 GLOBAL CHALLENGES FACING THE MINING INDUSTRY

The global challenges that the mining industry is facing currently may be traced back to the implications of 2008 – 2009 world financial crisis and few are mentioned in this section. According to McGuire (2010:1), global mining organisations in 2009, were most concerned with securing supply, managing commodity price volatility, and ramping back up in response to rising demand. The report also highlights that government intervention around the world has increased in 2008. In 2010, top priorities of the mining industry were based on attracting investments, finding new supply markets, and engaging local stakeholders in an effort to secure a license to operate. According to Richards (2010:2-13), the ten top issues that Deloitte believed would most certainly influence the global mining sector in 2012-2013 (in order of priority) are shown in Table 2.3.

Table 2.3: Top ten risks over five years

| 01 | Skills shortage | 01 | Resource nationalism |
| 02 | Industry consolidation | 02 | Skills shortage |
| 03 | Infrastructure access | 03 | Infrastructure access |
| 04 | Maintaining a social license to operate | 04 | Cost inflation |
| 05 | Climate change concerns | 05 | Capital project execution |
| 06 | Rising costs (cost inflation) | 06 | Maintaining a social license to operate |
| 07 | Pipeline shrinkage | 07 | Price and currency volatility |
| 08 | Resource nationalism | 08 | Capital management and new access |
| 09 | Access to secure energy | 09 | Sharing the benefits |
| 10 | Increased regulation | 10 | Fraud and corruption |

Source: Adapted from Elliott (2012:7-9)

Although Table 2.3 does not indicate year on year changes, not many changes in the ranking can be seen, the bigger swings are evident over the medium term. Five of the
risks have consistently remained crucial risks over this period, while the remaining five have fallen out of the top 10 in the table altogether.

During the 2008/2009 financial crisis, most companies were not focused on recruiting new employees or promoting science, engineering and technology (SET), as careers of choice in the mining industry. Young people chose careers in information technology (IT), law, accounting, administration, and human resources, among others, where mathematics and science were not always necessary to get a degree. When economic growth started around the world, such as the crude oil per barrel, platinum and gold prices reaching an all-time hike of about 100, 1850 and 1870 US$ (September, 2011), respectively, the skilled professionals the industry had were very saleable and mobile. It had probably lost thousands of professionals since the early 2009. It must also be noted that part of the problem was that insufficient funds had been spent on infrastructure maintenance and short-term projects in South Africa since 1994, while government focused mainly on other aspects such as a just and equitable society and housing. Richards (2010) believed that of all ten issues identified above, two of particular importance to the rest of the mining countries from 2011 will be the challenges of finding skilled workers to replace the aging population and the “taxes, regulations and new governments” category. The last issue has already been discussed in this chapter, while the issue of the lost generation is discussed in detail in the following chapter.

2.7 CONCLUSION

The modern mining industry operates in a global arena where the economic, social and legislative environments play crucial roles. It is imperative to view mining organisation as an open system that requires continuous monitoring and analysing of the dynamics of the external and internal business environment to firstly, identify the threats and opportunities of a mining organisation in order to build a sustainable competitive advantage.
Secondly, it should integrate the strengths and weaknesses of the organisation in order to adapt the mining organisation to a changing and turbulent world. Therefore, the mining transformation process does not take place in a vacuum as there are various challenges facing the mining industry.

In the following chapter, the overview of the skills shortage in the mining industry is discussed in detail.
CHAPTER THREE

AN OVERVIEW OF SKILLS SHORTAGES IN GOLD MINES

3.1 INTRODUCTION

Chapter two stressed the importance of a stable macro and micro environment for economic growth in which the methods that encourage investment in mining, as in other industries, are adopted. The discussion in this chapter provides an overview of the skills shortage in the mining industry.

Globalisation of the mining industry created creating an increasingly diverse and interconnected world, while modernisation of mining industry created some changes in methods of production which resulted in too few workers with adequate skills, or a mismatch between skills supply and demand (Daniels 2007:5). The mining organisations also face collective challenges as societies, such as balancing economic growth with environmental sustainability, and prosperity with social equity which could potentially protract and deepen the skills crisis. Consequently, the capacity to deal with environmental uncertainty and competencies that individuals need, to meet their goals, have become more complex, requiring more than merely mastering certain narrowly defined skills (Gordon, Halasz, Krawczyk, Leney, Michel, Pepper, Putkiewicz, & Wiśniewski 2009:40). Organisations’ environmental performance is becoming increasingly important from an investment point of view, particularly where resource nationalism or other regulatory mechanisms impact investment feasibility and market performance (PricewaterhouseCooper 2009:22).

The private and public sectors are concerned about the country’s capacity to meet short, medium and long term economic growth targets because of the skills shortages. This is a major constraint on the country’s prospects of achieving the kind of sustained economic growth that ensures wider participation in environmental conservation and addressing the challenge of social generational equity. The importance of skills
development for economic growth, environment protection and social development was recognised early (after 1994) during the tenure of the new democratically elected government, with the launching of a comprehensive skills development strategy. This strategy was based on the principle of life-long learning embedded in a National Skills Framework, administered by 23 Sector Education and Training Authorities (SETA), and funded by a one per cent payroll levy (Johnston 2007:5).

Most discussions regarding the implications of skills shortages are regularly highlighted in the media, which draws comments from governments, employers and unions. Shah and Burke (2003:1) further suggested that reports of skills shortages are more likely during times of an economic boom while surpluses are more likely during recessions. Surpluses do not attract the same degree of media attention as skills shortages. Capital allocation and skills shortage have re-emerged as the top two issues that influence the global mining sector in 2011 which call for increased levels of government support to alleviate these mining challenges (Richards 2010:2-13). Based on the discussion above, it is imperative that there is some understanding of skills shortage in order for intervention to be successful.

The standpoint of this study is purely from an economic perspective; looking at the skills shortage in the mining industry and whether improvements could be made in the way skills shortages are conceptualised and measured, as the South African economy adjusts to a new equilibrium position after 2008/2009 financial crisis. The study further seeks to identify strategic initiatives which would positively influence the supply of such skills and assist the mining industry in recruiting and retaining the talent in these scarce and critical professions.

3.2 CLARIFICATION OF THE SKILLS CONCEPTS

Important concepts are clarified fully in later chapters of this research report. The basic definition of skills, skills shortage and its causes are discussed in this section to demarcate the frame of reference of this study.
3.2.1 Skills and competencies

The concepts skills and competencies are used interchangeably in this study, but it should be noted that they are not necessarily synonymous. A skill is an ability to perform a productive task at a certain level of competence (Graham 2007:1). Since a skill is associated with a particular task, a person who does not possess such a skill is unlikely to be able to carry out this task or will be less productive than someone who does possess it. Although skills are often associated with formal qualifications such as through education and training, Enos, Kehrhahn and Bell (2003:370) cited the fact that skills can also be obtained through using informal learning mechanism and on-the-job experience. Formal classroom training is the mode of instruction most widely used by organisations to develop managers, but some researchers suggest that most managerial learning takes place informally (Enos, et al. 2003). Informal learning occurs in the presence of both action and reflection and includes self-directed learning, mentoring and coaching (Cross, Seager, Wentzel, Mafukidze, Hoosenn & Van Zyl 2009).

According to Ennis (2008:3-4), competency is the capability of applying or using knowledge, skills, abilities, behaviours, and personal characteristics to successfully perform critical work tasks, specific functions, or operate in a given role or position. This definition may further be categorised, (a) as the ability of an individual to perform effectively in a job-related area and (b) as what is required of an individual for effective performance. The latter meaning involves defining what is important to be successful in a job, while the first deals with the degree to which an individual does what is important to a job. Mlambo (2010.ix) defined skill as an ability and capacity acquired through deliberate, systematic and sustained effort to smoothly and adaptively carry out complex activities or job functions. This definition classifies skill as involving ideas (cognitive skills), things (technical skills) and/or people (interpersonal skills).

- Technical skill: Technical skill is the knowledge of and proficiency in the activities involving methods, processes, and procedures. Thus, it involves the ability to use the tools and specific techniques in a specific functional area that create the context in which most leaders work. Mechanics, for example, work with tools and
therefore their supervisor should have the ability to teach them how to use these tools.

- **Interpersonal skill:** It is the ability to work with, understand, motivate, and lead people either as individuals or as a work group. It relates to interacting with and influencing others, e.g. cooperative effort, teamwork and the creation of an environment in which people feel secure to express their opinion and to attempt creativity or innovation.

- **Conceptual skill:** Conceptual skill is the ability to look at the organisation as one whole system and to understand how a change in any given sub-system (part) of it, can affect the other sub-systems (parts) of the organisation. Conceptual skill permits a manager to generalise solutions of problems with respect to specific situations. It is an important aspect of leadership in that it applies logic to analyse the strengths and weaknesses of various approaches to the work to be done (Mumford, Campion & Morgeson 2007:156-157).

Generally, it appears that job candidates do not meet the requirements or fall short in delivering on the skills that employers rate most highly. When National Association of Colleges and Employers (2010:25-26) requested employers to rate the importance of certain skills/qualities desired when recruiting potential job candidates, communication skills were rated most important, as illustrated in Table 3.1.

**Table 3.1: Employer rating of importance of candidate skills/qualities**

<table>
<thead>
<tr>
<th>Skill/Quality</th>
<th>Weighted average rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication skills (Verbal)</td>
<td>4.65</td>
</tr>
<tr>
<td>Strong work ethic</td>
<td>4.61</td>
</tr>
<tr>
<td>Teamwork skills (works well with others)</td>
<td>4.59</td>
</tr>
<tr>
<td>Analytical Skills</td>
<td>4.56</td>
</tr>
<tr>
<td>Initiative</td>
<td>4.50</td>
</tr>
</tbody>
</table>

*Source: Adapted from National Association of Colleges and Employers (2010:25)*
When looking at the gap between what employers value and what the job candidate brings to the workplace, communication skills (verbal) and strong work ethic are the two attributes rated highly by employers (ratings above 4.60). Surprisingly, employers attach greater importance to verbal communication skills than to written communication abilities and other skills. This concern over the attitude of new recruits towards the job could probably be related to a real drop in the commitment to the job and organisation (National Association of Colleges and Employers 2010:25).

3.2.2 Skills measurement
The measure of skills and the monitoring of the skills set required to carry out a particular job is neither perfect nor straightforward task. There are various methods that can be used to measure skills. The most common measures of skills are qualifications or educational attainment; although of course it is possible to have skills without having qualifications such as on-the-job training but often not formally recognised. When identifying the skills required, management also needs to define a standard of excellence in order to inspire people to improve, and against which management can measure both individual and organisational performance (Tamkin 2005:4). Three steps of measuring skills are considered in this section. However, the fact that qualifications data is and easily comparable, such as the one provided in Table 3.2 indicate that they are the most regularly used measures.
The first step of skills measurement is to focus on basic skills (NQF level 1 to 3), which is concerned primarily with literacy and numeracy before tackling the deficit of other levels. It is imperative to begin with these levels as it is in this area that the disparity between mining and other industries appear to be the greatest. From the mining point of view, the basic skills may be defined as the ability to read, write and speak in English and to use mathematics at a level necessary to function at the mine workplace and in society at large (Sloane, O'Leary & Watson 2005:12). *Fanakalo* is still used as a means of communication in the mines and for the technical training of workers.

The second step is to focus on qualifications (intermediate skills). These skills are those located in the middle education and training bands. They include all pre-matriculation and their equivalents, but exclude degree-level qualifications in higher levels (Kraak 2003:674). When using qualification as an approach it is clear that the oldest members of the workforce are most likely to have few qualifications. Thus, nearly twenty labourers of those aged over 50 have no qualifications compared to less than ten labourers of those aged between 25 and 50. The limited opportunities that mine workers face for not speaking English on the work floor, as well as during ABET (Adult Basic Education and

---

### Table 3.2: Skills level on the national qualifications framework

<table>
<thead>
<tr>
<th>NQF level</th>
<th>Skill band</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low level skills</td>
</tr>
<tr>
<td>2</td>
<td>Shop-floor skills</td>
</tr>
<tr>
<td>3</td>
<td>----</td>
</tr>
<tr>
<td>4</td>
<td>Technical skills (intermediate)</td>
</tr>
<tr>
<td>5</td>
<td>Equivalent to matriculation and matric plus diploma</td>
</tr>
<tr>
<td>6</td>
<td>Engineering skills (High skills)</td>
</tr>
<tr>
<td>7</td>
<td>Professional skills (Equivalent to higher education degrees)</td>
</tr>
<tr>
<td>8</td>
<td>Management skills (Postgraduate courses)</td>
</tr>
</tbody>
</table>

*Source:* Adapted from Kraak (2005:69)
Training) training, do not affect only their proficiency in English but made it difficult for them to proceed to higher positions (Research Focus 2007:11). There is substantial literature available in respect of over- and under-education in the mining industry that suggests that a sizeable proportion of the workforce are mismatched in the sense that current job requirements imply a different level of qualifications than the job holder currently possesses. Tampkin, Giles, Campbell and Hillage (2004:17) suggested that the traditional unit of skills measurement is one indicator of educational attainment while education, qualifications and training are all proxies for skills.

A third step is to define skill in terms of occupational competency classification which will affect employee development and is linked to career management. An employer identifies, in this case, what skills employees need to refine in order to help them learn about and develop the competencies needed to move up or around the organisation (Durgin 2006:4). The theory here refers to the proportion of the workforce found in elementary occupations. This will reflect the industrial structure of the local economy, but again many of those found in elementary occupations have educational qualifications even up to degree level (Leitch Review of skills 2005:20). A fourth approach is to focus on the level of wages or salaries as this is a proxy measure of the value placed upon particular jobs or individuals by employers. A conventional definition of low pay is that level of pay which falls below two-thirds of the median level of hourly earnings for all employees. This produces a figure which is rather higher than the national minimum wage.

3.3 IMPORTANCE OF SKILLS IMPROVEMENT

The improvement of people’s skills is a win-win situation for the economy, society, employers and individuals themselves in the skills ecosystem. A skill ecosystem is defined as a self-sustaining network of workforce skills and knowledge in an industry or region (Windsor & Alcorso 2008:5). The network comprises a range of actors, as shown in Figure 3.1.
Figure 3.1: The skills ecosystem

Figure 3.1 illustrates that the benefits of skills may be thought of in the context of a skills ecosystem in which individuals, employers and the broader economic and social environment are in permanent dynamic interaction. Skills are of economic value to individuals as workers, to the organisations that employ them, and to the country as a whole through greater productivity and competitiveness. There are also considerable social benefits that accrue to individuals and communities which aid the development of a more equitable and better functioning society (Windsor & Alcorso 2008:5). The concept of a skills ecosystem directs attention to the interdependency of multiple actors and policies in creating and sustaining the conditions under which appropriate skills can be developed and deployed in clusters of organisations in particular areas (Yun & Lansbury 2008:19-20). Although these components of a skills ecosystem are interlinked, they form a useful classification system that the study used to organise the information from the investigation.
3.4 THE VALUE OF SKILLS

When trying to understand the social outcomes of skills, the study categorised the outcomes of skills development as being increased productivity, decreasing expenses and intangible benefits (Kelsey & Neild 2011:6).

- **Increased productivity**: Increased productivity is generated when workers are able to exploit technology, interact with clients positively, and willing to identify and exploit market opportunities and new ways of doing things. Skills can contribute to these outcomes, which can translate into improved profits and growth.

- **Decreased or avoided expenses**: Skilled workers can reduce expenses by undertaking routine maintenance, identifying hazards beforehand, detecting unsafe related issues and faults, solving problems smartly, making fewer ignorant errors and breakages and being able to address client complaints in a way that builds relationships. Skills can contribute to all these outcomes.

- **Intangible benefits**: When workers know that their employer is committed to their skills development they are more likely to stay, more likely to tell other skilled workers about their positive working environment, thus making further recruitment possible.

The improved skill levels help the applicant to (find) work in the first place, keep on working after entering the market and progress through the market into better jobs. A skilled and educated workforce is essential to productivity, sustainable economic growth, impact significantly on the effectiveness of capital investment and the ability of employers to adopt innovative work practices (Donnelle 2007:9).

The objective of every nation is to improve the standard of living and attain long-term sustainable growth. Both developed and developing countries focus on promoting higher productivity and creating employment opportunities to attain this objective (Yusof 2007:151). Skills development is central to improving productivity and employability as reflected in Table 3.3.
Table 3.3: The economic impact of improving the UK’s qualifications profile 2005-2020

<table>
<thead>
<tr>
<th></th>
<th>Low skills</th>
<th>Intermediate skills</th>
<th>High skills</th>
<th>Adult basic skills</th>
<th>Young people basic skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity (%)</strong></td>
<td>3.2</td>
<td>3.5</td>
<td>4.4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Employment (000s)</strong></td>
<td>375-425</td>
<td>350-400</td>
<td>335-385</td>
<td>75-105</td>
<td>65-95</td>
</tr>
<tr>
<td><strong>Net benefit (bn)</strong></td>
<td>£85-£105</td>
<td>£105-125</td>
<td>£125-£145</td>
<td>£50-£70</td>
<td>£60-80</td>
</tr>
<tr>
<td><strong>Annual cost (bn)</strong></td>
<td>£1.5</td>
<td>£3</td>
<td>£9</td>
<td>£0.8</td>
<td>£0.2</td>
</tr>
</tbody>
</table>

**Source:** Adapted from Garrett and Campbell (2010:11)

It is interesting to note in Table 3.3 that the differential impacts of investment at different qualification levels, for example, investment in higher level skills are associated with higher levels of productivity gain, while investment in lower levels of skills is associated with higher levels of employment gain. Leitch Review of skills (2005:11) reported that the tackling of low skills, through up-skilling an additional 3.5 million adults from the lower end of the skills spectrum, could deliver an average annual net benefit of 0.3 per cent of GDP. Most of this benefit comes from an increase in employment from 375,000 to 425,000. Similarly, improving intermediate and higher end skills deliver average annual net benefits of 0.4 per cent and 0.45 per cent of GDP respectively.

A recent study by Garrett and Campbell (2010:10) revealed that increasing the literacy score of a country by one per cent leads to a 2.5 per cent rise in productivity and 1.5 per cent increase in GDP per head. The study further suggest that an attempt to reduce the number of young people who drop out of formal education before the age of eighteen showed that encouraging an extra 50,000 to stay on by 2010 would lead to GDP being 1.1 per cent higher in the longer-term. Therefore, improving the skills of workers also improves the productivity of organisations and helps them to compete in the global economy (Leitch Review of skills 2005:22). Table 3.3 clearly indicates that higher skills
(net benefit of £125-£145) are associated with increased productivity and improved outcomes at the organisational level. For example, one study showed a ten per cent rise in net sales per worker with over three years training, while another study showed how the efficiency of production increased with training in manufacturing.

### 3.5 SKILL UTILISATION

An organisation must have a workforce with appropriate skills to address its organisational activities if it wants to perform effectively. The overriding message of this statement is that, if the training is relevant to peoples’ work, and the new skills and knowledge acquired are utilised, then there is a positive effect on productivity and job satisfaction and a reduction in absenteeism. Skills utilisation ensures the effective application of skills in the workplace by maximising performance through the interplay of employees, employers, government and society and the use of working practices (Scottish Government 2008:2). An organisational paradigm in respect of the link between skills and outcomes is presented below in Figure 3.2.

**Figure 3.2: Transforming skills into outcomes**

![Diagram](attachment:image.png)

(Less turnover and propensity to leave)

*Source: Adapted from Windsor (2009:4)*
Figure 3.2 illustrates that skills do not necessarily equal good jobs, productivity, competitive advantage and sustainability but only make a difference if skills are effectively utilised within the workplace. Demand is a derived demand; that is, hiring is not desired for its own sake but rather because it aids in producing output, which contributes to an employer's revenue and hence profits. Buchanan, Scott, Yu, Schutz, and Jakubauskas (2010) maintained that there is currently a growing recognition among policy makers in many countries that if skills are to contribute to economic performance and social well-being then they have to be used effectively in the workplace. The UK Commission for Employment and Skills (UKCES) further added that there is little value to an organisation having a skilled workforce if the skills are not used well (UKCES 2009:11). The concept of skills utilisation points to the need for policies revolving around productivity, innovation, economic development, work organisation, employment relations as well as skills to pull together as part of a balanced and coherent strategy for sustainable growth (Payne 2011:2). Productivity and employment challenges are discussed briefly below to demonstrate the utilisation of skills in an organisation.

### 3.5.1 Productivity challenge

Productivity is a relationship between outputs and inputs. It grows when an increase in output occurs with a less than proportionate increase in inputs, or when the same output is produced with fewer inputs (ILO 2008:1). Productivity can also be measured

- in monetary terms if the price received for an output rises with no increase in the cost of inputs, this is also seen as an increase in productivity.
- in terms of all factors of production combined (total factor productivity), or
- in terms of productivity, which is defined as output per unit of input, measured either in terms of the number of persons employed (as in this report) or in terms of the number of hours worked (ILO 2005:5).

Productivity, as the focus point of this study, is determined by several factors. First, it depends on the quality (skills and effort) of the workforce. Secondly, it depends upon efficiency wage theory which states that a rise in real wages may induce higher worker effort, hence improving productivity. Thirdly, it depends upon capital/worker ratio. A
higher capital/worker ratio is also expected to raise productivity, as each worker has more capital equipment at his or her disposal. It is important to recognise that skills development and other investments in human capital comprise only one set of factors necessary for productivity growth. Skills development alone cannot raise enterprise and national productivity. Other factors and policies are equally insufficient if they are implemented in isolation of skills development (International Labour Organisation 2008:2).

3.5.2 Employment challenge

The challenge for the country going forward is to improve its good employment performance, while also boosting growth in output per worker and output per hour so that all stakeholders share more evenly in market opportunities. This would provide organisations with a larger pool of workers, allowing a higher sustainable rate of growth, and allow everyone the chance to improve their pay and career prospects (Leitch Review of Skills 2005:16). A larger pool of workers refers to the workforce that is capable of learning new technologies and workplace practices, engaging in social dialogue and participating in opportunities for continued learning. Employers have serious concerns about a lack of basic skills in employees. Basic and vocational education prepares young people for the world of work and on-going workplace learning. Mining organisations should work with further education institutions to make learning more attractive to engage teenagers, for example by combining practical vocational and life skills with literacy and numeracy qualifications that will help them gain employment. This level of education is the minimum requirement for sustainable productive employment in a modern economy, and it is also the level that employers could reasonably expect most young people to have attained at school (House of Commons 2006:4-8).

Windsor (2009:3) posited that skills are not landing where they are needed since the recent statistics show only 14% of employers have significant problems recruiting people, 37% report employees have more skills than they require and only 5% report employees have less skills than they require.
3.6 SKILLS SUPPLY FOR MINING INDUSTRY

According to studies conducted by Johnston and Bernstein (2007:25) on the causes of the skills shortage in South Africa, revealed that there is an imbalance in the South African market with an oversupply of some skills and an undersupply of others. In general the South African market has an abundance of unskilled, unemployed people and simultaneously significant shortages in skills. Furthermore, a study by Van Aardt (2003) and supported by Woolard, Kneebone and Lee (2003) agreed that the South African workforce has too few members with the necessary educational qualifications to sustain high growth in a first world economy.

The South African economy has shifted from being an inwardly focused economy concentrated on minerals and manufacturing to becoming a more diversified and globally orientated economy requiring more specialised skills to maintain high economic growth (Department of Labour 2006:1). South Africa is also a surplus country with an estimated employable workforce of about 31.4 million people between the ages 15-65 but of which between 35% and 45% are unemployed. Although 96% of the workforce attended school, 51% of them did not pass matric (Grade 12) and only 37% have a post-matric qualification (Statistics South Africa 2010:17). Table 3.4 outlines the occupational distribution of employees in the mining industry.
### Table 3.4: Occupational distribution of workers: 2009

<table>
<thead>
<tr>
<th>Occupational category</th>
<th>Population group</th>
<th>African</th>
<th>Coloured</th>
<th>Indian</th>
<th>White</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Officials, Managers and Owner Managers</td>
<td>N</td>
<td>2 662</td>
<td>163</td>
<td>205</td>
<td>4 868</td>
<td>7 899</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>34</td>
<td>2</td>
<td>3</td>
<td>62</td>
<td>100</td>
</tr>
<tr>
<td>Professionals</td>
<td>N</td>
<td>3 224</td>
<td>316</td>
<td>384</td>
<td>8 074</td>
<td>11 998</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>27</td>
<td>3</td>
<td>3</td>
<td>67</td>
<td>100</td>
</tr>
<tr>
<td>Technicians and Associated Professionals</td>
<td>N</td>
<td>12 618</td>
<td>988</td>
<td>421</td>
<td>16 974</td>
<td>31 001</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>41</td>
<td>3</td>
<td>1</td>
<td>55</td>
<td>100</td>
</tr>
<tr>
<td>Clerks</td>
<td>N</td>
<td>16 393</td>
<td>1 150</td>
<td>366</td>
<td>6 396</td>
<td>24 305</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>67</td>
<td>5</td>
<td>2</td>
<td>26</td>
<td>100</td>
</tr>
<tr>
<td>Service Workers, Shop and Market Sales Workers</td>
<td>N</td>
<td>8 192</td>
<td>380</td>
<td>67</td>
<td>1 479</td>
<td>10 118</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>81</td>
<td>4</td>
<td>1</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>Agricultural and Fishery Workers</td>
<td>N</td>
<td>1 045</td>
<td>104</td>
<td>32</td>
<td>735</td>
<td>1 916</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>55</td>
<td>5</td>
<td>2</td>
<td>38</td>
<td>100</td>
</tr>
<tr>
<td>Craft and Related Trade Workers</td>
<td>N</td>
<td>32 778</td>
<td>1 884</td>
<td>369</td>
<td>21 990</td>
<td>57 022</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>57</td>
<td>3</td>
<td>1</td>
<td>39</td>
<td>100</td>
</tr>
<tr>
<td>Plant and Machine Operators and Assemblers</td>
<td>N</td>
<td>199 313</td>
<td>3 357</td>
<td>79</td>
<td>4 507</td>
<td>207 257</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>96</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Labourers and Related Workers</td>
<td>N</td>
<td>192 801</td>
<td>1 280</td>
<td>54</td>
<td>2 110</td>
<td>196 246</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>98</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Apprentices and Section 18 (1) Learners</td>
<td>N</td>
<td>6 612</td>
<td>302</td>
<td>16</td>
<td>960</td>
<td>7 891</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>84</td>
<td>4</td>
<td>0</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>N</strong></td>
<td><strong>475 638</strong></td>
<td><strong>9 924</strong></td>
<td><strong>1 994</strong></td>
<td><strong>68 096</strong></td>
<td><strong>555 652</strong></td>
</tr>
<tr>
<td></td>
<td><strong>%</strong></td>
<td><strong>86</strong></td>
<td><strong>2</strong></td>
<td><strong>0</strong></td>
<td><strong>12</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Source:** Adapted from Mining Qualifications Authority (2009:24)

According to Table 3.4, Africans form the majority of the MMS's workforce and are also the majority in all the occupational categories, with the exception of Senior Officials, Managers and Owner Managers where they constitute 27% of the workers, Professionals (20%) and Technicians and Associated Professionals (41%). These three occupational categories are dominated by whites. The efforts of mining companies to build a respectful and welcoming workplace that employs people as diverse and representative as the population they serve are continuous. Employment equity initiatives help them meet organisational needs while ensuring that they employ the best talent available.

The significant demographic changes of the global economy that needs organisations to anticipate change and positioning themselves well for the economic transformation,
suggest that the supply of skilled workers may not keep pace with demand in the future (Sommers & Heg 2002:1-2). Generally, to add to this crisis, unemployment by occupation reflects unemployment by industry. According to Mayer (2010:14) a disproportionate share of unemployed workers had been employed in construction and extraction occupations (13.7%), production occupations (9.0%), service occupations (20.4%), and transportation and material moving occupations (8.5%). Many construction and extraction workers (disproportionally distributed as shown in Table 3.4) are unique to the mining industry as many of them work with equipment that is only used in resource extraction.

A strong skills base, though not sufficient on its own, is an important element in a productive and sustainable economy, and developing countries such as South Africa are increasingly in competition for skilled workers with emerging mining countries such as Australia, India and China, which are investing strongly in higher level skills (House of Commons 2006:7).

3.7 SKILLS DEMAND IN THE MINING INDUSTRY

Mining is an inherently dangerous activity and the industry world-wide has a record of recurring accidents (leading to fatalities and occasional disasters) and a high incidence of occupational disease (Malherbe 2000:24). South Africa has very large, deep and rigorous mines, and a workforce with low levels of education and a high degree of illiteracy which has led to relatively high accident rates. Until the early 1990s South Africa’s problems were compounded by a typically hierarchical and racial organisation of management on the mines, which hindered effective dialogue between management and workers around improvements in safety (and in productivity) (Mabena & Nengovhela 2009:11).

Mineral resource development is unsustainable only if mining organisations ignore the complex interaction of economic growth, social development and the protection of the environment. The mines typically have a five to 50-years life-span horizon due to its cyclic nature and as all resources are finite and their success can only be ensured if
they invest in their long-term sustainability. A mine’s successful operation is inextricably linked to the skills and expertise of the people it employs, the customers and suppliers of the organisation, the safety of its operations and the nature of the relationships that it builds with neighbouring communities and governments (Gold Fields 2010:92).

International Labour Organisation (2006:153) contended that managers and supervisory officials should be in possession of an appropriate qualification and training, or have gained sufficient knowledge, skills and experience to qualify on the basis of competence, to ensure that they are able to:

- plan and organise safe operations, including identification of hazards, assessments of risks and the implementation of preventive measures;
- establish, implement and maintain an OSH management system;
- monitor the status of OSH in those operations for which they are responsible; and
- take corrective action in the event of non-compliance with requirements.

Managerial positions are often filled by skilled personnel and thus increasing the shortages of professionals such as engineers. An analysis of the demand for skills in the Mining and Minerals Sector (MMS) is shown in the Table 3.5. The occupational structure of current employment would provide insight into the types of skills employed in the Sector, while the population group and gender distributions is evident of the transformation that has taken place in the Sector and the transformation needs that still exist.
Table 3.5: Occupational distribution of employees in the mining and mineral industry: 2009

<table>
<thead>
<tr>
<th>Occupational category</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Officials, Managers and Owner Managers</td>
<td>7 899</td>
<td>1</td>
</tr>
<tr>
<td>Professionals</td>
<td>11 998</td>
<td>2</td>
</tr>
<tr>
<td>Technicians and Associated Professionals</td>
<td>31 001</td>
<td>6</td>
</tr>
<tr>
<td>Clerks</td>
<td>24 305</td>
<td>4</td>
</tr>
<tr>
<td>Service Workers, Shop and Market Sales Workers</td>
<td>10 118</td>
<td>2</td>
</tr>
<tr>
<td>Agricultural and Fishery Workers</td>
<td>1 916</td>
<td>0</td>
</tr>
<tr>
<td>Craft and Related Trade Workers</td>
<td>57 022</td>
<td>10</td>
</tr>
<tr>
<td>Plant and Machine Operators and Assemblers</td>
<td>207 257</td>
<td>37</td>
</tr>
<tr>
<td>Plant and Machine Operators and Assemblers</td>
<td>196 246</td>
<td>35</td>
</tr>
<tr>
<td>Apprentices and Section 18 (1) Learners</td>
<td>7 891</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>555 652</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Adapted from Mining Qualifications Authority (2009:22)

Table 3.5 indicates the latest available occupational distribution of workers in the mining industry and shows that the demand for highly skilled workers is relatively low. Only 9% of the total workforce is employed in the managerial, professional and technical categories (i.e. occupations that mostly require a tertiary education). The Sector employs approximately 2% of the people with tertiary educational qualifications in the country. Although highly skilled workers form a relatively small component of the total workforce in the industry, their skills are critically important. Professionals and technicians are employed in the following technical skills areas: Mining Engineering, Metallurgy, Chemical Engineering, Geology, Electrical Engineering, Mechanical Engineering, Analytical Chemistry, Mine Surveying and Jewellery Design and Manufacturing (MQA 2009:21-22).
3.8 MINING AS A SKILL

The idea of strategic skills needs is not what skills are and what skills will be needed for, as the economy continues along its most likely path, but, what skills would be needed if the mining organisations are to operate at their full potential (Holt, Sawicki & Sloan 2010:49). The people who work at the mines are not ordinary people doing ordinary jobs, they are strong and skilled people who know how to work together and get the job done. Everyday these people work with powerful machinery in difficult conditions to extract a range of natural wealth from the rock, process and refine it in plants. Furthermore, these people are fully aware of difficult condition where they work and make sure they use Personal Protective Equipment (PPE) to reduce the risk of injury. In addition to the use of engineering and administrative controls to reduce exposures to acceptable levels, the PPE’s are used to supplement these measures (Geigle 2010:4). Basically, all underground occupations use PPE as their only means of protection, as well as wearing safety boots to protect their feet, knee guards for their needs, eye goggles for sight, hand gloves, hard hats for head protection and ear plugs to protect their hearing. Furthermore, they work hard and safely.

When a worker has the skills to do a job, an employer must also assess whether a worker will tolerate particular employment relations and employment conditions, some of which may be regarded as deriving from the nature of the work. Mining is an interactive occupation that may be inherently stressful and emotionally draining (Lucas & Mansfield 2008:10). Mining is a skill of digging into the earth to extract naturally occurring minerals and/or any non-renewable resource including petroleum, natural gases even fossil water, usually from ore body or vein (placer or lode deposits).

Different ore veins have different difficulties. The easiest is mining plain rock, followed by iron ore and copper ore and leads to reduced skill gain. The hardest are silver and gold, resulting in the need of skilled workers. According to Shahriar, Oraee and Bakhtavar (2007:1), the decision as to whether mining will be on surface or underground is made before applying for mining rights (i.e. land zoning and permitting
process) and is based on the geometry properties of the ore deposit as well as its position with respect to the surface.

3.8.1 Methods of mining
Two methods of mining are discussed below in order to explain the concept of mining as a skill.

3.8.1.1 Surface mining method
Surface mining, also called open-pit mining or strip mining, is undertaken if the mineral is near the earth’s surface. This method usually is more cost-effective and requires fewer workers to produce the same quantity of ore/rock as underground mining does. In surface mining, after blasting with explosives, workers use huge earthmoving equipment, such as, power shovels or draglines, to scoop off the layers of soil and rock covering the mineral bed (United States Securities and Exchange Commission 2008:6). Once the mineral is exposed, smaller shovels are used to lift it from the ground and load it unto trucks. The mineral can also be broken up by using explosives, if necessary.

3.8.1.2 Underground mining method
Underground mining is used when the mineral deposit lies deep below the surface of the earth. When developing an underground mine, miners firstly dig two or more openings, or tunnels, deep into the earth near the place where they believe coal or minerals are located. Tunnels may be vertical, horizontal, or sloping, depending on where the vein of ore is in relation to the surface (United States Securities and Exchange Commission 2008:7). One opening allows the miners to move in and out of the mine with their tools and also serves as a path for transporting the mined rock by small railroad cars or by conveyor belts to the surface. The other opening is used for ventilation. In hard rock mining, ore is recovered by drilling, blasting and removing rock in sequences of panels, referred to as stopes. If left unfilled, convergence of these stopes occurs, as the prevailing ground stresses squeezes rock into the voids. This movement, if left unchecked, can result in rockbursts and other falls of rock within the underground working environment; clearly this is a potentially dangerous situation.
The mining method selection problem is one of the most critical and problematic activities of mining engineering with the intention to maximize the organisation’s profits, recovery of the mineral resources and provide a safe environment for the miners. The selection of skilled and competent persons and consequently capital resources, follow intuitively from there. Mining is an inherently dangerous undertaking and health and safety regulations are strictly enforced (Kyereh & Hoffman 2008:7). One of the most important critical skills required of mine workers is the ability to always be safety conscious and this inherent skill can only be acquired by new employee over time. Mining organisations have noted the effects of the loss of critical skills that ultimately lead to increased mine accidents which in turn resulted in a loss of productive time and capital losses in the form of accidents. These less visible factors build up over longer time frames and the prevention thereof are critical for a more efficient, effective and ultimately productive workforce (Daly 2000:16).

3.8.2 Types of mining occupations
Kennan (2011) reported that according to the Bureau of Statistics, only about half of the people in the mining industry directly work with the extraction and transportation of the natural resources. Though some kinds of mining occupations are in decline, there are increasing job opportunities that are categorised as professional, extraction and maintenance occupations.

3.8.2.1 Professional and related occupations
These occupations include a wide variety of skilled professions. Professional and related workers perform a wide variety of duties, and are employed throughout the mining industry. Before any mining can actually begin, a deposit of the resource needs to be found. This is the primary work of geologists and geological and petroleum technicians, who travel around the world using a variety of scientific instruments such as seismographs to find natural resources based on several scientific principles and procedures. When they find a likely spot, they drill for core samples to confirm the location. Once a location for a mine has been found, a team of mine designers is
gathered including mining engineers, technicians and environmental engineers (USA Department of Labour 2006:22).

3.8.2.2 Extraction workers
Extraction workers are drill machine operators who drill into the earth. Explosives experts plant the dynamite to expose the natural resources and the loading machine operators gather the rock to be transported to the surface and refined. Workers in extraction occupations usually must be at least 18 years old, enjoy good physical health, and pass occupational fitness test. A high school certificate is not necessarily required, but is usually preferred for career advancement while some companies may also require workers to pass a basic skills test. Most workers start as helpers and learn skills on the job; however, formal training is becoming more important, as more technologically advanced machinery and methods are used (USA Department of Labour 2006:19-20).

Construction, installation, maintenance, and repair occupations are other workers, who are not directly involved in the extraction process, work in and around wells, mines, and quarries. No matter what resource is being mined, there is a significant amount of machinery that must be kept in working order. Mechanics are needed to repair and maintain the wide variety of machinery, and electricians are needed to check and install electrical wiring. Mechanical and electrical repair work has become increasingly complex, as machinery and other equipment have become computerised. Most skilled occupations in construction or maintenance environments require several years of vocational training or experience in that occupation. Many schools in areas with mining operations often offer specialised mine technology programs (USA Department of Labour 2006:21).

3.9 CONCEPTUALISING SKILLS SHORTAGES
According to Shah and Burke (2003) skills shortages exist when the demand for workers for a particular occupation is greater than the supply of workers who are qualified, available and willing to work under existing market conditions. Skill shortages can be confused with shortages. However, an accurate definition of skills shortages differs from shortages in that shortages refer to the quantity of the workforce whereas
skills shortages refer to particular skills within the workforce (Greig et al. 2008:53). In addition, it may often be confused with two other related concepts recruitment difficulty, where an organisation finds it difficult to fill a vacancy, even though there is not a broader skill shortage. This may be due to the characteristics of the organisation, the location or the skill set required for the position. Furthermore, the other related concept is referred to as a skills gap which occurs when existing staff do possess the skills needed for the required positions.

The idea of a shortage seems straightforward and simple as it occurs when the supply of workers is not sufficient to meet the demand, at current rates of pay. It is however, a peculiar situation when looking at it closely, since:

• skills shortage is not easy to measure. It is not just the number of people, but also the number of hours they are willing to work, that matters: while some people work long hours, many others want to work part-time (OECD 2003:103);

• there is no universally applied definition of skills shortage. Workers with highly desired skills work in jobs that do not directly use their formal qualifications; alternatively, they are of working age, but not seeking employment. Vacancies may go unfilled, not because there is no one available to do the job, but because the wages and conditions on offer are unattractive (OECD 2003:105);

• there are no objective measures or direct indicators of skill shortages. Within every skills group, there is a range of abilities, from exceptional to ordinary; this variation in quality is important to employers, but not observable in measures of supply (Alpert & Auyer 2003:1); and

• no single empirical measure of occupational skills shortage exists, nor does it appear that one can easily be developed (US Bureau of Labour Statistics 1999:17).

A longstanding definition that appeals to economists is that by Arrow and Capron (1959:307) which stated that a skills shortage is a situation in which there are unfilled vacancies in positions where salaries are the same as those currently being paid to others of the same type and quality. An alternative definition is that of Barnow, Trutko and Lerman (1998:7) that stated shortage is market disequilibrium between supply and demand in which the quantity of workers demanded exceeds the supply available and
willing to work at a particular wage and working conditions at a particular place and point in time.

According to Trendle (2005:4) skills shortage occurs when the amount demanded within particular occupational categories or skills exceeds the available supply of these skills. The demand for an additional amount of skills depends on the Marginal Revenue Product (MRP) and the Marginal Cost (MC) of the worker. The MRP is calculated by multiplying the price of the commodity or service by the Marginal Physical Product of the worker. If the MRP is greater than a firm's Marginal Cost, then the firm will employ the worker since doing so will increase profit. In economic theory, the firm will only employ workers up to the point where MRP=MC, and not beyond,

Skills shortage is frequently highlighted in the media drawing comments from the governments, employers and unions. Reports on shortages of information technology and communication skills featured regularly until quite recently (Shah & Burke 2003:1). According to Momberg (2008) the shortage of skills in South Africa, is more serious than was believed and the full effect of the lack of expertise is yet to be felt.

3.9.1 Effect of skills shortage on the South African economy

According to Esterhuizen (2011), the mining industry is still recovering from the global financial meltdown but has significantly rebounded during the past six months (late 2010) with commodity prices rising to all-time highs in many However, there are few large projects that are being started even though a large number of feasibility studies that were stopped by mining companies during the recession have been restarted. New feasibility studies that are been undertaken would significantly increase the skills demand for consulting engineers and the execution of the majority of these projects are estimated to follow within the next six months to a year. However, these new projects would be affected by the global skills shortage. The execution phase of a mine project is more intensive than the feasibility phase, estimated to a ratio of about five to one in terms of professional staff requirements for the execution phase of a project and its feasibility phase (Esterhuizen 2011).
Momberg (2008) reported that economists, researchers and industry insiders believe that the shortage of skills is the biggest challenge faced by the economy. Companies complain that they are unable to meet affirmative action quotas because of the shortage of qualified black people. Emigration, early retirement and quitting because of deteriorating working conditions and relatively low wages are said to be blamed for the lack of skilled human capital.

3.9.2 Existence of skills shortage

A careful assessment of skills available and skills needed would allow an organisation to maximise its core strengths while minimising its weaknesses. In other words, a selective capacity reduction at a time of crisis would allow the organisation to first create stability and then prepare for the eventual upturn in the economy, a prospect often forgotten when companies are tempted to focus only on survival (Davidson, Harshak, Rabb & Blain 2008:7).

The rising skills shortages have become one of the main problems facing the mining and minerals sector throughout the world. Mineral exploration and production need to increase significantly to meet rising demand, in the coming years, and this requires more engineers, drilling crews and geoscientists. The mining industry requires many kinds of workers. There are a number of causes of skill shortages, and the relevance of these causes varies across industries and regions. Many case studies have identified one or two key causes impacting on a region. However, the cause of a particular shortage is often a combination of many factors. The diversity of causes of shortages means that the treatments that work in one case will not necessarily work in another. This section brings together these perspectives into two models, namely, drivers of skills shortage as well as push and pulls factors.

3.9.2.1 Drivers of skills shortage

The forward looking projections of skills shortage have to be based on macroeconomic forecasts that link changes in aggregate demand and its determinants (such as exchange rates and interest rates) to trends in sectoral output, productivity and
employment. These will then be used to generate occupational and qualifications forecasts, using trends in those relationships (Holt et al. 2010:46). There have been a number of attempts to identify the drivers of skill shortages. Canterford (2006:9) developed a model based on existing literature and case studies supplied by the Area Consultative Committee (ACC) network to highlight the drivers of skills shortages outlined in Figure 3.3.

**Figure 3.3: Drivers of skills shortage**

<table>
<thead>
<tr>
<th>Macroeconomic focus</th>
<th>Sectorial focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Change</td>
<td>FLEXIBILITY MOBILITY</td>
</tr>
<tr>
<td>Globalisation</td>
<td>Secondary job opportunities</td>
</tr>
<tr>
<td>National economy</td>
<td>Career development</td>
</tr>
<tr>
<td>Regulatory Framework</td>
<td>Work conditions</td>
</tr>
</tbody>
</table>

**PROXIMAL CAUSES**

- TRAINING
- WASTAGE
- MIGRATION
- WORKFORCE EXISTS

**SKILLS SHORTAGE**

Source: Adapted from Canterford (2006:9).

Figure 3.3 shows the causes of skills shortage that may be used to measure and indicate the extent of skills shortages. However, an understanding of the underlying root and proximal causes of skills shortages is necessary to effectively treat the problem. The root causes are listed as largely macroeconomic variables that deal with the state
of the economy and the current competition from outside. The root causes fall into two broad categories, namely, those that influence the demand for employees which are macroeconomic in nature, and those relating to the flexibility and mobility of workers, which represent the supply side of the market equation by explaining why workers may or may not be prepared to relocate to another geographic region to fill a vacant position. Globalisation, for example, causes increased competition from foreign firms and a need to raise skill levels in South Africa. On the other hand, the flexibility and mobility of workers are more microeconomic in nature. Recently laid off skilled mine workers in the Free State Province may need considerable persuasion before they would move to skilled jobs in Gauteng Province (Kline & Knox 2006:11). When skills are in demand, skilled workers choose their location based on a number of personal preferences. Understanding why skilled workers choose to locate in a region can help regional employers provide incentives to attract workers in a competitive market (Grigg & Da Silva 2008, and Canterford 2006:9).

The proximal causes are of a more immediate nature and are often used to explain the actual skills shortages on hand. Insufficient training can lead to skills shortages. Highly skilled professionals not using their skills lead to what is referred to as wastage of skills. The combination of these underlying root causes and proximal causes demonstrate the multi layered and complex nature of the skills shortages problem. Research suggests that many of the people that do choose to migrate to a regional location, termed internal migrators in the academic literature, do so seeking a lifestyle change.

3.9.2.2 Push and Pull factors of skills shortage

African countries continually lose a significant number of trained nationals, with for example, a third of South Africa’s artisans and engineers leaving the country over the past 40 years, referred to as Brain Drain, to markets like Canada and Australia, who decide to emigrate and live abroad in search of higher incomes and a better standard of living, among a host of other reasons. According to Breinbauer (2007:2-3), such migration may take any of the following forms:
• **External brain drain:** which occurs when trained and skilled workers leave their country to go and work in developed countries and up to 100,000 people are believed to have left South Africa over the last three years, and 70% of skilled South Africans still in the country are considering emigrating, despite government calls for them to stay and help their country. The external drain has two components, namely permanent and temporary. Permanent brain drain occurs when skilled workers emigrate, like regular citizens, to other countries. Temporary brain drain occurs when skilled workers travel abroad for brief periods of time, generally for one to six months but not uncommonly staying abroad on contracts of a year or two. This temporary brain drain is far more common than the permanent loss of skilled workers. The demand for South African professionals is a tribute to the quality of education and training provided in South Africa, and many are highly respected practitioners, in various fields, throughout the world. This has prompted some government officials to call for a stricter regulation of the international movement of professionals.

• **Internal brain drain:** consists of two subdivisions. Firstly, it occurs when skilled workers leave their vocational sector entirely to work in another sector, stemming from the need to earn a survival salary. Lastly, it occurs when trained and skilled workers are not employed in the fields of their expertise in their own country, is commonly known as brain waste. Locally, mining companies are not only losing workers to other mining companies, but also to major engineering and construction projects in South Africa associated with the construction and maintenance of roads, railways, airports, bridges, harbours, large buildings, dams, water supply and sanitation facilities. This high turnover of artisans and a loss of engineers have forced the mining industry to do a comprehensive review of training materials and programmes, job grading and conditions of employment. This is a striking issue in the countries in transition with emerging economies, as the people concerned are often the more skilled ones (Dévai, Mensink & Papaioannu 2002:13). Figure 3.4 shows the push and pull factors of organisational professionals.
The discourse in this study is about these two forms of brain drain. There are many salient factors contributing to migration and are hereby categorised under mining
industry and individual perspective. Some factors that are generally relevant to the mining industry include poor conditions of service, human rights abuses, incorrect placement of trained personnel, disregard for local talent, scarcity of jobs, limited access to education, poor healthcare services, a high level of crime, and the fear of losing valued relationships developed in host countries. Some reasons underpinning individual migration decisions, where official data exists, are for work, study or to join a partner or immediate family (Horsfield 2005:126). However, a more sophisticated understanding of individual reasons can be gained by differentiating between factors that push migrants away from one country and pull them towards another, as illustrated in Figure 3.4.

This model presented comprehensive factors that influence the propensity of professionals to leave their current organisations to work in other sectors or foreign countries. There are push factors, stimulating workers to consider leaving their country of residence (World Bank 2004:2), and there are pull factors exerted by destination countries, making them more attractive places to live and work (Lowell & Findlay 2001:3). Locally, mining companies are not only losing workers to other mining companies, but also to major engineering and construction projects in South Africa associated with the construction and maintenance of roads, railways, airports, bridges, harbours, large buildings, dams, water supply and sanitation facilities. This high turnover of artisans and a loss of engineers have forced the mining industry to do a comprehensive review of training materials and programmes, job grading and conditions of employment. Mlambo-Ngcuka (2006) cautioned that, unless skills shortage causal factors are identified and tackled at all levels of the economy, it could undo all the gains of the past years.

3.9.2.3 **Specific skills shortage factors relevant to mining industry**

After the 2008/2009 financial crises, South Africa’s mining industry found itself in a situation where reintegration into the international economy mandated skills changes to the methods of production, competitiveness and sustainability. This resulted into too few workers with adequate skills, or supply was not able to match the demand.
There are reasons contributing to the skill shortage (Peek, Fenard, Gantes, & Theiler 2008:19-21), and they include:

(a) *Unprecedented surge in the demand for mining products*

There is a significant increase in the demand for energy and the resulting hike in the price of oil, gold and platinum in the commodity market. There has been, for example, a very substantial increase in energy demand that is expected to accelerate. Much of this is the result of many developing economies, but primarily from China and India, now experiencing high levels of economic growth.

(b) *High average age of professionals in the industry*

The average age of professionals in the mining industry is one of the highest of any industry, with many people having retired or retiring in the next few years. There is ample evidence that the average age of professionals in the global mining and mineral industry is high. A global survey of 300 oil and gas companies, for example, carried out by the Energy Institute concluded that the median age of their staff was 45 years. Around 50 labourers or professionals in exploration and production are aged between 40-50 years, while barely 15 labourers are junior recruits aged between their early 20s and mid-30s. The Financial Times reported that the average age of oilfield engineers is 48 years, globally, and in the USA 50 years.

(c) *Fewer students enrolling in mining related courses*

Student enrolment in mining related courses has been on the decline for many years. Although enrolment has picked up somewhat in the last 2-3 years, the level is still well below that of the early 1980s. According to Peek et al. (2008) the number of experienced workers in the industry is now rapidly declining, the pool of possible replacement workers is shrinking. Booz (2007:17) found that graduate recruitment into the industry from established Western universities and organisation schools has been in decline, as has been the case for most companies looking for technically skilled employees. The pool of possible replacement of workers is shrinking as the number of experienced workers in the industry is now rapidly declining.
This shrinkage is illustrated by the analysis of AngloGold Ashanti South Africa region bursary population of 2004 (see Table 3.6), as it is detailed by discipline of study, type of tertiary institutions and includes the split between historically disadvantaged South Africans (HDSA) and white males (WM).

Table 3.6: AngloGold Ashanti South Africa Region Bursar Population (2004)

<table>
<thead>
<tr>
<th>Discipline</th>
<th>University</th>
<th>University of Technology</th>
<th>Pre-tertiary (Mining)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HDSA WM Tot</td>
<td>HDSA WM Tot</td>
<td>HDSA WM Tot</td>
<td>HDSA WM Tot</td>
</tr>
<tr>
<td>Mining</td>
<td>9 3 12</td>
<td>8 9 17</td>
<td>2 3 5</td>
<td>19 15 34</td>
</tr>
<tr>
<td>Engineering</td>
<td>16 6 22</td>
<td>11 3 14</td>
<td>-----</td>
<td>27 9 36</td>
</tr>
<tr>
<td>MRM</td>
<td>18 4 22</td>
<td>2 1 3</td>
<td>-----</td>
<td>20 5 25</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>9 4 13</td>
<td>2 2 4</td>
<td>-----</td>
<td>11 6 17</td>
</tr>
<tr>
<td>TOTAL</td>
<td>52 17 69</td>
<td>23 15 38</td>
<td>2 3 5</td>
<td>77 35 112</td>
</tr>
<tr>
<td>% EE</td>
<td>75% 25% 61%</td>
<td>39% 40%</td>
<td>60% 69%</td>
<td>31%</td>
</tr>
</tbody>
</table>

Source: Adapted from AngloGold Ashanti (2004)

Against the background of a growing number of graduate school leavers in South Africa who cannot afford a tertiary education, the AngloGold Ashanti bursary scheme focuses primarily on identifying and supporting promising students with aptitudes particularly, engineering sciences. In 2004 a total of 112 students benefited from the scheme at a cost of R11.5 million (US$1.79 million). Bursaries are offered for full-time studies at either universities or universities of technology (formerly technikons) in the fields of mining engineering, geology, survey, electrical/mechanical engineering, metallurgy and other mining-related fields of study.
(d) The unfavourable image of the industry

There is a perception among many students that mine and mineral exploration is not a respectable organisation to be in, much less so than the computer or biotechnology organisations. It has a public image as a pollution-prone industry, wrecked by cycles of boom and bust, run by monopolies and engaged in price fixing. There is also an unjustified notion, that mining is technologically obsolete, sunset rather than a sunrise industry and young people do not like the mining lifestyle (Peek et al. 2008:24). The typical work environment of people working as machine operators, miners, team leaders and mining support workers in underground hard-rock mining is challenging and physically demanding. Workers have to work kilometres underground in dark, narrow, confined spaces with high temperatures and humidity (Research Focus 2007:8). The average production worker in the mining industry works 45.3 hours per week, although schedules can vary widely. Some sites operate 24 hours a day, 7 days a week, particularly in oil and gas extraction as well as, underground mines, creating the opportunity for some mining workers to work long shifts several days in a row, and then have 3 to 5 days off.

The recruitment of women in the mining industry was made difficult by the fact that mines are employers of predominantly full-time workers, an increasing number of whom are contractors for development, production and maintenance. The remote location of some sites, such as offshore oil rigs and some mines, requires some workers to actually live onsite for weeks at a time, often working long hours, followed by an extended leave period onshore (Bocoum 2003:4). Due to migrants, a living-out allowance by the mine companies and a lack of housing opportunities in the mine surroundings, workers have settled in shacks that have no access to sewage, refuse removal, electricity or piped water. This causes a higher incidence of water pollution and respiratory infections that are reinforced by the use of coal and other burning materials as substitutes for electricity.

Scientists and technicians work in office buildings and laboratories, while miners and mining engineers spend much of their time underground in the mine. Geologists who
specialise in the exploration of natural resources may have to travel for extended periods to remote locations, in all types of climates, in order to locate mineral or coal deposits (USA Department of Labour 2006:20). Although more women are working in all aspects of mining in some countries, mining is still a male-dominated industry. However, any increase in female employment is generally from a very low base.

(e) Suspension or cancellation of certificates of competency in the mining industry

Although mines’ health and safety conditions have improved dramatically, dust generated by drilling in mines still places miners at risk of developing either of two serious lung diseases, pneumoconiosis from coal dust or silicosis from rock dust (Burger 1999:97-103). Furthermore, the Occupational Health and Safety Act, 85 of 1993 (OHSA) regulates dust concentrations and levels in mining workplaces are closely monitored. Consequently, underground workers have their lungs x-rayed when starting a job, with a mandatory follow-up x-ray a year later, in order to monitor any development of respiratory illness. Compensation for occupational diseases and injuries is currently provided for in South Africa by two different statutes, that is, the Compensation for Occupational Injuries and Diseases Act (COIDA) and the Occupational Diseases in Mines (Brandt. 2009:1)

Crowson (2008:5) stated that South African Chamber of mines had labelled new mining Health and Safety law, which included higher financial penalties and a criminal liability clause South Africa’s new mining health and safety law, as unconstitutional. The South African mining industry could lose the services of a considerable number of highly skilled managerial and professional workers, by choosing to work where they could face the threat of imprisonment or their certificates of competency could be nullified. Certain competencies are demanded from workers before they can operate underground, in terms of Health and Safety regulations. The Blasting Certificate of Competency is, for example, a legislated requirement needed by all workers operating in the industry who are working with, or handling explosives (Research Focus 2007:8).
Certificates of competency are issued by commissions of examiners under the auspices of the DMR upon a candidate meeting minimum requirements and essential knowledge of the operations of mines set for each class of certificate. According to Badenhorst (2011) these certificates are a prerequisite to being able to work in certain positions at mines and candidates have to pass examinations and meet practical requirements before they are issued with such certificates. In most instances, these certificates are the culmination of many years of study and practical application. These certificates include the miner’s blasting certificate, which authorises the holder to charge up and initiate an explosive blast. The mine overseer’s certificate authorises the holder to take charge of a section of the mine, and the mine manager’s certificate entitles the mine manager to manage the mine and mining operations under his or her control. Various departments of engineering and surveying also have legal appointments.

The Health and Safety Directorate of the Department of Mineral Resources (DMR) has significant and far reaching powers under the Mine Health and Safety Act, No. 29 of 1996 (MHSA) that is intended to enforce compliance with the statutory minimum standards for safe mining. Sections 54 and 55 of this Act make provision for the DMR inspectors to halt mining activities where the health and safety of employees are endangered and to suspend or cancel certificates of competency held by persons working at mines where such persons are guilty of a dereliction of their statutory duties (Badenhorst 2011:1).

Skills shortages lead to sub-optimal production and depending on the technology may substantially inhibit production. Shortages may also make the country less competitive in a fast moving global economy. Management needs to be able to identify current and predict future skills shortages, both in quantity and quality, and often by geographical regions (Shah & Burke 2003:1).

3.9.3 Size of skills shortages
According to Huq (2007:47) skills shortage can be quantitative (not enough workers) or qualitative (existing workers do not have the right skills). There is a general
understanding that the skills shortage in the mining industry is large and growing, but there is in fact little detailed information about the size of this deficit. Only a few studies have been carried out estimating the shortage under different scenarios of projected commodities prices and production levels. Below are some of those studies and their main findings.

According to Peek et al. (2008:16), a study by Cambridge Energy Research Associates (CERA) in 2007, estimated the expected shortage of engineering and project management staff. It found that around 55,500 engineers will be needed to deliver the over 400 major projects expected to come on stream over the next five years. Its survey identified a current base of 55,100 engineers involved in upstream activities. However, with an average age of 51 years, CERA calculated that over 50 per cent of this workforce will have retired by 2015, an attrition rate of six per cent per year.

A study conducted by the Society of Petroleum Engineers (SPE) concluded that, with a total workforce in the oil and gas industry of 375,000 technical workers in 2006, there would be an overall shortfall of around 30,000 professionals by the year 2012 (Peek et al. 2008:17). The estimated shortage would be felt mostly in the following occupations: geologists, geophysicists, loggers, tool pushers, drillers, petro physicists and production engineers (Petroleum Federation of India 2006:6).

A compilation of the initial findings of three surveys conducted by the Energy Institute, Norman Broadbent and Deloitte, revealed that there was going to be a significant skills shortage which would not affect all areas of competence equally. Furthermore, a survey conducted amongst the oil and gas organisation executives concluded that this shortage would mostly affect the technical skills specific to the industry, such as petroleum engineers and geoscientists (Energy Institute, Deloitte and Norman Broadbent 2008). In contrary, a 2006 study by Schlumberger reported that skills shortage occurs as a result of demographic challenges (ILO 2012:8). It concluded by saying that there were enough graduates and enough students in geosciences and petroleum engineering in the world and many needed to be relocated to areas of high demand (Peek et al. 2008:16).
In acknowledging the difficulties that confront an enquiry into skills shortage in South African mining industry, the study referred to a series of skills shortage problems to stretch from the lack of coherent application of skills concepts to mechanisms for calculating the level and severity of the skills crisis, to developing and implementing interventions to address scarce skills (National Skills Authority 2007:2).

3.9.4 Analysis of skills shortage in the mining industry

Measuring skills shortage is a difficult task. The Department of Employment and Workplace Relations (DEWR) is assigned with the task of determining where skills shortages exist. While comprehensive data is not available at the regional Gold Coast level, a wealth of published and unpublished data from the Queensland DEWR was available. In order to shed some light on the skills shortage situation in South African mines, DEWR conducted skills shortage assessments of organisations with reported vacancies, as indicated in Table 3.7. Based on their findings they identified the occupations that appear to have a skills shortage.

Table 3.7: Measuring of skills shortage

<table>
<thead>
<tr>
<th>Indicators of skills shortage</th>
<th>Theoretical explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacancy</td>
<td>Indicate recruitment problems and number of vacancies reported by employers. Indication of whether market imbalances reflect relative or absolute level of skills shortage.</td>
</tr>
<tr>
<td>Wage pressure</td>
<td>Good indicator when change in earnings can be detected although it will sometimes under report when wages are subject to control. Comparison of particular occupation wages given, the individual's qualifications, indicates how employers respond to these shortages.</td>
</tr>
<tr>
<td>Broad market pressure</td>
<td>Annual changes in unemployment and employment rate given the overall growth of South African economy. The indicator could be displayed by looking at the causes of skills shortage relative to employment. There is an inverse relationship between skills shortage and unemployment.</td>
</tr>
</tbody>
</table>

Source: Adapted from Holt et al. (2010:39-41)
The indicators that are presented in Table 3.7 are indeed related to the core notion of skill shortages but have different likelihoods of over or under-predicting the scale of any shortages. Generally, it seems reasonable to think of them as a workable and pragmatic response to the inherent difficulties in formulating the concept of skill shortages. There are different perspectives attached to the concept of skills shortages. Measuring skills shortage is a difficult task, one can only analyse skills shortage by distinguishing between scarce and critical skills, while skills shortage may be measured by means of formal education and experience in the mining industry.

### 3.9.4.1 Scarce and critical skills

Scarce skills, according to the Department of Labour and the Sectoral Education and Training Authorities (SETA), refer to occupations in which there is a scarcity of qualified and experienced people, currently or anticipated in the future, either because such skilled people are not available, known as absolute scarcity, or they are available but do not meet employment criteria, known as relative scarcity (Daniels 2007:2).

Critical skills in this study refer to specific skills within occupations and categorised as generic skills, such as problem solving, conflict resolution, numeracy, or team work and particular occupational skills required for performance within that occupation (Mabena & Nengovhela 2009:33). Mining Qualifications Authority (2007) made an identification of relevant critical and scarce skills in the mining sector. The data provided in Table 3.8 are weighted data and extrapolated to the whole mining sector in the Free State province and differentiated according to absolute and relative scarcity of skills.

**Table 3.8: Scarce and critical skills in Free State mines**

<table>
<thead>
<tr>
<th>Code</th>
<th>Occupation</th>
<th>Absolute Scarcity</th>
<th>Relative Scarcity</th>
<th>Total Scarcity</th>
</tr>
</thead>
<tbody>
<tr>
<td>132201</td>
<td>Finance Manager</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>133201</td>
<td>Engineering Manager</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>133503</td>
<td>Production or Operations Manager</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>133504</td>
<td>Operations Manager</td>
<td>8</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>136304</td>
<td>Foreman</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Code</td>
<td>Job Title</td>
<td>Required</td>
<td>Vacant</td>
<td>Total</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
<td>----------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>139902</td>
<td>Environmental manager</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>232202</td>
<td>Surveyor</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>233201</td>
<td>Civil Engineer</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>233301</td>
<td>Electrical Engineer</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>233502</td>
<td>Mechanical Engineer</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>234401</td>
<td>Geologist</td>
<td>4</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>251301</td>
<td>Environmental Health Officer</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>311903</td>
<td>Environmental Science Technician</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>312301</td>
<td>Electrical Engineering Draftsperson</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>312302</td>
<td>Electrical Engineering Technician</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>312502</td>
<td>Mechanical Engineering Technician</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>312903</td>
<td>Mining Technician</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>321202</td>
<td>Diesel Motor Mechanic</td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>322303</td>
<td>Welder</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>323201</td>
<td>Fitter</td>
<td>2</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>323202</td>
<td>Fitter and Turner</td>
<td>8</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>323501</td>
<td>Millwright</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>334101</td>
<td>Plumber</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>341101</td>
<td>Electrician</td>
<td>8</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>342101</td>
<td>Air-conditioning and Refrigeration Mechanic</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>411401</td>
<td>Enrolled Nurse</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>712201</td>
<td>Driller</td>
<td>119</td>
<td>119</td>
<td></td>
</tr>
<tr>
<td>712202</td>
<td>Miner</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>821701</td>
<td>Construction Rigger</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>72</strong></td>
<td><strong>273</strong></td>
<td><strong>345</strong></td>
</tr>
</tbody>
</table>

*Source: Adapted from Mining Qualifications Authority (MQA) (2009)*

Table 3.8 shows drillers and miners are the most needed in the relative scarcity column basically because they do not need any formal training except shop-floor training such
as a Blasting Certificate of Competency. Therefore, as one of the country’s largest private employers, the mining sector needs people from across the board and anybody could find a place in mining. In high demand at the moment, both absolute and relative, are artisans and engineers from all disciplines including metallurgy, geology, mechanical, electrical, civil and industrial. In particular, the mining industry experiences severe shortages in many of the above areas, specifically in the areas of trades and professionals. According to Mlambo-Ngcuka (2006) every year, South Africa universities produce 1400 engineers and only about half of these graduates register with the Engineering Council of South Africa (ECSA) as practising professionals. JIPSA has determined that to meet projected demand, the average annual output of engineers from the higher education sector needs to increase by 1400 to 2400 a year, whereas artisans will need to increase more than double from 5000 to 12500 every year over the next four years (Lomely & McNamara 2008:6). Measures need to be put in place to ensure that these graduates become registered professionals. Otherwise, South Africa must in the short-term increase its efforts to fast-track the importation of skills to meet immediate demand. According to Mlambo-Ngcuka (2006), the country has experienced a major increase in infrastructure development and other large capital projects, and all projections suggest that this growth phase will continue for the next decade.

Haskins (2008) claimed that the South African mines has suffered a steady decline in production in recent years owing to a critical shortage of skills, underinvestment in new equipment and a lack of enterprise development, which will ultimately result in jobs, skills and economic losses unless government and industry intervenes. Additionally, with a predominantly employee-driven job market, the mining industry is continually called upon to come up with new strategies for attraction and retention, including new ways to enhance workforce diversity whilst incorporating the competing needs and views of key stakeholders, such as, shareholders, unions, managers and so on. This study provides the mining industry with information on what other industries around the globe are doing in order to attract and retain skilled and knowledgeable workers and the short and long term benefits of such initiatives.
According to McGee and McGill (2003) organisations and industries can work towards addressing current and future skills needs through a variety of approaches, including:

- undertaking strategic workforce profiling and planning and through this, skills formation strategies will be developed; and
- incorporating flexible models of skills shortage and workplace practices in order to employ trainees or apprentices and up-skilling of the existing employees.

3.9.4.2 Profiling of skills in the mining industry

The productivity and growth of the mining industry do not need only the number of employees but also the skills profiles of these employees. The knowledge, skills and competences that South Africa need to be competitive in the global market is a high priority on the South African policy agenda (Slingenberg, Rademaekers, Sincer & Van der Aa 2008:25). A high-profile emphasis on priority skills should not obscure the fact that South Africa is short of all skills, starting with basic literacy and numeracy.

According to Johnston and Bernstein (2007:15-18) the discussions of skills and growth in South Africa have to take cognisance of three (but not limited to three) certain realities:

- The global market in skills: Countries seeking higher levels of economic growth have no option but to compete in this market in order to retain as much of their own human capital as they can, and to recruit from elsewhere when it is necessary to boost their own pool of skills, as South Africa did with the importation of medical doctors and Science teachers from Cuba.
- Historical legacy of discrimination and exclusion: This has left South Africa’s pool of skilled human capital disproportionately located in the white population. This has two negative effects; firstly, the South African pool is vulnerable to erosion by emigration to overseas countries and ageing or early retirement to pursue other vocations. Secondly, it sets up difficult choices between making the most of
existing skills for growth and delivery and giving priority to transformation goals of making the workforce representative of the country’s demography.

**Government choice to address poverty and unemployment:** The South African government has chosen the high road of skills to address these problems. This involves two strategies. The first is to seek higher levels of economic growth through competitive and export-led growth. The second strategy is that of developmental state. These strategies go hand in hand with the delivery of services particularly in the case of health and education and housing that enables previously excluded people to gain access to the market. The implementation of these strategies requires people with technical skills to participate directly in infrastructure projects and service delivery, as well as skilled, experienced managers to organise all aspects of policy implementation. Therefore, it can be deduced that without the necessary skills, both strategies will fail (Johnston & Bernstein 2007:15-18).

When acknowledging the existence of skills imbalances, the South African government developed National Skills Development Strategies (NSDS). The NSDS seeks to address problems of economic growth, while simultaneously addressing social problems of a high level of unemployment, which are directly related to a workforce which is largely under skilled or poorly skilled (Louw 2009:10). JIPSA (2007) was set up as a government intervention, whose primary role is to identify the clusters of skills that are critical, come up with sets of necessary interventions, highlight the bottlenecks, and recommend solutions (Amos, Ristow, Pearse & Ristow 2009:175). One of the provisions of NSDS is that mining organisations should submit a training report on an annual basis. Below in Table 3.9 is a 2008 Anglo Gold Ashanti Training Report which covers the period from 1 April 2007 to 31 March 2008.
Table 3.9: Racial breakdown of training beneficiaries

<table>
<thead>
<tr>
<th>Racial groups</th>
<th>Number trained</th>
<th>Per centage</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>17 139</td>
<td>87.6</td>
</tr>
<tr>
<td>Coloured</td>
<td>96</td>
<td>0.49</td>
</tr>
<tr>
<td>Indian</td>
<td>24</td>
<td>0.12</td>
</tr>
<tr>
<td>White</td>
<td>2 307</td>
<td>11.79</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>19 566</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Adapted from AngloGold Ashanti (2008:2)

Table 3.9 shows that 19,566 employees were trained over a 12-month period and that employees from Coloured and Indian communities have the lowest number of trainees in that period. The reason might be that most people from these communities are not willing to work or venture into the mining vocations probably due to the risk associated with working at the mines and exposure to health and safety risks. The other issue is the management perception that the lack of skills was exacerbated by the necessary government intervention, such as, Black Economic Empowerment (BEE) or Mining Charter, which requires every mining organisation to achieve a minimum of 40% HDSA demographic representation (Baartjes 2011:18) within five years, as follows:

- Executive Management (Board) level by 2014;
- Senior management (EXCO) level by 2014;
- Core and Critical skills by 2014;
- Middle management level by 2014; and
- Junior management level by 2014;

The study aimed to build on transformation in place and improve the quality and quantity of skills being developed, in order to ensure that the mining industry (and then South Africa) maintains a strong competitive economy and high quality of life. When anticipating the Mining Charter implementation review in 2009 by the government, employers and unions, the Chamber of Mines assessed the progress (Table 3.10) of the mining industry on its charter commitments.
Table 3.10: Percentage target and actual for HDSA in South Africa

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior management</td>
<td>33</td>
<td>26</td>
<td>26</td>
<td>15</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Professionals</td>
<td>55</td>
<td>54</td>
<td>50</td>
<td>57</td>
<td>56</td>
<td>56</td>
<td>47</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Technicians and associated professionals</td>
<td>49</td>
<td>48</td>
<td>48</td>
<td>50</td>
<td>48</td>
<td>45</td>
<td>37</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Clerks</td>
<td>84</td>
<td>86</td>
<td>97</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>96</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Services and sales</td>
<td>82</td>
<td>82</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>99</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Craft and related trades</td>
<td>44</td>
<td>40</td>
<td>50</td>
<td>57</td>
<td>55</td>
<td>53</td>
<td>44</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Plant and machine operators</td>
<td>58</td>
<td>50</td>
<td>97</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
<td>97</td>
<td>97</td>
</tr>
</tbody>
</table>

Source: Adapted from Department of Labour (2008)

In general there is on the positive side a slight improvement to reach the HDSA target. On the contrary, however, there is still a very small pool of African, Indians and Coloured matriculants who possess subjects and grades to access these programmes. This has caused a severe limitation at trying to minimise the risks associated with mining and at a time when programmes like these are necessary to achieve a more representative workforce and to meet the employment equity criteria (Adler & Reed 2002:7-8). Table 3.11 indicates the educational qualification levels of the mining workforce as in 2009.
Table 3.11: Educational qualification of the mining workforce in 2009

<table>
<thead>
<tr>
<th>Qualification level</th>
<th>N</th>
<th>%</th>
<th>NQF Band</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No schooling</td>
<td>111 673</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-ABET</td>
<td>21 505</td>
<td>4</td>
<td></td>
<td>133 178</td>
<td>24</td>
</tr>
<tr>
<td>Grade 3/ ABET 1</td>
<td>29 112</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 4</td>
<td>18 553</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 5/ABET 2</td>
<td>26 817</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 6</td>
<td>28 031</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 7/ABET 3</td>
<td>40 062</td>
<td>7</td>
<td>GET</td>
<td>209 716</td>
<td>38</td>
</tr>
<tr>
<td>Grade 8</td>
<td>29 580</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 9/ ABET 4</td>
<td>37 562</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 10</td>
<td>40 628</td>
<td>7</td>
<td>FET</td>
<td>170 359</td>
<td>31</td>
</tr>
<tr>
<td>Grade 11</td>
<td>34 994</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 12</td>
<td>94 737</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates</td>
<td>27 686</td>
<td>5</td>
<td>HET</td>
<td>42 399</td>
<td>8</td>
</tr>
<tr>
<td>First 3-year Degrees and Diplomas</td>
<td>10 467</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honours and 4-year degrees and</td>
<td>3 222</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher Diplomas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctoral and Master’s Degrees</td>
<td>1 025</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>555 652</strong></td>
<td><strong>100</strong></td>
<td><strong>555 652</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Mabena and Nengovhela (2009:26)

The majority of unemployed individuals are said to be structural because of poor education and possession of limited skills, while many companies increasingly demand high-skilled workers, but this is not the case with mining companies. Table 3.11 shows that 92 per cent of the mining workforce has either grade 12 educational qualifications or less. This mismatch has developed over many years. Past policies have done little, if anything, to close the skills deficit in the economy through the provision of high quality education. Employers have the means to change the educational profile of the subsectors by appointing recruits with higher levels of schooling. However, Research Focus (2007:v) suggested that employers still have a habit of recruiting people with little schooling as operators and labourers, owing to the following:

- the limited number of higher educated people living in the communities surrounding the mining operations;
- the lack of interest in mining of people with higher levels of education;
• problems in retaining better educated new recruits;
• their sense of responsibility towards workers who had been retrenched by the sector in the past;
• companies’ need for recruits with mining experience; and
• shortages of people with certain skills, for example drillers.

3.9.4.3 Incorporating flexible models and planning for skills development
The better understanding of the problem of skills shortages as it is linked to this research is to explore various conceptual frameworks which can support this study. Consequently, a simple model extracted from the research done in the water industry in Australia is used below to understand the nature of skills shortages and possible actions meant to address the problem of skills shortage. Figure 3.5 shows a simple model of employment in an industry.

Figure 3.5: Simple model of employment within an industry

![Figure 3.5](image)

Source: Adapted from Barrett (2008)

There has been much discussion of skills shortages in various industries. However, much of these discussions focussed on demand where retirements and numbers leaving the industry are summed to produce a projected “gap” in the workforce. Barrett
(2008) argued that over time, as shown in Figure 3.5, the change in the number of people working in an industry will be the difference between the leakage inputs and the outputs that results in the following three possible situations:

- The workforce demand and supply of skill are in balance
- There is oversupply of skilled workers
- There is a skills shortage

Figure 3.5 outlines some workforce issues that influence skills shortage, namely, retirements, remuneration, working conditions, graduates and migration rate of skilled workers. According to Barrett (2008) the model suggests several possible responses to a shortage: increase number of graduates; decrease resignations and retirements; outsourcing; introduce flexible work practices; increase skilled immigrants and increase recruitment of experienced people. Figure 3.6 depicts the planning process for highly skilled supervisors in the mining industry.
Figure 3.6: Planning for highly skilled, productive and safe supervisors in the mining industry

Figure 3.6 highlights the major considerations an organisation needs to take into account when planning for highly skilled, productive and safe supervisors. If the expected outcomes of increased performance and effective health and safety management are to be realised, an individual's development needs to be targeted to ensure he/she acquires the essential skills, knowledge and experience aligned to the position. Some tools (Mining Industry Skills Centre, Inc. 2010) that could assist in this regard are as follows:

- Identify required skills sets;
- Develop effective recruitment processes;

Source: Mining Industry Skills Centre, Inc. (2010)
• Match the individual’s capability to the current work level;
• Predict an individual’s future growth potential;
• Create focussed development plans;
• Provide effective training;
• Establish a robust support and coaching culture; and
• Implement and utilise processes to monitor and measure effectiveness.

Furthermore, for the demand of skills to occur some institutional factors must be in place which would prevent prices from increasing or increasing sufficiently to restore this imbalance. Consequently, skills shortage should not persist in situations where prices are flexible.

3.10 DETERMINANTS OF SKILLS SHORTAGE IN SOUTH AFRICAN MINES

When pursuing the objective of determining the current state of skills development in companies in South Africa, the research reveals patterns in skills development at the level of enterprise size and at the level of the sector education and training authorities (SETA). SETA is understood to be crucial intermediary structures between governments on the one hand and private and public organisations on the other hand, that must through various means coordinate, regulate and incentivise investment in training (Paterson, McGrath & Badroodien 2003:1).

Organisations are requested to provide data in the workplace skills plans (WSPs) on scarce occupations, and to quantify their projected needs over one year and three years. Also provided were the reasons for scarcity, and details of the typical learning pathways required to develop individuals for these occupational roles. SETA, through the analysis of the Workplace Skills Plan (WSP) and Annual Training Reports (ATR) submitted by employers, identify scarce skills or a skills gap and develop a Sector Skills Plan which reliably synthesise the skills needed across their sector (Food and Beverage SETA 2011:31).
• **Workplace Skills Plan (WSP):** The WSP identifies areas where skills are needed and plans interventions to address those needs. It provides SETA with the information it needs to compile a meaningful Sectoral Skills Plan, especially for scarce and critical skills. Once an organisation has submitted a duly completed WSP on time, a grant amounting to 50% of the levy will be paid to the organisation to ensure there is enough funds available for training of its employees.

• **Annual Training Reports (ATR):** An annual training report is submitted towards the end of each financial year by each of those organisations who submitted a WSP. This report reflects the organisation’s education, training and development activities that were implemented. Any significant deviations highlighted in the ATR from what was specified in the WSP, and explanation for this may be required.

The SETAs have not been able to perform this function to meet expectations for a number of reasons: firstly, large numbers of small and medium enterprises do not participate. Secondly, the quality of data in many WSPs is questionable and thirdly, many SETAs did or do not have the technical expertise to build credible models of demand. A fourth challenge is to recognise that the creation of SETAs with bounded operational responsibilities creates artificial boundaries between sectors that will inevitably limit the effectiveness of skills planning that takes the full economy into account (Bhorat & Jacobs 2010:30).

The ideal seven types of indicators that would inform an assessment of skill shortages (Infometrics 2006:2-3) are listed below.

• Vacancy fill rates
• The relative volume of vacancies
• Evidence of excessive wage pressures
• Assess the occupations exposure to product and market competition
• Evidence that the current demand for the skill will be sustained
• Evidence about the length of time it might take for the South African education system to address identified skill shortages
• Evidence about the degree of specialisation in different occupations

The first three sets of indicators are used predominantly in this section as a means for identifying the presence of skills shortages, which should be used to monitor as many occupations as possible on an on-going basis. The next three indicators are more about identifying in which cases of skills shortages might an immigration intervention be more appropriate. Finally, an indication of occupational specialisation provides a list of occupations where skill shortages are more likely to occur and potentially would have disruptive impacts (Infometrics 2006:3).

3.10.1 Measuring skills shortage
Shah and Burke (2003:18) noted two practical methods (that are used in this study) to measure skills shortage:

• Identifying observable characteristics such as education, qualifications, occupation, and experience. This method includes market economic indicators, such as vacancy, hiring and separation rates, relative wage movements and employment and unemployment changes to infer imbalances for particular occupation groups

• Define skills relating to objective measures of the attributes possessed by individuals or required to undertake a certain job, e.g. cognitive abilities, motor skills and interpersonal skills. This method utilises employer-based surveys, interviews and focus groups in the main to make inferences on imbalances.

The approaches above tend to be the most commonly adopted in practice. This largely reflects practical considerations, as factors such as qualifications, occupation, and age are more readily observable. It must also be noted that observable skills proxies only explain a proportion of the divergence in worker wages; while workers with higher qualifications and more experience are more likely to earn more than those with lower qualifications and less experience, it does not rule out observations where this does not hold nor the deviation of outcomes are observationally similar to workers (Infometrics 2006:5).
According to Erasmus and Breier (2009:153) the identification and measurement of scarce skills are complicated; measuring of critical skills would require much more intensive investigation. One would need to do a skills audit, preferably backed by qualitative research, to put numbers on gaps in skills profiles and shortages in specialist skills. But one needs to go further than measuring the current problem areas. It is also necessary to project estimates of scarce and critical skills caused by replacement demand and economic growth, as well as factors of employment requirements and the effects of changing occupational requirements.

3.10.2 State of skills shortage in South African mines

Reports about shortages of physicians, nurses, skilled trades people, truck drivers, and many other occupations and professions have become commonplace in the pages of our daily newspapers across the country. It is becoming increasingly apparent that these shortages are not isolated, short-term anomalies, with easy “quick-fix” solutions. Instead, they are the outcome of structural trends that are fundamentally affecting the supply and demand for skilled labour (Workplace Partners Panel 2006:8).

While most organisations adhere to the notion of a pipeline strategy whereby organisations focus their recruitment on young entry-level candidates who are then trained to become future managers, this strategy appears to be failing in many instances. The reasons for failing are rooted in the demographic trend of an aging population are:

- lost skills during the past decade due to emigration;
- Widespread poaching by competitors due to general shortages of managers and more experienced workers; and
- the requirements of an advanced economy in which knowledge, skills and innovation are nothing less than prerequisites for continued prosperity.

In this sense, current examples of specific occupational shortages are indicative of a more significant, longer and widespread human resource challenge that will directly or
indirectly affect all sectors of the South African economy. This raises the issue of identifying scarce and critical skills in the mining industry, in particular, three types of scarce skills. The first two types can be seen as skills shortages, while the third is more correctly defined as a skills deficit:

- There is a shortage of artisans and other technically trained workers, such as electricians, technicians, mechanics, etc. Engineers and scientists also feature high on the list of scarce skills. These shortages are especially of concern in the manufacturing sectors.
- There is a shortage of middle and senior managers. This skills shortage exists within all industry types, e.g. mine managers or shaft managers in the mining industry, foremen and managing engineers in the manufacturing industry and general business managers in the services industry. Management skills, it seems, are so problematic that poaching is endemic across industries.
- As far as entry-level positions are concerned; the constraint is not necessarily the quantity of graduates, but rather the quality of these graduates. The problem therefore relates to a skills deficit, *in terms of quality* rather than a skills shortage *in terms of numbers* (Business Leadership South Africa 2006:iii).

When explaining the market response to skills shortages one should take cognisance of the combination of past and present factors. A professional career in the mining sector usually starts with a university degree in the natural or engineering sciences (e.g. environmental science, engineering, surveying or geology). These degrees usually require maths and physical science at matriculation level for university entry requirement. The shortage of maths and science teachers in South African schools and the generally poor quality of education in these subjects mean that many school-leavers are automatically excluded from considering a science degree (Karar & Pietersen 2009:7). However, the skills shortage cannot be solved in the short-term, it requires long-term strategies from mining organisations and the State to ensure adequate funding of education and research. This study will endeavour to deal with this problem by providing an overview of mining skills trajectory occupations. According to Bhorat and Jacobs (2010:31) there are different approaches that can assist in understanding
the trajectory of skills demand, of which, three are mentioned here: modelling, forecasting and scenario-building.

- The use of macro-economic models to predict future growth as a basis to construct broad skills supply strategies.
- The use of methods that involve taking a realistic future growth/output target set for an economic sector and then working backwards from this desired state to estimate the demand for skills that would be required through time to meet the given target.
- The use of demographic data to measure changes in employment by occupation over a series of years. Trend lines can be used to estimate future demand.

These three approaches are discussed extensively in this section, in particular its application to professionals and technically trained workers, managers and entry-level workers. These are three occupations of interest to this study.

3.10.2.1 Skills of technically trained workers

Mining projects have to be conceived, conceptualised and developed, designed, implemented, operated and ultimately closed at the end. All of these stages require significant technical input. However, it must be noted that a high level of technical input is particularly required in conceptualisation, implementation and closure (Stacey, Hadjigeorgiou & Potvin 2008:245).

According to Pauw, Oosthuizen, and Van der Westhuizen (2006:16), technical skills shortage is partly explained by declining enrolment in engineering sciences at tertiary institutions during the 1990s. In an effort to ensure that the higher education system produces graduates in line with national needs, the Department of Education set national targets for the proportion of enrolments and graduates by field of study. The targets are 30% for business, commerce and management, 40% for human and social sciences, and 30% for science, engineering and technology (Ministry of Education, 2001). A trend that was dramatically reversed between 2004 and 2007 in relation to university degrees such as in Human and Social Sciences as outlined in Table 3.12
Table 3.12: Enrolments in and graduations from public institutions by field of study

<table>
<thead>
<tr>
<th>Enrolments</th>
<th>Graduations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business, commerce and management</td>
<td>238,534</td>
</tr>
<tr>
<td>Human and social sciences</td>
<td>303,403</td>
</tr>
<tr>
<td>Science, engineering and technology</td>
<td>202,552</td>
</tr>
<tr>
<td>TOTALS</td>
<td>744,489</td>
</tr>
</tbody>
</table>

Source: Adapted from Council on Higher Education (2009:37)

Between 2004 and 2007 the enrolment patterns in public higher education came close to the targets, although in science, engineering and technology, enrolments consistently fell about 2% short. Related to this, is the premium placed by students on obtaining university qualifications as opposed to more practical FET college qualifications. Students would much rather obtain, say, a human science degree than a technical diploma, despite the lower employment prospects attached to the former (Erasmus & Breier 2009:43). Workplace training at manufacturing organisations has also been declining, partly due to the unfavourable economic conditions that existed during the 1980s and 1990s. However, the uncertain policy environment with respect to the future of apprenticeships may have also played a role. At the time of the introduction of learner-ships, the perception existed that learner-ships would replace apprenticeships despite the fact that many manufacturing organisations feel that apprenticeships are more appropriate as a model for workplace training. The end result felt now is a shortage of people with technical skills and some years of experience.

According to Calldo (2008:3-4), a number of studies mentioned below have confirmed that the skills shortage in engineering sector is a real problem in South Africa and a constraint to economic growth.
Deloitte and Touché, for instance, released a report in June 2007, indicating that 81% of organisations struggle to find appropriate staff, with 76% saying that finding skilled employment equity candidates was a particular problem.

The South African Institution of Civil Engineering in 2006 reported that 79 of South Africa’s 231 local municipalities did not have a single engineer, technologist or technician. South Africa has only one engineer for every 3 200 people, compared to one engineer for every 130 people in China, one engineer for between 250 and 300 people in Europe, and one engineer for 450 people in Australia, according to the South African Institution of Civil Engineering (SAICE). South Africa produces about 1 400 engineering graduates every year, but this will have to be expanded to at least 2 400 to meet the current skills deficit.

The South African Association of Consulting Engineers (SAACE) conducted a survey late in 2006, and over 90% of organisations surveyed revealed that they were looking for engineering personnel. More than 95% of organisations said that they were struggling to find engineers and technologists.

Eskom Human Resources MD, Mpho Letlape said in 2006 that she estimated that the group would need at least another 470 engineers, 700 technical staff, 90 quantity surveyors and 600 buyers over the five-year term of the R84bn expansion programme (Calldo & Du Plooy 2008:2).

When comparing the 2006 report of SAICE and 2010 report of the Committee on Engineering Capacity Building, it is clear that a shortage of engineers is an international phenomenon and South Africa is experiencing an acute skills shortage, as shown by Table 3.13. Erasmus and Breier (2009:88) cite the declining interest in engineering as a career, a major common factor globally.
Table 3.13: Skills shortage: engineer to population ratio

<table>
<thead>
<tr>
<th>Country (Population)</th>
<th>Population per Engineer</th>
<th>No of registered engineers</th>
<th>Country</th>
<th>Population per Engineer</th>
<th>No of registered engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway (4 600 246)</td>
<td>122</td>
<td>37 685</td>
<td>Australia (20 372 452)</td>
<td>455</td>
<td>44 767</td>
</tr>
<tr>
<td>China (13000000000)</td>
<td>130</td>
<td>10 000 000</td>
<td>Hong Kong (5 000 000)</td>
<td>463</td>
<td>10 798</td>
</tr>
<tr>
<td>Finland (5 357 934)</td>
<td>136</td>
<td>39 537</td>
<td>Malaysia (25 500 000)</td>
<td>543</td>
<td>47 000</td>
</tr>
<tr>
<td>India (1020000000)</td>
<td>157</td>
<td>6500000</td>
<td>Chile (14 973 843)</td>
<td>681</td>
<td>22 000</td>
</tr>
<tr>
<td>Greece (15 000 000)</td>
<td>172</td>
<td>87 337</td>
<td>Poland (40 265 683)</td>
<td>748</td>
<td>53 796</td>
</tr>
<tr>
<td>Denmark (5 520 295)</td>
<td>179</td>
<td>30 926</td>
<td>Singapore (4 240 000)</td>
<td>1341</td>
<td>3 161</td>
</tr>
<tr>
<td>Canada (30 337 000)</td>
<td>179</td>
<td>169 512</td>
<td>Korea (45 985 289)</td>
<td>2135</td>
<td>21 534</td>
</tr>
<tr>
<td>Sweden (9 254 613)</td>
<td>209</td>
<td>44 352</td>
<td>Hungary (10 661 7479)</td>
<td>2214</td>
<td>4 815</td>
</tr>
<tr>
<td>Germany (82 443 000)</td>
<td>217</td>
<td>380 000</td>
<td>Romania (23 434 194)</td>
<td>2909</td>
<td>8 056</td>
</tr>
<tr>
<td>Brazil (184 203 744)</td>
<td>227</td>
<td>811 483</td>
<td>South Africa (46 888 200)</td>
<td>3166</td>
<td>14 806</td>
</tr>
<tr>
<td>Iceland (270 603)</td>
<td>266</td>
<td>1 019</td>
<td>Sri Lanka (18 732 255)</td>
<td>5595</td>
<td>3 348</td>
</tr>
<tr>
<td>France (60 656 178)</td>
<td>276</td>
<td>220 000</td>
<td>Tanzania (36 766 356)</td>
<td>5930</td>
<td>6 200</td>
</tr>
<tr>
<td>Ireland (3 917 203)</td>
<td>280</td>
<td>14 000</td>
<td>Namibia (2 030 692)</td>
<td>6346</td>
<td>320</td>
</tr>
<tr>
<td>Japan (121 000 000)</td>
<td>303</td>
<td>400 000</td>
<td>Zimbabwe (12 746 990)</td>
<td>6373</td>
<td>2 000</td>
</tr>
<tr>
<td>UK (58 821 000)</td>
<td>311</td>
<td>189 406</td>
<td>Swaziland (979 000)</td>
<td>12238</td>
<td>80</td>
</tr>
<tr>
<td>USA (296 771 226)</td>
<td>453 389</td>
<td>762 000</td>
<td>Zambia (11 261 795)</td>
<td>12783</td>
<td>881</td>
</tr>
<tr>
<td>Argentina (36 260 130)</td>
<td>389 453</td>
<td>80 000</td>
<td>Ghana (21 029 853)</td>
<td>12792</td>
<td>1 644</td>
</tr>
</tbody>
</table>

Source: Adapted from Committee on Engineering Capacity Building (2010:24)

The international benchmark of an average population per engineer shows that South Africa lags behind other developing countries. In South Africa, one engineer services 3 166, compared to Brazil’s 227 and Malaysia’s 543 per engineer. Some of the largest nations in terms of population in the world are in this second stage of development of which China, India and possibly Brazil are current examples. Nations in this stage have
rapidly increasing demand for resources, experience rapid urbanisation, and thus also experience extensive and substantial environmental problems. The poorest nations operate primary production-based and subsistence type economies. This is the first stage of economic development. The discrepancy in the benchmark points to one thing and that is that South Africa is severely under-engineered (Watermeyer & Pillay 2012:48). The shortage of engineering practitioners is evident in the number of competent engineers available for on-going projects). It has also led to cases where work which requires the input of competent engineers is carried out without such input. However, this cannot be allowed to continue as all spheres of government are dependent on engineering services to address vital needs for South African communities (Engineering Council of South Africa 2010:1-2).

3.10.2.2 Skills at management level
According to Mbabane (2008:12) management may be referred to as a level of responsibility rather than a clear-cut profession or qualification. This can render the endeavour to quantify managers meaningless. A group of security guards in a particular complex normally have one of their members as their supervisor. The supervisor of these guards, a fellow security guard, would then be a manager. The same goes for virtually every other group of professionals, from machine operators to mine manager. In this case the term management refers to a set of functions and responsibilities, over and above technical knowledge, that can be learned and gained by training. The criteria for dividing these functions and responsibilities are numerous and may vary, but three basic managerial skills that are relevant for effective managerial work include technical, interpersonal and conceptual skills (Kumar & Jain 2010:59). Mbabane (2008:40) suggested that there is no scientific method of working out the exact quantity of skills that are scarce, as this involves a range of variables, some of which are exogenous to the sector or industry concerned. One of the indicators that were used to quantify the shortage of management skills by the HSRC is the fill rate. The fill rate is used by the New Zealand Department of Labour (2005) with some reservations and many caveats. It simply refers to the number of vacancies that are filled by employers after they had
been advertised. Furthermore, the problematic nature of management as a profession (Mbabane 2008:13) is that there is no:

- Standard qualification, such as LLB. for lawyers, which is a prerequisite for a person to be a manager in that discipline, even the highly rated MBA on its own, does not guarantee that the candidate will be eligible for appointment as manager.
- Lack adequate information on the skills composition of the population. Many engineers for example, work as managers. Therefore, for this reason, the analysis of skills needs of management should be undertaken with caution.

Scarce skills in the mining industry are concentrated in the occupation of the Production and Operations Manager. The main driving force is the high replacement demand due to retirement as well as the need for greater transformation at top management levels, despite some positive changes to the racial profile of the group (Mining Qualifications Authority 2011:100). Managers and supervisors in the MMS need a combination of industry-specific knowledge and understanding of technical knowledge of labourers. In most instances managers and supervisors are drawn from the workforce (and therefore already have technical and functional knowledge) and are developed through combinations of formal training programmes such as MBA programmes, short courses, and in-service training (MQA 2011:87).

Managers are generally sourced from within the professional ranks of the MMS. Additional training is then provided through tertiary education (including MBA courses), management development courses and special executive training programmes. General training opportunities for the development of managers are sufficient; however, an obstacle for the MMS is the limited availability of sector-specific training. Mine Health and Safety audits (2008:27) reported that key challenges that remain in terms of meeting the demand for managers are the availability of HDSAs with the required skills combinations, as well as the chronically insufficient output of Government Certificates of Competency (GCC). GCCs are required for appointment at managerial and supervisory levels in the mining sector. The purpose of these certificates is mainly to ensure that the
appointees know their legal duties and responsibilities in respect of mine health and safety issues. Competency certificates are issued by the department for explosive handling and blasting, winder engine drivers (driver of mine conveyance for underground mines accessible through shaft installation), on-setters (controller of conveyance movement) mine surveyors, mine managers and engineers. The current competency regime does not cater for subsequent changes in legislation and technological development. Once a person obtains the competency certificate he or she is qualified for life. This is a serious shortcoming when one thinks that a supervisor in the mining sector may be responsible for up to three hundred workers at a time (Mine Health and Safety Audits 2008:37).

As the global economy expanded dramatically between 2002 and 2007, business managers are concerned about the intensifying international competition for talent, the impact of not having the right people in place to lead and confront business challenges, as well as employing below-average candidates just to fill positions (Beechler & Woodward 2009:273). Shortages at management level may simply be a problem of insufficient organisation level training and ineffective pipeline strategies. The organisation ought to have a plan for developing managers and be reviewed continuously since the demand for leadership talent greatly exceeds the supply. Only a few organisations are prepared for what the McKinsley consulting organisation has called the “War of talent”. While poaching and emigration (the brain drain) has been identified as part of the problem, a stark critic may point out that proper talent management and middle-management training opportunities at the organisation level may have prevented management shortages from reaching endemic proportions (Business Leadership South Africa 2006:iv). However, it may also simply point at the fact that organisations are struggling to find the right calibre of entry-level persons that can be trained to become future managers. This point relates to the skills deficit among graduates in South Africa.
3.10.2.3 Skills deficit at entry level

The skills deficit, on the other hand, relates directly to issues around education in South Africa (Erasmus & Breier 2009:199). These deficiencies are normally very specific to a particular job and occur as a result of changes in the work environment such as changes in technology and changes in legislation (for example health and safety legislation) etc. Skills gaps in the Mine and Mineral Sector are generally taken care of by employers through in-service training. The skills gaps that do occur in the Sector are therefore reflected in the skills development priorities that employers determine for themselves.

• Various organisations pointed out that they believed the poor quality of education at school level, especially in mathematics and science is to blame for the low enrolment numbers in key study areas, as well as poor academic performance of students in general. Substandard education and inappropriate qualifications at tertiary institutions, especially historically Black institutions, are also of concern (Erasmus & Breier 2009:199).

• There is a perception among employers that current educational subsidies are causing institutions to focus on enrolling large numbers of students rather than on the quality of education.

• Related to the skills deficit is the issue of a lack of soft skills. Many organisations felt that graduates lacked soft skills such as communication and general language skills (especially in English), which caused them to be unsuccessful in interviews. Often students are not ready for the workplace emotionally and struggle to adapt to the corporate environment (Salleh, Sulaiman & Talib 2010:211)

Learner-ships can potentially be successfully implemented as training programmes that aim to bridge firstly, the soft skills deficit - narrowing the gap between the workplace environment and student life and lastly, the gap where training and education obtained at educational institutions are deemed inappropriate or insufficient (Business Leadership South Africa 2006:iv). One such example is employing students without Accounting degrees and enrolling them in Chartered Accountancy conversion courses offered at some universities. Much scope exists to employ graduates with potential and
converting their qualifications by enrolling them in abridged conversion courses. At present learner-ships are almost entirely focused on entry-level positions, probably due to the strong emphasis placed by the Department of Labour on the absorption of matriculants or entry-level unemployed learners (the grants are structured such that subsidies for unemployed learners are higher than those for employed learners). Ironically, despite severe skills shortages at middle-management level, few organisations are using learner-ships to provide training for middle-managers despite the fact that the learner-ship system is adequately equipped to deal with such learning (Business Leadership South Africa 2006:iv). In this regard SETAs, organisations and educational institutions should work together towards developing and implementing suitable and appropriate higher-level learner-ship programmes that would gear organisations toward training future managers, and ultimately targeted at where the shortages currently exist.

3.11 CONCLUSION

South Africa's skills shortages are widely regarded as a key factor preventing the achievement of targeted growth rates. A shortage of skills is a source of concern to organisations, and when acute is likely to hamper the quality and quantity of their output. There is some dispute as to the nature and extent of these shortages, given that the country also has a large pool of unemployed people or graduates. Discussions of problems caused by skill shortages are regularly highlighted in the media, which draws comments from governments, organisation and households about scarce and priority skills. The skills shortage problems are further exacerbated by confusing and varied suggestions around the identification, estimation and successful ways to address these skills needs. Moreover, this chapter presented the more recent, and constant discourse of skills shortages in the market, and it is often difficult to ascertain whether these are purely perceived or factual cases, which will be presented later in the findings of this research. The various meanings of the skills shortage discussed in this chapter helped to identify the circumstances under which any such shortage is likely to be naturally and efficiently resolved through market forces. It further helped to identify those instances where direct policy intervention is called for to assist the market.
The discussion in the following chapter concerns skills development that emphasises the importance of the role played by the vocational education and training system in assisting with the smooth matching of the skills wanted by employers, with the skills offered by workers. The value of addressing the skills shortage should contribute to make organisation sense to individuals, employers and government to invest in skills development.
CHAPTER FOUR

SKILLS DEVELOPMENT IN THE MINING INDUSTRY

4.1 INTRODUCTION

A persistent theme in public and private discussions has been the state of skills in the South African economy and society, the significant gap between an organisation’s current capabilities and the skills it needs to achieve its goals. Furthermore, an organisation can no longer grow or remain competitive if it cannot fill critical jobs with employees who have the right knowledge, skills, and abilities. Chapter three shed light on the need for both quality of the needed skills and the numeric imbalances in employment that created a number of human capacity building issues that will be discussed in this chapter in order to map out relevant interventions needed at all levels. This scenario further exposed weaknesses of the set of institutional arrangements that assist, form and shape the education and training system of South Africa as the main contributor to the national skills crisis (Rasool & Botha 2011:6, and Daniels 2007:2).

The problem of skills shortages is being approached in a number of ways but three important points are manifested in this chapter. Firstly, when mining organisations are unable to recruit the skilled workers they need, they would endeavour to up-skill their existing workforce. Secondly, various studies of skills shortage illustrate in their findings that there is no quick fix solution to the skills problems that have developed over a substantial period of time. Thirdly, there has been much reference to skills development as one way of supporting economic growth. The investment in skills development is a shared responsibility between public and private sectors; as organisations are giving high priority to managing the risk of skills shortage, and government is expected to create an environment that is conducive to supporting these efforts.

The pressures and initiatives mentioned above have made this country a poaching ground for Australian and Canadian organisations. South Africa is well-known for its mining expertise, and the industry is competing for skills in the global sourcing market.
The mining industry is also competing for scarce skills with infrastructure, construction, manufacturing and other industry sectors, while facing pressure for increasing the pace of transformation. The integration of transformation to skills development in this study is done through human capacity building. Human capacity building is broadly divided into two areas: education and training, government and management interventions. Although large numbers of workers employed are unskilled the mines also require underground engineering that applies scientific knowledge intensively (McCarthy 2005:31).

Brown (2009) suggested that the continuing development of new skills and knowledge throughout the life of mines are valuable to individuals and essential for the economy. The South African government is giving the issue of skills shortages considerable attention as it realises with growing clarity that it is not sufficient to expand formal education institutions alone while neglecting the work structures that allow the highly skilled professionals to expand their abilities. The proliferation of new legislation, like employment equity legislation and the mining charter for women, reflect the government’s efforts to address this shortage. Various legislations are aimed at developing the skills and employability of all citizens in order to alleviate poverty, address historical inequalities, create employment opportunities and improve the competitiveness of the national economy (Du Toit & Van Tonder 2009:20–21).

4.2 RATIONALE FOR SKILLS DEVELOPMENT IN THE MINING SECTOR

The need for skills development in South Africa may be explained through two broad approaches that are extremely difficult to reconcile and which have contrasting value systems, namely, demand-driven and skills development policy requirement. They represent a high concern for worker responsibilities and for employee rights. A demand-driven approach is aimed at tying skill supply more closely to employer needs. All employers have expectations that they want employees to meet (Comish, Daboval, Phelps & Rader 2004:3). Skills development policy requirement and by far the most dominant, involves the setting of social targets for the proportion of the workforce holding qualifications at various levels. These are targets that are formed independently
of employers and are based on governments' view of what constitutes a minimum platform for employability (Payne 2007:24).

4.2.1 Demand-driven approach

The skills shortage has a widespread effect on South Africa. It affects the level of economic productivity and reduces the country's capacity to develop a knowledge society. This, in turn, affects the country's functioning in the global economy. A key limitation of early projections of a skills shortage was the emphasis on employment levels and changes by occupation rather than replacement demands. Such projections tend to focus upon the expansion (or contraction) demand arising from growth or decline in occupational employment. When thinking about the link between employers' future skills needs and possible consequent skills shortages in the marketplace, it is necessary to consider not just the expansion demand for workers by occupation, but also the replacement demand. There is indeed a strong argument for suggesting that the greatest market challenges are likely to come from people retiring, rather than from new jobs being created (Holt et al. 2010:45). When considering the future demand for technicians as an example, there is a clear trend for the growth in technician employment across a range of sectors driven by:

- growing technological complexity: driving up skill levels across the production sectors;
- the growing attention given to higher value-added product market strategies: accentuating the need for higher and intermediate vocational and technical skills; and
- the changing skills mix in some professions, for example in the public and professional services.

The main focus of this section is the replacement demand. Replacement demand suggests that roughly 150 000 new market entrants will also be required to deal with the impact of retirement, mortality and emigration (Akoojee 2011:13). Total replacement demand is the sum of these four elements. When this total replacement demand is
added to expansion demand, an estimate of expected net requirements for each occupation is obtained. This measure provides an indication of the number of newly qualified entrants likely to be required in each occupational group over a period of time (Wilson, Woolard & Lee 2004:13-17).

4.2.1.1 Net migration of skilled workers
Up to 300 qualified engineers leave South Africa every year, and according to Johan Pienaar of the Engineering Council of South Africa (ECSA) the number is an estimate and could even be higher. The estimate of 300 engineers is based on the engineers who cancel their registration with ECSA before they emigrate. According to Pienaar about 14 900 engineers were registered with ECSA in November 2005, and the latest figures show that on 31 January 2008 the figure was 14 351), despite 1 290 engineers qualifying every year at South African universities (Gower 2008, and Calldo & Du Plooy 2008:4). As the global market for skilled professionals is growing, many South Africans are attracted by the opportunities and salaries on offer in other countries (Joubert & Calldo 2008:18-19).

(a) Migration measurement a source of concern
The migration of skilled professionals from the country has been an increasing source of concern over the past few years. This has been acknowledged by the Department of Home Affairs and Statistics South Africa. The doubts arose as the empirical findings indicated that departures are more than the data published by the Central Statistics Services of various countries (Bhorat, Meyer & Mlatsheni 2002:8). Skills migration is clearly a reality and must also be taken into account in the modelling, as these losses would deplete the source country’s level of human capital and thus reduce the capacity of that country to achieve as much technological progress as other economies (Glass & Choy 2001:9). Official South African emigration statistics therefore undercounted the loss by around three-quarters and this is demonstrated by Table 4.1 below.
Table 4.1: Emigrations from South Africa 1989-2003

<table>
<thead>
<tr>
<th></th>
<th>People emigrated</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Departures</td>
<td>Arrivals</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td>21 973</td>
<td>56 351</td>
</tr>
<tr>
<td><strong>Canada</strong></td>
<td>1 363</td>
<td>23 186</td>
</tr>
<tr>
<td><strong>New Zealand</strong></td>
<td>11 112</td>
<td>29 236</td>
</tr>
<tr>
<td><strong>United Kingdom</strong></td>
<td>40 408</td>
<td>219 856</td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td>11 753</td>
<td>40 199</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>92 612</td>
<td>368 829</td>
</tr>
</tbody>
</table>

Source: Adapted from Stern & Szalontai (2006:141-2)

Table 4.1 demonstrates how jittery it is to quantify and capture the full dimensions and likely impacts of the brain drain from the country. Statistics South Africa, for example, recorded a total of 92 612 people (including 20 038 with professional qualifications) emigrating from South Africa between 1989 and 2003 to the five main destination countries above. However, destination country statistics of immigrant arrivals from South Africa paint a rather different picture: they show 80 831 professionals and 368 829 total immigrants arriving from South Africa during the same time period. In sectors such as health and education, skilled South Africans are being recruited for work overseas on fixed contracts. While it might be argued that this is a temporary loss, the impact on these over-burdened and under-staffed sectors within South Africa is still considerable. It is unclear how often these contracts are renewed, or whether these professionals remain overseas at the end of their contracts (Maja & Nakanyane 2007:21).

(b) Measuring the brain drain

There are no accurate estimates of the number of people who have emigrated from South Africa since 1994, especially since calculations often do not include South Africans who have left and then returned. The Centre for Development and Enterprise (CDE) estimates that between 1989 and 2003, over 520,000 South Africans had emigrated (Polzer 2010:3). Eagar (2008:19) confirmed the statement above by looking
at the official documentation of migration in South Africa. The official source for skills migration data in South Africa are the annual reports published by Statistics South Africa. These sources are the result of a joint effort between the Department of Home Affairs and Stats SA. It is the Department’s responsibility to record the number of people that leaves and enters the country via any of the major airports in South Africa. The data for emigration is obtained from forms BI-117 which were required by law to be completed by those departing for international destinations from one of the country’s three international airports in Durban, Cape Town and Johannesburg during the period of 1970 to 2007. However, the last report was published in 2005 and contains information for 2003. The requirement for completing departure forms was dropped in 2007, which means that there are no more up-to-date or officially gathered data of emigration. When individuals leave they are required to fill in a departure form, in which they state their reasons for leaving. Stats SA then captures the relevant emigration information from the departure forms. The data for immigration is obtained from forms BI-55, BI807 and BI-834 which are completed by immigrants who have been approved by the Department of Home Affairs as immigrants upon their arrival in South Africa (Eagar 2008:20).

According to Bhorat et al. (2002:3), in mid-1998 the Southern Africa Migration Project (SAMP) undertook a study to estimate the quantum of the skilled South African workforce and examine and access the range of factors that contribute to skilled workers who intend leaving South Africa. According to the findings of SAMP, the preferred countries of emigration were the big five: the United States (24%), Australia (22%), the United Kingdom (15%), New Zealand (12%) and Canada (11%). This suggests that these five countries will continue to both benefit from and actively recruit skilled South Africans. The survey surprisingly discovered little racial difference; skilled Black South Africans were just as likely to want to leave as White. However, there was a distinct gender difference with males of all races more likely to want to leave than females (Marks 2004:12).
The economic impact of the brain drain on South Africa is insufficiently researched, ambiguous, and deserving of more rigorous research and analysis at national-level. Sectoral studies have suggested that the temporary and permanent loss of skilled people is having a negative impact on the country. A survey of 200 private and public sector companies (employing an estimated 101,000 people) certainly unveiled considerable private-sector concern. The survey found that a third of the companies considered that post-1994 skills emigration had had a significant impact on their operations. Most affected was the high-tech sector (33 per cent) followed by manufacturing (11 per cent), education/health (10 per cent), and business services (9 per cent) (Crush & Williams 2005:19).

4.2.1.2 Mobility of skills
According to the Landelahni Business Leaders (2010:2), the mining industry is competing for scarce skills with infrastructure, manufacturing and other local industries as well as in the global mining arena. Engineers and artisans are highly mobile due to the transferability of their skills. Formal employment in the construction sector decreased progressively in the 1990s reaching a low in 2001 when the industry had lost more than 200,000 jobs. An increase in infrastructure investment since 2003 has seen a steady increase in the number of jobs created and the accompanying challenge to secure requisite skills. This challenge has been exacerbated in recent times by the announcement of the Gautrain, infrastructure for the 2010 FIFA World Cup and government's R372bn infrastructure investment programme for upgrading power stations, building roads, airports, harbours, improving other services at municipal level, construction of the Gautrain, and the boom in the construction industry (Du Toit & Roodt 2008:1). The strong focus of the EPWP on intensive construction also places extra demands for qualified supervisors and managers (Department of Public Works 2007:2). Rasool and Botha (2011:10) pinpointed the dilemma of major infrastructure building projects happening simultaneously while everybody is sourcing their skills from the same pool. A discussion of the 2010 World Cup and Eskom follows in the next section.
• **The 2010 World Cup in South Africa:** According to McKechnie (2008), with the Fédération Internationale de Football Association (Fifa) 2010 World Cup, the shortage of engineers, quantity surveyors, technicians and architects in the construction industry placed great pressure on infrastructural growth. There is a shortage of engineers in this country. Seven hundred engineers join the economy every year from universities. By 2010 the need was about 11 000. This means that South Africa needed 16 times more engineers than it had (Mackenzie-Hoy 2008).

• **Eskom infrastructure investment:** Following the persistent denial of skills shortage by Eskom, experts maintain that when it finally started preparing to meet the challenge of expansion it found the expertise and experience wanting. Eskom admitted that its workforce has dropped from 60 000 to half of that. According to Eskom's 2007 annual report, it needs 6200 engineers, technicians and artisans over the next five years, and 1400 that year alone. SA produces about 1400 engineers a year, according to the Joint Initiative for Skills Acquisition (JIPSA). The inadequacies in the present education system, together with the poor results in mathematics and science, exacerbate the problem. Furthermore, the apprenticeship system is underutilised. The levels of artisan training have dropped from about 300 000 registered artisan apprentices in 1975 to an estimated 3000 in 2006, a ten-fold drop (Calldo & Du Plooy 2008:1-3).

### 4.2.1.3 Retirement in the mining industry
There are a number of factors contributing to the lack of skills in the industry, an aging skilled workforce and the nation's equity legislation are two most important factors. Training and development is not just for filling current needs, but to ensure adequate human capital is available to replace the aging workforce. The Landelahni Business Leaders (2010:7) held the view that the South African mining industry has an aging workforce, particularly in respect of engineers and artisans; this current state of skills shortage is likely to become much more acute in the next 10-15 years. Research in Canada shows that 40% of the mining workforce is likely to retire over the next 10 years and that an additional 81 000 skilled people will be required to meet current and future industry needs owing to retirement. Australia shows a similar trend. Skilled jobs in
mining will double in the next 10 years to 215 000. Some 80% of mining houses in Australia currently indicate they are short-staffed. In 2005, the US Society of Mining Engineers reported that 58% of members were over the age of 50. Against this background we must be mindful that it takes 12-15 years for an engineer to be sufficiently experienced to serve in a substantive managerial capacity.

There is a parallel in South Africa, where many of the previous senior white managers have retired or have taken early retirement to clear the way for affirmative action appointments. However, a recent study indicated that 60 per cent of senior public service positions are still vacant. Many technical posts, in particular, have not been filled. According to the government's Joint Initiative for Priority Skills Acquisition (Jipsa), at least 12 500 artisans should be produced each year over the next four years to meet demand. However, South Africa continued to suffer a severe shortage of qualified, competent and experienced artisans. When acknowledging the skills crisis, the need for the people nearing retirement age 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. These elder workers or even recent retirees can be mentors to the younger staff in accelerated development programmes (Norman 2010:87).

The challenge of replacing retiring workers may be greater within organisations facing large numbers of retiring workers, but only if those workers will indeed be replaced. It is possible that some organisations will simply downsize, substitute technology or machinery for labour, or find various other ways of compensating for the loss of skills. Whether or not retiring workers are expected to be replaced has implications for the nature and magnitude of the skills shortages issue, and what potential actions will be taken in the future (Workplace Partners Panel 2006:30).

4.2.1.4 In-service mortality

It is possible to use the race, age and gender specific mortality rates in order to replace demand for skills arising from deaths in each occupation. The use of mortality rates, one
can calculate the risk of dying for each member of an occupational class in the survey data and use this to arrive at the number of people that will be required to replace those dying over the forecast period. Incidence of some occupational illnesses in the mining industry is often compounded by HIV/AIDS and tuberculosis. The problem of occupational health is complex. The complexity emanates from the multi-factorial causation of disease such as environment, lifestyle and disease causing agents. Manifestation of disease is not uniform in all individuals exposed to the same working conditions. Disease may be the result of a number of causes, some of which are specific to the workplace and others unrelated to the occupation (Wilson et al. 2004:28).

4.2.2 Skills development policies approach
The history of the current framework for education in South Africa traces its origins back to the trade union movement uprisings in the 1970s and 1980s, whereby the contention point was that the demands of employees for a living wage were repeatedly rejected by employers on the grounds that, firstly, workers were unskilled and therefore their demands were unjustified and secondly, the problem of low productivity and health and safety issues were compounded by the general low literacy levels of employees, particularly in the mining sector. There is no doubt that improvement in skills development leading to health and safety knowledge would contribute greatly to the reduction of injuries and fatalities at mines.

The promulgation of the Mine Health and Safety Act in 1996, following Judge Leon’s recommendation in his commission report, saw the establishment of the Mining Qualifications Authority (MQA) which was subsequently established as mining Sector Education and Training Authority by the Skills Development Act of 1998. The MQA is one of 23 Sector Education and Training Authorities (SETAs) established in terms of the Skills Development Act (No. 97 of 1998). Like all other SETAs, the MQA administers the skills development levy grant system, performs quality assurance functions on behalf of SAQA and administers the learner-ship system of the Mining and Minerals Sector (MMS). The MQA also houses the Standards Generating Body (SGB) for the MMS and is therefore responsible for the development and regular revision of unit
standards and qualifications for the sector (Research Focus 2007:1). The MQA is responsible for facilitating skills development in the mining industry (Heine 2008:16). Their work is geared towards eliminating illiteracy in the mining sector. This is done through training and encouraging Adult Basic Education and Training (ABET). MQA is required as a SETA to identify the scarce and critical skills needs. The skills strategy is designed to support economic and employment growth and social development. There is only one way that a government can achieve its objectives and that is by use of legislation.

- **The South African Qualifications Authority Act no 58 of 1995**: The first institution that was established by this law is the South African Qualifications Authority and was tasked to oversee reconstructed and re-developed education and training which reflects the objectives of the National Qualifications Framework (NQF).

- **The Employment Equity Act 58 of 1998**: In addition to this legislation, the MPRDA required the development of a broad-based socio-economic empowerment charter that would set the framework, targets and timetable for affecting the entry of HDSAs into the mining industry. As a consequence, the Broad-Based Socio-Economic Empowerment Charter for the South African Mining Industry (Mining Charter) was developed in 2002 and was accepted by Parliament in October 2002 after an intense consultation process with Government, employers and organised labour. The Charter covers a wide range of areas for transformation. These areas include human resources development, employment equity, migrant labour, mine community and rural development, housing and living conditions, procurement, ownership and joint ventures, beneficiation, licensing and financing. The Charter specifies mechanisms and targets for human resources development.

The two acts that currently regulate skills development in South Africa and the payment of levies are the Skills Development Act (No. 97 of 1998) (as amended) and the Skills Development Levy Act (No. 9 of 1999).
• **Skills Development Act (No. 97 of 1998):** The Skills Development Act spells out how government and industry will go about to improve the skills level of workers. The emphasis of this act is placed on training people in such a way that they become fully equipped to do a specific job, rather than general education. General education is of course necessary and provides a good educational background, but in many cases it still does not fully enable a person to immediately do a specific job. The spirit of the law is to place people in a position to perform a task, skilled and qualified, without delay. Furthermore the law makes special provision for learning while working. In short: this act is there to make training happen.

• **Skills Development Levies Act (No. 9 of 1999):** The short supply of skilled staff is a serious obstacle to the competitiveness of industry in South Africa. The levy grant scheme aims to expand the knowledge and competencies of the force resulting in improvements in employability and productivity. This will be achieved through new approaches to planning for training, learning programmes, incentives and an improved employment service. If you participate fully in the scheme you will reap the benefits of a better skilled and more productive workforce. The payment of levies towards this grant scheme is legislated in terms of the Skills Development Levies Act. The intention is to stimulate skills development by enabling employers to reclaim some expenditure on skills development initiatives.

The Skills Development Levy was launched in 2000, this monthly levy, equivalent to 1% of payroll, is mandatory for all companies that pay PAYE or have an annual wage bill of R250 000 or more. This levy is paid to the South African Revenue Services (SARS) who, after deducting a 2% handling fee, allocate the funds as follows; 18% goes to the National Skills Fund (NSF) which approves and finances skills development and training projects at a national level, and 80% goes to the appropriate Sector Education and Training Authority (SETA). The money in the Fund may only be used for projects identified in the National Skills Development Strategy (NSDS) as national priorities or projects related to the achievement of the purposes of the Skills Development Act. NSDS is published by the Department of Labour every five years, the previous cycle
being 2006-2010. The NSDS guides the activities of the SETAs and other skills development bodies (Willemse 2002:56-57).

Training and skills development in the mining, construction and engineering sector are provided through three major pathways of learner-ships, further education, and higher education and training (Department of Public Works 2007:6). A brief overview of these pathways is given below:

i) **Learner-ships:** A learner-ship is a training pathway introduced under the National Qualifications Framework. It combines theoretical training at a college, or through a private training provider, with relevant on-the-job training. In order to enrol for a learner-ship a candidate has to be contracted to an employer who will provide practical on-the-job training.

ii) **FET training:** Artisan training takes place in the further education and training (FET) band. Learners receive theoretical education in foundational mathematics, science, basic communication, and the respective technical subjects. The practical component of the training is introduced as simulated learning in colleges, with the learners expected to advance their practical training at their places of employment.

iii) **HET training:** Higher education and training is provided by universities and universities of technology. The universities of technology (former technikons) offer technician and technologist-type programmes. In this stream learners undergo theoretical training at the colleges, and have to complete a six-month experiential learning period with an accredited employer to graduate. Graduates have to register with professional councils to practise as engineering technologists and technicians. Universities provide engineering-type programmes where learner enrolment is dependent on obtaining passes in higher grade mathematics and science. Most engineering programmes are four years long and upon graduation learners have to register with the respective professional councils to practise as engineers.
It is also important to investigate the extent to which the inequalities associated with demographics are being redressed in all levels of education.

4.2.3 **Addressing skills shortage in the long-term: education**

Any sustainable solution aimed at addressing the skills shortage in general, needs to take into consideration all levels of education.

**4.2.3.1 Schooling system**

Prior to 2008 only 25 000 Higher Grade Matric Mathematics passes were obtained and given these low figures, the pool of suitable students is even smaller. Following the introduction of the National Senior Certificate (NSC), the number of students writing Mathematics increased significantly. However, the increase did not translate to higher levels of students who meet the basic requirements of admission for engineering programmes (Engineering Council of South Africa 2010:1-2). ECSA states Physical Science and English as essential subjects for admission in engineering programmes. The National Senior Certificate leavers who have acceptable levels of Mathematics, English (Higher Grade) and Physical Science (MSE) is the target group for engineering. However, the engineering profession competes with others such as accounting and health sciences. ECSA believes that the pool of talent from which engineering skills are sourced should be expanded and maintains that a logical solution would be focusing on previously disadvantaged groups as the majority.

A hierarchically organised workforce, in which entry-level jobs required relatively few skills but a high level of industrial discipline, replaced the single craftsman who personally carried out all the tasks associated with a product. The early part of the 20th century saw education reformers introduce vocational preparation to the curriculum of which secondary education and the vocational school was born (Adams 2007:1). Secondary education accommodated vocational preparation in different ways. Typically,
lower-secondary education offered general vocational skills and awareness and appreciation of the world of work, while upper-secondary technical and vocational education included courses preparing youth for entry level.

4.2.3.2 Higher education system
Demand for secondary and post-secondary education is growing in developing countries as a consequence of successes in providing basic education for all. A major source for expanding secondary education is social demand so that the demand for secondary schooling could grow exponentially as the educational levels of the general population rises (Figueroed & Anzalone 2003:3). In turn, this is raising the issue of how much vocational content should be provided in the curriculum. Evidence from advanced and developing countries shows distinctive trends in the combination of general schooling and vocational content. While there is pressure from some educators to start vocational preparation as early as junior secondary education, the pattern globally is to defer specialisation until senior secondary education, with advanced countries pushing vocational content even later to post-secondary education (Adams 2007:2).

4.2.3.3 Candidacy programmes
The final component of a country's formal education system comprises the higher education institutions. This sector plays an important role in skills development at the higher end and produces scientists or innovators who are capable of introducing change, as well as managers who are capable of managing change. The starting point should be to understand how the graduate becomes a consistently competent individual, capable of undertaking the whole task activity and competencies required for registration with ECSA. The process relies on the supervision of the graduate’s work by a competent engineering professional (ECSA 2010:2). Firstly, the graduate should undergo induction, and then observe processes and work of competent engineers. The candidate should assist established practitioners and perform specific processes under close supervision. The level of supervision is then reduced as the candidate performs
specific processes as directed by supervisors and full responsibility is taken for supervised work. The candidate then progresses to performing specific work with detailed approval of work outputs. Full responsibility to the supervisor is taken for the immediate quality of work. Finally, the candidate works in a team without supervision and recommends work outputs to the supervisor.

This method of developing candidates from graduation was historically embedded in organisations, parastatals, municipalities, engineering organisations, mining companies. With the move to a lean organisation, there has been a retreat from this culture and practice of training. In many companies that hire engineering graduates, programmes are haphazard and supervision and mentoring are lacking. That is not to say that there are no exemplary training schemes (ECSA 2010:2). According to the Department of Labour (2003:17) the ideal situation for a sustainable solution would require all levels of education to be considered, but this task is difficult due to the

- absence in some instances of accurate and up to date information.
- lack of time series data which enables the tracing of trends over time, especially with regard to the availability of data broken down by population groups, and
- inability to disaggregate national level data and the corresponding lack of specific output signals that are meaningful to planners.

This section explores throughput of learners from education and training institutions and aims to quantify how many learners are going through the system, what their training comprises and how many qualify or complete their studies and the possible absorption of them into employment. This is then contrasted with what the sector needs currently and in the future. This facilitates the identification of appropriate interventions to ensure that the number of learners going through the system and that qualify can meet demands of the market and the sector.

4.2.4 Addressing skills shortage in short-term
Some methods of the mining industry used to address the skills shortage in the short term are to recruit workers from overseas and recruitment of women for underground workings.

4.2.4.1 Migrant workers

According to Cross et al. (2009:22) the current acute shortage of vital skills in South Africa has a significant impact on the future flow of highly skilled professionals into the country. South Africa needs skilled immigrants for three interrelated reasons: first, it suffers from a severe skills shortage that has built up steadily over many years; secondly, it is constantly losing skilled people to the global market; and lastly, its education and training system is dysfunctional. This means that it starts from a very low base, suffers constant attrition, and cannot quickly make up the backlog, or replacement for the on-going loss (Johnson, Altbeker & Bernstein 2010:8). The acknowledgement of the South African government and business alike that essential skills are not found within the country and would have to be sourced elsewhere, led to a relaxation and implementing of more efficient immigration policies in order to address the skills shortage in the country. The quota work permit system that has now been developed provides an opportunity for skilled workers to enter the country, with entry permission based on the scarce and critical skills already identified as required (Cross et al. 2009:24).

The immigration policies facilitate the entry of people with skills in demand and provides them with a pathway from temporary to permanent residence via a work permit for two years as long as they have an offer of on-going employment. New Zealand has granted work permits to 3,530 people under either the talent visa or LTSSL policies, since the work to residence policy came into effect in 2002. The Immediate Skill Shortage List (ISSL) and the Long Term Skill Shortage List (LTSSL) are two instruction instruments in New Zealand, through which the government that seeks to utilise immigration as part of the solution to meet skills shortages and the skills gap, use these sources. The ISSL and LTSSL are reviewed twice a year with submissions considered from industry representatives and employers (Bedford 2006:242).
However, the problems relating to immigration systems are numerous, but two are mentioned here, firstly, the slow processing and issuing of work permits, which can take from two to four months. These delays have been blamed for contributing to the skills shortage as slow and uncertain entry hinders and discourages skilled people from coming to the country. Therefore the state of the immigration system in South Africa, as well as the breakdown of consular sections at South African embassies based in other countries, make it difficult to recruit foreign skills proactively (Cape Argus 2007).

Secondly, official figures for 2001 indicate that South Africa lost six times more professionals and technicians than it gained. South Africa has lost approximately 20% of its skills through emigration. In addition, 70% of skilled South Africans consider emigrating (CDE 2002:5). White skilled professionals are the majority of those who leave the country. However, there are also Black people who do. However, because of the country’s history, skills are concentrated in the White population. In 1997 alone, the emigration of skilled professionals cost the government about R68 billions of investment in human capital because of the loss of skilled South Africans. Bhorat et al. (2002:4) stressed the severity of this huge loss of skills. Furthermore, statistics from South African sources do not reflect this ‘brain drain’ accurately. However, immigration statistics from foreign countries do reflect the size of the problem (Van Rooyen 2000: 26–29). The reasons for inaccurate emigration statistics include:

- emigrants not completing forms at South African airports to avoid complications if they decide to return;
- the travel allowance of R500 000 does not mean they must emigrate officially; and
- younger skilled workers do not have large amounts of money and official emigration does not concern them (Mitchell 2003).

There are various reasons (push factors) why these skilled residents emigrate. The push factors include crime, employment equity, poor working conditions, poor service delivery, high living costs, declining education standards, unfriendly business environment, low-income levels and political events. Affirmative action is a large
concern of White people (Rogerson & Rogerson 2000). Because of affirmative action many white South Africans have left their country to seek greener pastures (Ramphele 2008:19). According to Rogerson and Rogerson (2000:49), 74% of the people who emigrated were unhappy with the level of taxation, 68% were concerned with family safety and security and 71% were unhappy with living costs.

4.2.4.2 Outsourcing and subcontracting of labour
Similar to global trends in employment, roughly one third of all people working in the mining industry are now employed through a non-standard employment contract. The majority of these are employed by brokers, to whom the mines have outsourced or subcontracted a portion of their requirements and, with whom the mines have commercial contracts. Subcontracting organisations range from larger, established contractors employing over 1 000 workers to micro-enterprises employing between one and 100 people (MQA 2011:28).

While subcontracting is not a new phenomenon in the industry, it has increased substantially since the 1990s. Surface mine work that tends to be subcontracted includes non-production functions such as catering, cleaning, security, and building construction and maintenance. Subcontracting of core underground work includes specialised work, such as shaft sinking, as well as general mining activities where contactors either mine certain shafts or parts of shafts, or work in integrated teams alongside permanent employees. The unions’ concerns around subcontracting relate to issues such as lower pay, more dangerous work, and limitations of not being allowed to become members of any trade union or access to social benefits such as sick-leave and death benefits. Employers point to the challenges of maintaining profitable operations in uncertain market conditions as a key reason for using subcontractors. In addition, this has a positive impact on employers’ BEE compliance scores as many subcontractors are BEE companies (Mining Qualifications Authority (MQA) 2011:28). The main objectives of sub-contracting and outsourcing of operations, particularly in the
more labour intensive jobs, like mining, is to enable organisations to reduce their overhead costs by externalising the capital and other costs associated with the direct employment of labour (Hoq, Amin & Ali 2009:36).

4.2.5 Overview of supply and demand of skills
Morris and Reed (2008:202) were of the opinion that the consensus on education and apprenticeship training is that, at current graduation levels, the skills base cannot be maintained or broadened. This in itself justifies efforts to encourage participation in formal programmes. One of the priorities of the sector is to ensure a flow of new entrants, sufficiently trained to fill new employment as well as opportunities to replace workers who are leaving the market or the sector. The new entrants should be sufficient to correct the current imbalances in the sector, both in terms of skills shortages as well as race and gender profiles. School children need to have access to career guidance in the construction sector. The apprenticeship strategy seems to have been successful due to the sector commitment to skills development, similar commitment through the learner-ship system must be shown.

According to Kraak (2003:667) conceptualising the skills development strategy for South Africa in this manner would entail targeting the three complementary skills development components:

- Expanding the high-skills area: South Africa has a relatively sophisticated infrastructure for transport, information technology, telecommunications, financial markets, higher education, and science and technology; all of which require or employ highly skilled personnel.
- Meeting low-to-intermediate skills demand: The development of a new high technology enclave in manufacturing does not displace the previous regime which was based on mass production and jobbing processes.
- Catering to the low-skills sector: South Africa is characterised by a high-level of unemployment, income inequality and social polarisation.
Following the above discussion, the organisation’s most valuable advantage would be in attracting, managing and developing people in the most effective and efficient way possible. The concept of Human Capacity Building is appropriate for discussion in this section as it refers to the differentiated skills formation system in South Africa that firstly incorporates three bands of skills and secondly, seeks to build a development strategy around the integration and interlocking of these bands.

4.3 HUMAN CAPACITY BUILDING IN THE MINING INDUSTRY

Capacity building is a conceptual approach that is closely related to education, training and human resource development (Enemark & Williamson 2004:2).

4.3.1 Evolution of capacity building concept

Over the past several years (United Nations Environment Programme (UNEP) 2002:10-11), it has become clear that capacity building is central to the quest for sustainable development. If society is going to realise the goals of Agenda 21, which were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in South Africa in 2002, the ability of regional organisations, national governments and civil society to address the principal challenges of sustainable development must be reinforced. According to paragraph 137 of the WSSD Plan of Implementation, UNEP and other United Nations agencies should strengthen their contribution to sustainable development programmes and the implementation of Agenda 21 at all levels, particularly in the area of promoting capacity building. Chapter 37 of Agenda 21, under the heading National mechanisms and international cooperation for capacity building, states that the ability of a country to follow sustainable development paths is determined to a large extent by the capacity of its people and its institutions as well as by its ecological and geographical conditions (Abaza 2002:11).

In broad terms, capacity building is viewed as a long-term process that focuses on the capacities of organisations, infrastructure and communities through the provision of technical support activities, such as coaching, training, specific technical assistance and
resource networking. Capacity building or development is the process by which individuals, groups, organisations, institutions and societies increase their abilities to perform core functions, solve problems, define and achieve objectives, and understand and deal with their development needs in a broad context and in a sustainable manner. Capacity building (UNESCO 2006:2) in broad terms is concerned with the following:

- **Human capacity development** - the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively.
- **Organisational development** - the elaboration of management structures, processes and procedures, not only within organisations but also the management of relationships between the different organisations and sectors.
- **Institutional and legal framework development** - making legal and regular changes to enable organisations, institutions and agencies at all levels, and in all sectors, to enhance their capacities.

The focus of this study is on human capacity development, another pillar of a capacity building framework that includes the education and training, as well as retention of professional and other participants in the regulatory system. The South African mines suffer from a seriously under-skilled workforce and an effective increase in the provision of training is a key to economic regeneration. On the other hand, there is evidence of the high mobility rate amongst the skilled employees seeking greener pastures. Figure 4.1 depicts a framework for human capacity development to recruit, develop and retain the talented employees.
Figure 4.1: A framework for human capacity development

Vision: Managers manage their HR and strategic partners, fully qualified, satisfied and engaged

Respect

Professional

Fair and consistent

Safety

Strategy: Recruit, develop and retain

Diversity

Capacity building

HR skills and competencies

Talent management

Improve:
- Ability to achieve vision and goals
- Establish development activities

Recognise:
- Unique position of individuals
- Which skills and competencies will contribute to job effectiveness

Ensure:
- Supply meets demand
- Developed strategies will address any gaps
An effective human capacity development strategy according to Figure 4.1 is a means of keeping employees aligned with the values and mission of an organisation by developing a culture that encourages employees to focus on a higher purpose for their work. Values that support this kind of cohesive operation include respect, safety, professionalism, honesty and consistency. Furthermore, organisations should develop human resources strategies to recruit, develop and retain skilled, committed and accountable individuals. Three strategic priorities need to be identified: capacity building (improve), HR skills and competencies (recognise), and talent management (ensure). These priorities should support human resource’s vision and strategy which is built on four core values (respect, fair and consistent, professional, and safety). Professional development refers to the enhancement of personnel working in professional and related occupations by providing them with new skills, knowledge and attitudes for performing new tasks strictly related to the mining industry.

4.3.2 Human capacity development
The two possible dimensions of human capacity building (McGrath 2004:203) that are relevant to this study have been identified as the source (learners should get work experience across a series of relevant training) and management (that learners should be assisted to gain work experience through pre-arranged and supervised subcontracting work) as shown in Figure 4.2.

Figure 4.2: Human capacity in the mining industry
Resources include things that are traditionally thought of as ‘hard’ capacities, such as infrastructure, technology, finances, and staffing whilst visionary and innovative management is always available and involved, would create the conditions for capacity building through which appropriate objectives are set and achieved.

4.3.2.1 Resourcing skills base
Training and development assumes a wide range of learning actions that expand capacity, ranging from training of the employees for their present tasks, to facilitating the smooth functioning of the mining operations system. In addition, knowledge sharing improves the business horizon and customer service, and meets the current and future challenges of the organisation. Therefore, benefits of training and development are strategic in nature both for employer and employees, and hence much broader (Niazi 2011:43, and United Nations 2010:16). According to Niazi (2011:44) the need for developing employees is compelling because

- a sound training and development plan contributes to increased productivity and quality of work.
- the development strategy reduces staff turnover and absenteeism and also helps to improve motivation among the employees, and
- in order to stay ahead of competitors, training and development should incorporate innovation and reinvention, which is only possible when training encompasses a wide range of learning actions.
Therefore, an ideal training is part of an organisation-wide strategy and it is linked to business goals and organisational performance. According to Olujide (2005:40) training may broadly be categorised into two types pre-service training and in-service training. Pre-service training is more academic in nature and is offered by formal institutions following definite curricula and syllabuses for a certain duration to offer a formal degree or diploma. Work candidates have to attend regular classes in a formal institution and need to complete a definite curriculum and courses successfully to receive a formal degree or diploma. They are not entitled to get a professional job unless they earn a certificate, diploma, or degree from the appropriate institution. Pre-service training contents emphasise mostly technical subject matter such as crops, animal husbandry and fisheries as well as pedagogical skills to prepare the students to work in agriculture. In general, two types of pre-service training are available to agricultural staff.

Mercer (2007:iv) stated that an in-service training is offered by the organisation from time to time for the development of skills and knowledge of the incumbents. In-service training is a process of staff development for the purpose of improving the performance of an incumbent holding a position with assigned job responsibilities. It promotes the professional growth of individuals. It is a program designed to strengthen the competencies of extension workers while they are in employment. In-service training is a problem-centred, learner-oriented and time-bound series of activities which provide the opportunity to develop a sense of purpose, broaden perception of the clientele, and increase capacity to gain knowledge and mastery of techniques. In-service training may broadly be categorised into five different types (Olujide 2005:40).

- **Induction or orientation training**: Induction training is given immediately after employment to introduce the new extension staff members to their positions.
- **Foundation training**: Foundation training is in-service training which is also appropriate for newly recruited personnel. Besides technical competence and routine instruction about the organisation, every staff member needs some professional knowledge
• **On-the-job training**: Foundation training is made available to employees to strengthen the foundation of their service career. In-service training is of course useful in filling gaps in previous training which have become apparent after agents have gone to work. This method is used for teaching specific skills at a specific level.

• **Refresher or maintenance training**: This training is offered to update and maintain the specialised subject knowledge of the incumbents, and is provided by the superior officer or the subject-matter specialists to the subordinate field staff.

• **Career development training**: This type of in-service training is designed to upgrade the knowledge, skills and ability of employees to help them assume greater responsibility in higher positions (Olujide 2005:40-45).

All of these types of training are needed for the proper development of extension staff throughout their service life. Joubert and Calldo (2008:20) cited the biggest problem regarding the skills crisis as lying in the South African education system. Currently, matriculation results are a disappointment. South Africa spends large sums of money on education (Expenditure on education as a percentage of GDP in 2006 was 5,4%, while the average expenditure for 190 other countries was 4,7%), but it is still not providing the right quality of students. South Africa just does not produce enough students with HG mathematics and science for continued study in critically scarce occupations such as engineering, etc. In 2006 only 4,77% students (overall) passed mathematics on HG, and 5,63% Science on HG. In 2007 these figures declined further.

Various policy proposals should be considered to improve the educational outcomes in South Africa. Poor quality education, poor subject choices and poor performance of students were frequently raised by organisations as just some of the key concerns about education in South Africa. Although these interventions can be put into practice immediately, their impacts are only likely to be visible in the longer period given the nature of the educational problems (Business Leadership South Africa 2006:vii).
• **Addressing the poor quality of school outcomes:** Firstly to 4, 50% for students who passed mathematics on HG and 4.98% for Science on HG (Joubert & Callido 2008:5), greater funding of career guidance services that are offered either at schools or off-site is needed. This will prove invaluable in inculcating the importance of mathematics and science amongst learners, which organisations believe is not fully appreciated by young people. Secondly, the restructuring of educators’ remuneration packages on the basis of scarce skills. Hence, we would expect that through such a reallocation, science and mathematics educators, for example, would be remunerated more than other educators.

• **Restructuring state subsidies for tertiary institutions:** Firstly, the current state subsidy system, biased heavily in favour of throughputs, should be restructured to include a (regularly reviewed) ranking of the quality of the institution and an ‘employability’ criterion. Institutions ranked as high quality ones which, through their certification, manage to secure employment for most of their graduates, are therefore likely to attract the largest proportion of the subsidy. Secondly, a special dispensation, *outside of current funding envelopes*, should be secured to support tertiary enrolment in areas where there are skills shortages. Again, employers should define where these shortages exist.

• **Restructuring and marketing of FET colleges:** Firstly, careful consideration of the current curricula at FET colleges is needed. It is crucial that industry standards are met as far as organisations’ expectations of practical knowledge and experience is concerned. Secondly, industry support and trust in the FET system is vital. Many organisations have applied for accreditation as training providers and opted to conduct learner-ships and apprenticeships themselves rather than outsourcing this to FET colleges or other academic institutions. This is a reflection of the current distrust of the private sector in public training, which poses a threat to the credibility and future of the FET system. Thirdly, perhaps a ‘soft’ recommendation, but one that is considered vital, revolves around the fact that FET colleges are viewed within the African community as a second best option for post-matric training. Hence, a key policy intervention would involve marketing FETs in African communities, and in particular repositioning them within these communities as
institutions offering valuable and highly marketable skills. The severe shortage of artisans reported consistently by manufacturing organisations, reinforces the need for this intervention (Business Leadership South Africa 2006:viii).

Effective performance of any function requires a well-trained human resource base of managerial, professional and technical personnel. This involves both specialised training and professional education, and in-service training needed for role-specific activities. This dimension is concerned with how people are educated and trained, and how they are attracted or directed to careers within particular organisations.

4.4.2.2 Managing and retention of skilled workers
Effective performance requires the utilisation and retention of skilled people. Thus, capacity development must include the organisational structures, processes and management systems, in particular the personnel management systems, which make the best use of skilled human resources, and which ensure their retention and continued motivation. While there are numerous factors that help shape capacity building engagements, Light and Hubbard (2006:17-20) claimed that there are four key elements of management that play a significant role in determining the size, shape and ultimate success of a mining project, depicted in Figure 4.3.

Figure 4.3: Four elements of capacity building
Figure 4.3 that the first key to thinking about how to approach capacity building is to recognise that these four elements are all inter-related. Although the desired outcome should determine the change strategy, which informs who should champion the effort and how much time and money it requires, in practice all four are in a dynamic relationship. According to Light and Hubbard (2006:17-20) the resources available would affect the choice of outcome and the champion may influence the chosen change strategy based on the following:

- **The desired outcomes:** The gold mining company strives to achieve a predetermined objective at least cost and desire to maximise output from the limited amount of resources. The outcomes vary in nature and scope and for this study, the desired outcomes are organisational performance, managing propensity to leave, competitive advantage and sustainability. In order to achieve these desired outcomes, applied organisational analysis in order to determine the true nature and extent of skills shortage in the gold mining sector (Wandersman, Imm, Chinman & Kaftarian 2000). Organisational analysis involved gathering information through questionnaire and literature review.
• **Change Strategies:** The CEO’s of gold mines reports show that their organisations expressed the growing concern that their traditional strategic planning models to address skills shortage may be out-dated and there is a need to have fresh plans. Based on the data collected, the best change strategy that is appropriate and most effective for finding the solution of the problem at hand, would be decided upon.

• **Champions:** Capacity building programmes need a champion who would ensure that predetermined action plan is put into action. This is done through the engagement and involvement of people most affected by the shortage problem and helping them adopt the planned change. Usually, one or more persons is or are assigned the task of driving the capacity building initiative, planning the overall approach, driving the implementation timetable and promoting it to everyone affected. One of the reasons why capacity building fails is the lack of a champion who has the skills, time and resources to make a success of the initiative.

• **Resource outcomes:** Capacity building engagements require sufficient resources in order to succeed. As an organisation engages in the above activities it acquires new knowledge about organisational actions and outcomes. Organisational capacity expands when learning goes beyond solving a specific problem to gaining the skills and knowledge to solve future problems (Light & Hubbard 2006:17-20).

Therefore, teams with conscientious talented people perform at a higher level and exceptional business performance is driven by superior talent. Analyst research has proven that organisations using talented management strategies and solutions exhibit higher performance than their direct competitors and the market in general.

**4.3.3 Human resources skills and competency**

When optimising the Human Resources function, recruiting for productivity and performance would require aligning employees’ daily activities to the organisation’s core business competencies and strategies, while improving upon those skills that not only add value, but also enhances the image of the HR department. It must also be noted that staffing and recruiting is costly and requires specific skills and knowledge in order to help organisations to sustain a competitive advantage in attracting and retaining top
and diverse talent. According to Barefield (2004:3) there are several factors causing an increase in spending on hiring efforts, for instance:

- *Increased storage*. Demographic trends such as the aging of the workforce and decreasing birth rates.
- *Increased employee turnover*. Employees currently change jobs more often than they have in the past and that even satisfied employees are increasingly investigating job opportunities.
- *The costs of recruiting*. Some experts theorise that the cost of recruiting equals 50-60% of an employee’s first year salary or and up to 100% for certain specialised, high-skill positions.

### 4.3.4 Talent management

According to Schultz and Grimm (2008:54) the mining industry globally, is faced with a shortage of qualified talent to meet its production needs. Every year there are more people leaving than entering the mining sector to pursue other job and career opportunities. Some of the key reasons for this trend include the general image of the industry, the declining numbers of graduates from mining related programs, and the draining of talent and knowledge as a result of mining industry turn-over and retirement. In an organisation, talent management is becoming an increasingly crucial way of approaching HR functions.

As a rule industry wide mining solutions are firstly, aimed at improving the industry’s image, improving relations with the educational sector, and attracting skilled foreign workers. In addition, the government recommendations and directives call for an increased number of HDSA in the mining workforce as well as for the recruitment of general engineering and technical talent from other industries. Lastly training and development programs together with the improvement of industry standards for the development of necessary industry knowledge and skills are thought to help in overcoming the current challenges (Schultz & Grimm 2008:54). While all of these strategies are part of a comprehensive solution to the problem, they are still generic in nature. Managers tend to focus on correcting weaknesses rather than capitalising on
each person’s unique talents. The current talent supply shortage is often portrayed as a problem beyond the control of the individual organisation, or as being primarily a recruiting issue. In addition to losing new talent, the industry currently has more than 50% of mining employees over the age of 40. Retirement poses a serious impending issue, with more than 40% of employees expecting to retire over the next ten years. Moreover, Cubbingham (2007:4-6) described talent management as follows:

- an outcome to ensure the right person is in the right job;
- a process to ensure leadership continuity in key positions and encourage individual advancement; and
- a decision to manage supply, demand and flow of talent through the human capital engine.

### 4.3.4.1 Talent management process in mining industry

Talent management (also known as Human Capital Management) may be defined as the skill of attracting highly skilled workers, of integrating new workers, and developing and retaining current workers to meet current and future business objectives. Companies engaging in a talent management strategy shift the responsibility of employees from the human resources department to all managers throughout the organisation. There are three major stages (Figure 4.4) to the Talent Management process and each stage has a number of activities that result in tangible outputs.

**Figure 4.4: Talent management process**
The talent management process consists of recognising the key talent areas in organisation, identifying the people in the organisation who constitute its key talent, and conducting development activities for the talent pool to retain and engage them and have them ready to move into more significant roles. The process of attracting and retaining profitable employees, as it is increasingly more competitive between organisations and of strategic importance, has come to be known as “the war for talent”.

There are several ways to identify talent knowledge in an organisation and one of the methods is from employee performance records. The previous performance records can be analysed using a Data Mining method in order to find out the patterns and rules related to employee performance. The generated rules and patterns can perform a prediction model related to talent performance (Jantan, Hamdan & Othman 2010:698). The decision support system can be used to forecast the right talent for the right job at the right time.

4.3.4.2 Evaluations
Current employee performance within a specific job has always been a standard evaluation measurement tool of the profitability of an employee. However, talent management also seeks to focus on an employee’s potential, meaning an employee’s future performance, if given the proper development of skills and increased responsibility (Butterfield 2008:37). Management must evaluate employees’ knowledge, skills and competencies as these talent attributes are an important competitive tool, hence talent needs to be maximised and recognised as one of the discrete sources of organisational competitive advantage (Bano, Khan, Rehman & Humayoun 2010:6).

4.3.4.3 Outcomes of talent management
A key failure of many traditional talent management systems is a mismatch between supply and demand. This results in an over-supply of management talent resulting in
employee turnover, or layoffs and restructuring, or an under-supply where key positions cannot be filled (Collings & Mellahi 2009:13). It is generally in the organisation’s best interest to retain members of the talent pool as opposed to losing them due to turnover (Somaya & Williamson 2008:29). Hence, a focus on factors that explain employee retention and turnover is also a relevant mediating variable. Schreuder and Theron (2001:28) contended that the retention of talented employees by employers is imperative because the organisation’s competitive advantage is often dependent on the specialised knowledge and skills possessed by these employees.

According to a survey conducted by the American Bankers Association and the Corporate Executive Board in early 2009 amongst more than 3,500 bank CEOs about talent management practices at their institutions, it was found that banks depend heavily on internal talent and lack succession plans (Edrington & Johnson 2009:15). As shown in Figure 4.5 below.

**Figure 4.5: Bank`s sources of talent**
Figure 4.5 illustrates that banks fill 60 per cent of their posts internally. The goals of recruitment and career development are the same, they want to employ the best talent at challenging jobs, and therefore, are connected to each other (Edrington & Johnson (2009:15). Creating talent pools internally and helping mining organisation assess employees can save time and lower overall recruiting costs. Cappelli (2008a) suggested that when developing talent pools, some factors would facilitate their effective development, namely, organisations should combine internal development and external recruitment in filling talent pools. Furthermore, it is more effective to develop talent within the broader context of the organisation, rather than with a particular succession role in mind. According to Cappelli (2008b) this prevents developing employees to fit narrow, specialised roles but rather, once developed employees can be developed, to fill roles with broader competencies which would fit a range of roles.

4.4 CONCLUSION
While the identification and measurement of scarce skills are complicated, measuring critical skills requires much more intensive investigation. One needs to do a skills audit, preferably backed by qualitative research, to put numbers on gaps in skills profiles and shortages in specialist skills. But one needs to go further than measuring the current problem areas. It is also necessary to project estimates of scarce and critical skills due to replacement demand and economic growth, as well as factors of employment requirements and the effects of changing occupational requirements. This chapter considered replacement demand as arising from retirements, net migration, movement into other occupations and in-service mortality. Indeed, given the relatively low rate of economic growth in South Africa coupled with high mortality, it can be expected that replacement demand would exceed the creation of new positions.

The possibility of skill imbalances in the market is important from both a policy and individual perspective. Such information can, in conjunction with corresponding demand estimates, throw light on possible future developments in South African markets, highlighting potential mismatches and thus help inform decisions on investments in skills development, especially formal qualifications, made by individuals, organisations and government. An analysis of the supply of skills in the learner-ship, further education and training (FET) and higher education and training (HET) shows that increasing numbers of learners are entering training institutions, which could suggest that the supply would more than adequately cover the increased demand over the next five years. However, taking into account the low throughput ratios, lack of access to experiential training for qualification purposes and non-accreditation of certain curricula, together with normal attrition rates as well as changes in work processes, the ability of the supply pipeline to meet the required demand is far from certain. On the other hand, if there are sufficient numbers employed, many of the individuals in the sector lack the critical skills, knowledge and experience to effectively manage and ensure the delivery of infrastructure in terms of requisite standards of cost, quality and time. Such capacity constraints are all the more important given that the public sector contributes around 60% to the government's R372 billion infrastructure investment programme of upgrading power stations, building roads, airports and harbours. Capacity building requires and in
depth analysis regarding where an organisation stands in comparison to where it hopes to be in the future, and develops the skills and resources to get there. Human capacity building focuses on leveraging strengths of current employees and new recruits in order to fill critical skills gaps.

This study would present the hypothesised model and discussion on the operationalization of research variables in the following chapters.
CHAPTER FIVE

A MODEL FOR MANAGEMENT PERCEPTIONS OF SKILLS SHORTAGE IN GOLD MINES

5.1 INTRODUCTION
The literature review in previous chapters indicated the difficulty of defining the means to address skills shortage as it is fraught with differing images and perspectives depending on the investigator’s role and activity within the workforce and economic development system. The altering industrial structure is in itself the result of changes in the patterns of consumer demand, technology and organisational evolution, as well as the evolving pattern of national competitive advantage that continues to change the balance of occupations, qualifications and skills required in the market (Campbell, Baldwin, Johnson, Chapman, Upton & Walton 2001:210).

Jeanson (2010) suggested that doing a literature search on skills shortage is complicated by several additional technical hurdles. Firstly, the area of skills shortages has been researched extensively, and the body of literature relevant to the research question is quite significant. Secondly, not all published research on skills shortage is valid, possibly due to small number of samples and other differences in the survey procedure. This means that care needs to be taken in consideration in drawing comparisons with past results. However, it must be noted that experiments usually push technology to its limits, and it is difficult for many researchers to resist over-concluding their results. Hence, it is the objective of this study while reviewing the literature to sort out speculation from fact. Third, the paradigm in which the data are interpreted may be wrong. This is especially of concern in the field of social science such as human capacity building, in which the reasons for intention to leave and turnover is assumed rather than tested. When recognising these biases up front it may eventually entail that the investigator must re-evaluate all the published data under a different paradigm and that the process of literature review be critical and rigorous (Jeanson 2010).

The purpose of this chapter is to present a theoretical and conceptual framework which underlies the problem statement and solutions to skills shortages presented in the
previous chapters and give direction to this study. These areas of curiosity motivated the study to look for arguments in terms of questions and hypotheses that provide conceptual coherence to the research and contribute to knowledge. The independent variables that influence the organisational performance such as productivity, competitive advantage, turnover and sustainability are recently much debated issues both in economics and business strategy research. Once the study has separated fact from speculation and has established a sure foundation of knowledge in a particular field of interest, it asks specific questions of this established foundation, like whether the reliable data that have been published depict discontinuity. It is possible that no research group has looked at their data from this perspective. If no publications answer this question, the observation immediately opens a potential research investigation. The next step would be to generate a hypothesis to answer this question and designing experiments to test it.

5.2 MODELLED INFLUENCES OF SKILLS SHORTAGE IN GOLD MINES
Skills shortages and gaps in chapter three are considered as shortcomings in the education pipeline in its totality and thus solutions for a specific skills shortage need to be addressed in all education bands: GET, FET and HET. On the other hand, occupational or workplace learning has been conceptualised as a separate, parallel stream: in as much as it applies to people with formal degrees that want to further their knowledge and career perspectives, in the mining industry occupational learning mainly allows for people that have not had sufficient opportunities to go through the formal education system to still earn qualifications at various NQF levels. This is learning that is not structured by a specific professional or pedagogic intervention, but allows workers to learn from their work and to learn as they work. (Department of Water Affairs 2009:17-18).

Secondly, the conceptual framework demonstrates the theory of the sequence of cause and effect that ultimately leads to a particular problem (turnover and propensity to leave) or, turned around to a positive view (performance, competitive advantage and sustainability), a particular ultimate result. They typically trace relationships in order to
enable this study to develop questions, express testable hypotheses and underlying assumptions more accurately. Several hypotheses are developed from the expected effects of management perception leading to organisational outcomes.

5.3 OPERATIONAL DEFINITION OF RESEARCH VARIABLES AND HYPOTHESES

The three main components that constitute the conceptual framework in Figure 5.1 are dependent, mediating and independent variables and are discussed in the section that follows.

5.3.1 The modelled outcomes of skills shortage

Employees’ skills are the backbone of any business success and therefore, they need to be motivated and maintained at all costs to aid the organisation to be globally competitive in terms of providing quality products and services to society (Appollis 2010:31). This study identifies four business-related variables that occurred as a result of changes in skills requirements, namely, performance, intention to leave, competitive advantage and sustainability. Secondly, the conceptual framework demonstrates the theory of the sequence of cause and effect that ultimately lead to a particular problem (turnover and propensity to leave) or, turned around to a positive view (performance, competitive advantage and sustainability), a particular ultimate result. Figure 5.1 depicts the modelled influences and outcomes of the hypothetical model of this study.
Figure 5.1: Modelled influences and outcomes of management perceptions regarding skills shortages in gold mines

INFLUENCES

Working Environment
- Safety
- Health
- Occupational fatalities
- Physical

Employment conditions
- Retirement
- Recruitment
- Contracts
- Rewards
- Fringe benefits
- Placements

Resources
- Funds/costs to hire
- Educational qualifications
- Labour
- Competency level
- Infrastructure

Education and Training
- Technical/engineering skills
- Experience
- Training
- Institutions
- Literacy levels

OUTCOMES

Organisational Performance
Propensity to leave
Competitive advantage
Sustainability

Management perceptions of skills shortages in gold mines

Independent variables
Source: Researcher’s own construct

Dependent variables
5.3.1.1 Organisational performance

Aluko (2003:172) defined performance as the execution or accomplishment of work, tasks or goals according to a certain level of desired satisfaction. However, in this study, the specific emphasis is on how organisational performance is operationalized and measured in terms of the ability of an organisation to satisfy the desired expectations of three main stakeholders, comprising of owners, employees and customers (Hur 2007:8). Aluko (2003:172-173) stated the desired expectations of these three stakeholders in terms of the following parameters:

- Owners’ satisfaction with financial returns or profits from organisational operations;
- Employees’ satisfaction with the conditions of work, such as wages and remuneration, style of supervision, rapid promotion and the ability of the organisation to guarantee job security, resulting in a desire to stay with the organisation; and
- Customers’ expressed satisfaction with the quality of the products of the organisation.

March and Sutton (1997:699) posited that in most studies of organisations, organisational performance may assume the role of an independent variable through the likely existence of bidirectional relationships; direct and reciprocal effects. It is however, more likely to appear on the left-hand side of the equation as a dependent variable. The emphasis of organisational performance being a dependent variable is most explicit in the field of organisational strategy that this study follows which is often defined as having organisational performance as its primary focus. The idea that performance is to be predicted, understood, and shaped is commonplace throughout the discussion of this study.

According to Marimuthu, Arokiasamy and Ismail (2009:270) and Khan (2010:159) researchers have used financial and non-financial metrics to measure organisational performance. The financial measures include profit, sales, and market share whereas, non-financial performance includes customer satisfaction, innovation, workflow improvement and skills development leading to a decrease in staff turnover. Non-
financial measures include productivity, quality, efficiency, and the attitudinal and behavioural measures such as commitment, intention to quit, and satisfaction (Small Business Research Centre 2008:5). Richard, Devinney, Yip, and Johnson (2009) identified three similar areas that performance measurement may be based on; financial performance (profits, return on assets, return on investments, etc.), market performance (sales, market share, etc.) and shareholder return (total shareholder return and economic value added, etc.)

Performance measures are intended to be used in strategic planning, to inform planners as to problems that require attention, and allow planners to monitor progress toward goals. Many mining organisations use scorecard systems to assess strategic and operational dimensions of performance in addition to standard financial reporting systems and operational reports (Barr & Cook 2009:19,21). Balanced scorecards are used to aid in balancing short and long-term objectives of the organisational performance to also include shareholders, customers, internal processes, and innovation and learning as a measurement framework beyond traditional financial and accounting.

According to Peek et al. (2008:28), some analysts have pointed out that the skills shortage is already showing negative effects on organisational, industrial and national level, pointing out to situations such as project delays or running behind schedule. Such delays are very expensive as organisations have to use contractors or temporary workers that usually are expensive to hire. A recent survey of ten oil and gas organisations in USA by Gould, Naha, Childs, Nyati, Rew, Foster and Romero (2007:4) attempted to quantify the increase in hiring and replacement costs (salaries and bonuses) and the cost of extra training and loss of productivity that came about as a result of skills shortage, as well as calculating profits lost due to the use of inexperienced staff. The study concluded that the US oil and gas industry lost between US$4 and US$5 billion in 2006 as a result of the skills shortage. The study by Bennet (2009:15) pointed out that high productivity organisations are much more likely to experience the effects of skill shortages than small organisations. The findings of this
study suggested that skill shortages can almost completely eradicate the productivity advantage of the best performing high-tech organisations.

Furthermore, an empirical study in UK (Forth & Mason 2006:5) reported that many organisations choose to tolerate or take for granted the impact of skills shortage for too long until the negative effects on performance becomes clear and identifiable. Employers sometimes resort to the plaguing of skills shortage with less productive low-skilled workers and by reducing the bargaining power of employees in relation to worker effort.

Based on the discussion above the following is hypothesised:

**H05**: *Management perceptions of skills shortages do not influence organisational performance in gold mines.*

5.3.1.2 Propensity to leave

The losing of key employees has long been recognised as a costly part of doing business especially when replacing workers and the contest for talented employees between organisations is considered (Hissom 2009:4). The word costly may refer to opportunity cost while an organisation is in the process of finding a replacement for the individual who has left. During this period the duties of an employee who have left the organisation may have to be assumed by remaining employees, leading to increased work demands, stress, and uncertainty until the open position is filled. Even when a replacement is found, time may have to be devoted by employees to training the replacement or socialising the individual about the group norms. This replacement may create dissatisfaction among some employees who were hoping that they will be promoted and fill that position (Al-Harbi 2011:15).

Another reason is that the organisations have already incurred some expenses on their employees in terms of induction and training, developing, maintaining and retaining them in their organisation.
Although, there is no standard framework for understanding the employees turnover process as a whole, a wide range of factors have been found useful in interpreting employee turnover. Propensity to leave is a dependent variable used in this study to predict staff turnover (Ongori 2007:49). It is mentioned in general theories of planning that the behaviour of employees suggest that the intention to leave is a strong predictor of actual turnover rates among staff members (MacIntosh & Doherty 2010:107) and when identified, corrective measures to prevent turnover could be taken in advance (Van Schalkwyk, Du Toit, Bothma & Rothmann 2010:2). According to Grobler, Wärnich, Carrell, Elbert and Hatfield (2006), a high turnover in employees costs South Africa several millions of Rands a year through decreased productivity, increased accidents and quality problems.

Propensity to leave as a concept may be defined as the degree of employee’s desire or perceived likelihood that they do not want to stay with their employer due to various antecedents (Kahumuza & Schlechter 2008) and where quitting and searching for alternative employment occurs actively (Park & Kim 2009). Employees with high withdrawal intentions from the organisation have already made a decision subjectively that they will be leaving the organisation in the near future (Masri 2009:16). The propensity to leave is categorised as a dependent variable in this study. Firth et al. (2004) claimed that there are several reasons why people leave the organisation, such as insufficient information of how to perform the job adequately; extensive job pressures; and dissatisfaction regarding the working environment or employment conditions. Additionally, Ali Shah, Fakhr, Ahmad and Zaman (2010:169-172) reviewed various research studies and indicated that employees in the organisation resign for a variety of reasons. Hunjira, Ali, Chani, and Rehman (2010:3058) identified these various reasons as independent variables and employee intent to leave as a dependent variable.

Firth et al. (2004) believed that management’s ability to actively monitor workloads and maintain a good working relation between supervisors might not only reduce stress, but also increase job satisfaction and commitment to the organisation. Managers also need
to monitor both the extrinsic and intrinsic sources of job satisfaction available to employees. These activities could assist in retaining talented employees and reducing turnover. The three variables - demographic, organisational and attitudinal, that are related to propensity to leave - identified by Masri (2009:27), are examined in more detail below.

(a) Demographic Factors
Khatri, Budhwar and Fern (1999:5) stated that the demographic factors that have been found to have stable relationship with propensity to leave in previous research studies include age, tenure, level of education, level of income, and job category (managerial or non-managerial). Several studies have reported negative relationship between turnover intention and three demographic factors, age, tenure, and income level (Khatri et al. 1999). This means, the higher the variable, the lower the turnover. The amount of education, on the other hand, is found to be positively associated with turnover suggesting that an employee with a higher education level and possessing skills has an increased affinity for more enriching jobs with higher compensation (Heydarian & Abhar 2011:32). Finally, Chiboiwa, Samuel and Chipunza (2010:2103) claimed that non-managerial employees are more likely to quit than managerial employees.

Findings of the studies on the relationship between gender and turnover are mixed. Many studies have reported that no significant relationship exists between gender and turnover intentions (Martin & Roodt 2008:25). According to Khatri et al.1999:5) males are more likely to quit than their jobs than females are, as they are in most cases the breadwinners for their families and have a greater achievement-orientation than females do. Consequently, males may leave the current job in favour of a more attractive job if their expectations are not met. On the other hand, females have reportedly shown higher turnover rates than their male counterparts where gender biases and stereotypes are common in the workplace (Ganesan 2010:18).

According to Ali Shah et al. (2010:169-170) another variable that contributes to turnover intentions is job-hopping. Job-hopping occurs when employees switch jobs for no
apparent reason, over trivial matters or even over minor disagreements with their supervisors. This happens when there are plenty of jobs available because of shortage.

(b) Organisational factors
There are many factors attached to an organisation that push employees to quit. Amongst them, are salary, benefits and facilities; size of the organisation (the number of staff in the organisation); location of the organisation (small or big city); nature and kind of organisation; stability of organisation; communication system in organisation; management practice and policies; and employee empowerment (Ali Shah et al. (2010:170).

(c) Attitudinal factors
Attitudinal factors are variables such as job satisfaction, work-related stress and level of commitment in the organisation. According to Loquercio (2006) it is relatively rare for people to leave jobs in which they are happy, even when offered higher pay elsewhere. However, sometimes employees are pushed to leave due to dissatisfaction in their present jobs to seek alternative employment. Satisfied employees are less likely to quit (Ali Shah et al. 2010:170). This was confirmed by the Lum, Kervin, Clark, Reid and Sirola (1998) study of paediatric nurses, that suggested that organisational commitment has the strongest and most direct impact on the intention to quit whereas job satisfaction has only an indirect influence.

A study by De Lange, De Witte and Notelaers (2008) found a relationship between low department resources, low job autonomy, low work engagement with intention to leave and later quitting to work for new organisation. Simpson (2008) confirmed this report by stating that staff interaction (a job resource) was positively related to engagement and thinking of quitting was negatively related to involvement in a cross-sectional study of nurses. Hence, Saks (2006) believed that employees who are more engaged, trust their employer and therefore report more positive attitudes and intentions towards the organisation.
Various pull factors derived from literature are: high salary, career advancement, new challenges and interesting work, job security, good location of organisation, better culture, life-work balance, more freedom/autonomy, good reputation of organisation, values, more benefits, and good employer (Ali Shah et al. 2010:172).

Against the background of the above discussion it is hypothesised that:

\textbf{H0}^6: \textit{Management perceptions of skills shortages do not influence propensity to leave in gold mines.}

\textbf{5.3.1.3 Competitive advantage}

The issue that the improvement of South African economic performance and competitiveness is largely dependent on the changes at the micro and organisational level has been at the centre of long-run public policy debates in recent decades. Critical of late is the ability to innovate and develop clusters of competitive enterprises in particular industries (De Silva 2005:13). Essentially, what this means is ensuring that businesses have the skills needed to innovate, respond to changing market pressures, enhancing their productivity and profitability and retain their competitive advantage in the market. The mining industry is driven by consumer consumption while continually facing tough economic pressures of low commodity market prices and high operating costs that in turn make the mining operational decisions more complex.

According to Lin and Huang (2011:5100) competitive advantage is defined in terms of attributes and resources of an organisation that creates value either by generating greater-than-expected returns from available resources or by allowing an organisation to outperform its rivals on certain behavioural measures in the same industry or product market. Producing value that is rare and inimitable results in introducing the customer relations management as a competitive advantage for an organisation (Alipour & Mohammadi 2011:32).
According to Kahreh, Ahmadi and Hashemi (2011:29) competitive advantage may be defined as an organisational capability to perform in one or many ways that competitors find difficult to imitate now and in the future. Therefore, competitive advantage may be recognised as a strategic goal and a dependent variable. The rationale behind classifying competitive advantage as a dependent variable is that the good performance is related to achieving a competitive advantage (Reed & DeFillippi 1990:90). When resources are equitably distributed, steering organisational performance into high opportunity areas, everyone in the organisation appear to be doing well.

An organisation has a competitive advantage when it implements a strategy competitors are unable to duplicate or find too costly to imitate. An organisation can be confident that its strategy has resulted in one or more useful competitive advantages only after competitors’ efforts to duplicate its strategy have ceased of failed. The speed with which competitors are able to acquire the skills needed to duplicate the benefits of an organisation’s value-creating strategy determines how long the competitive advantages will last (Bordes 2009:3). Thus, competitive advantage means having low costs, differentiation advantage, or a successful focus strategy (Bordes 2009:5).

Perreault and McCarthy (2002) described competitive advantage as a state when an organisation has a marketing mix, that the target market sees as better than a competitor’s mix. This is relevant to the mining organisations, as they are long-term investment organisations, each doing their own marketing in order to attract investors (Van Den Berg 2008:415). Their competitive advantage ranges from being:

- Lowest cost focus
- Ore reserve dominance and extensive growth
- Being the best at what they do
- Pursuing innovation and mechanisation
- Effective purchasing
- Financing ventures and pursuing opportunities
- Competitive barriers using mineral rights, processing and refining methods.
Competitive advantage succeeds only if it allows the organisation to provide superior value and satisfy customers/investors better than the comparison/rival organisations (Perreault & McCarthy 2002).

Although some managers of mining organisations consider their human resource practices and problems as a high priority and acknowledge that they can play a significant role in developing competitive advantage, one of the biggest difficulties faced by them is gaining a competitive edge from the improved capability of people (Huang & Wei 2010:17).

The raw materials used in catalytic converters are found in their natural state in South Africa. As stated by Larkin (2002:43), South Africa has 60 per cent of the world’s platinum group metals (PGM’s) and 70 per cent of the world’s chromium. It is a fact that competitiveness is not one of the properties of the mining organisation as these materials are sold in dollars at world market prices.

Njuguna (2009:36) believed that human capital may be the most important and critical factor for competitive advantage in the organisation because it is the most difficult to imitate. However, human capital is more mobile than other intangible resources and therefore may seem an unlikely source of sustained competitive advantage. Nevertheless, DeNisi, Hitt and Jackson (2003:5) argued that the mobility of human capital makes it less of a threat to competitive advantage than it would first seem to be. According to Van den Berg (2008:15), for a mining organisation to remain competitive, it must integrate its human capital with other complementary resources, work effectively and efficiently, and use this integration to create organisational capabilities. Therefore, losing one resource or a few skilled workers may not lead to a loss of competitive advantage. Instead, a competitor would have to gain access to all of the resources and the system in place to influence those resources; an extremely difficult task. On the contrary, and despite the mobility of talented employees DeNisi et al. (2003:6) believed that human capital is now seen as one of the most important sources of competitive advantage.
According to Memon, Mangi and Rohra (2009:4184) the interpretation of minimal impact of skills shortage on competitive advantage above is about the overall strategy of the organisation, but many researchers who support Resource-Based Value (RBV) agree that more attention should be given to internal resources and particularly human capital. Human capital is an important source of competitive advantage; it can augment the organisation’s competitive advantage through cost leadership and differentiation (Memon et al. 2009:4182). The cost component that can be affected by the development of human capital is marginal and not considered sufficient to keep or make the industry competitive.

Although there are few research studies regarding specific relationship between management perceptions of skills shortage and competitive advantage, the above discussion suggest that:

\[ H0^7: \textbf{Management perceptions of skills shortages do not influence the competitive advantage of gold mines.} \]

5.3.1.4 Sustainability

The ability of organisations to engage the trust of communities, governments and investors is critical to their sustainability, with corporate reputation playing a significant role in this. Sustainable development in its broadest sense is identified by the mining industry as an important focus (MMSD 2002). Sustainable development has a number of meanings. Sustainability is defined by the Brundtland report (World Commission on Environment and Development 1987) as the development that meets the needs of the current generations without compromising the ability of future generations to meet their own needs through an integration of environmental protection, social advancement and economic prosperity. The Department of Mineral Resources (2010:5) concurred with this statement that mineral resources are non-renewable in nature; forthwith the exploitation and mining of such resources must put emphasis on balancing economic benefits with social and environmental needs without compromising future generations in the process of using these natural resources.
The meaning of these two definitions illustrates that before the mine closure, the mine has a responsibility to provide sustainable socio-economic development of mining communities in which it is situated by minimising the impact of mining practices on biodiversity. This shift in focus has been reinforced, or perhaps initiated, by an acknowledgement that local communities are increasingly influential in regulating access by mining organisations to local resource deposits. Frequently, when mining organisations create new mines, they strip the land of all plant life, destroying animal habitats and threatening the region’s biodiversity (Lins & Horwitz 2007:11). The main objective of this study is to measure the commitment of the mines to maintain profitable business performance and corporate responsibility such as being committed to producing safe and sustainable products; awareness of the adverse impact mining operation can and have had on the environment; and commitment to establishing and nurturing constructive relationships with its stakeholders (shareholders, employees and community).

The rationale of choosing sustainability, the creation of an organisation that can sustain financial, social and environmental resources over long-term, as the dependent variable in this study is that it has also become a major focus for businesses in the 21st century and warrants systematic investigation (Bradbury 2003:173). Organisations, mining in particular, are the main contributors to the many environmental problems that the community is facing and therefore need to play a critical role in addressing such issues (Senge 2007). Thus, the mining industry has been subject to increasing public scrutiny (Kapelus 2002), with a focus on both its reputation and its role in sustainability (PricewaterhouseCoopers 2005). The Chamber of Mines actively engages both locally and internationally in programmes aimed at achieving sustainable development through mining. It supports its members in improving their sustainable development performance and in countering unwarranted negative perceptions about the benefits that mining can bring to a sustained better life for all its stakeholders.

The availability of a highly skilled professional workforce is critical to the South African mines’ ability to meet its longer term economic, social an environmental objectives. In
the broader context of sustainable development, healthy and safe working conditions are among the first expectations for sustainability, the expectation that risks in mining will not deprive workers of their livelihoods or of their quality of life, that the new worker would base his/her decision on to join the organisation, or not to (Hermanus 2007:531).

The integration of three elements of sustainable development, namely, business efficiency, waste minimisation and continuous improvement systems, needs a special kind of skill.

(a) Business efficiency

According to Rasool and Botha (2011:1) South Africa still faces considerable skills shortages, despite a number of education reforms, like changes to the school curricula. This phenomenon has been highlighted regularly through the media and further drew criticism from social partners like employer bodies, trade unions and the government. There seems to be consensus amongst Bhorat et al. (2002), the Centre for Development and Enterprise (2007) and Kraak’s (2008) findings that skills shortages are major obstacles to economic growth and job creation in South Africa. Kraak (2008:22) and the Harvard Group, that was appointed by National Treasury to analyse growth prospects for South Africa, concurred with these findings on skills shortages and came to the conclusion that human resource shortages is a major impediment to socio-economic growth and development in SA.

(b) Waste minimisation

A lack of skills provision in the environment sector is having a negative impact on the protection of the environment. Various studies anticipated the skills needs of the economy and the failure to reap potential benefits in terms of quality jobs and environmental sustainability, and address the challenges of increased international competition or climate change wisely. Inadequate skills development is holding back many environmental organisations from fully delivering on their mandates. (Bulgarelli, Lettmayr & Kreiml 2009:13).
Improvement

The development of community capacity is a crucial component of establishing a sustainable community and, therefore, the government requires that each mine prepare a comprehensive integrated development and implementation plan for communities where mining takes place. These regulations have now become a prerequisite for mining license renewal. Governments, the private sector, civil society and relevant international development partners should work together to provide vocational training, retraining and professional development within the context of lifelong learning geared to filling skills shortages in sectors essential to sustainable development. They should prioritise women, young people and vulnerable groups in these efforts. In terms of implementation, there have been some major criticisms from some theories against a structural approach to sustainable development in that it is a top-down approach that focuses basically on economic growth and material prosperity (Gallopín 2003:7).

There are concerns about the future sustainability of the mining industry that relies on technicians and tradespeople. The mining industry is competing for scarce skills with infrastructure, manufacturing and other local industries as well as in the global mining arena. Engineers and artisans are highly mobile due to transferability of their skills. SA is known for its top mining expertise and is likely to continue to be a preferred poaching ground for mining talent (Landelahni Business Leaders 2010:2).

According to the Industry Skills Councils (2009:2) the current measures are already significantly increasing the demand for trained and accredited renewable energy system designers, installers and smart meter technicians. However, there are already skills shortages in these areas and mining industry analyses indicate that skills shortages in the mining and mineral sector would continue into the foreseeable future and intensify as the nation begins to transform itself to realise a reduced carbon footprint and considerable aged retirements expected in the next few years (Industry Skills Councils 2009:27).
Although there are limited research studies regarding the specific relationship between management perceptions of skills shortage and sustainability, the above discussion suggests that:

\[ \text{H0}^8 : \text{Management perceptions of skills shortages do not influence sustainability of gold mines.} \]

5.3.2 Management perception as mediating variable

The shift from unemployment to skills shortage was noticeable with utilisation rates that further leave the definition of skills shortage to employers’ discretion. Therefore, skills shortage is by nature an employer perception construct and the purpose of the literature review was to help reveal skills shortage issues and variables with which to contend in trying to gain a deeper, balanced understanding of the problem in the context of workplace skills development initiatives (Tan, Savchenko, Gimpelson, Kapelyushnikov & Lukyanova 2007:13-18). According to Van den Berg (2008:415) the current problems faced by South African mining organisation include:

- Produce at the lowest cost sustainably
- Build a premier investment brand name
- Harness a high performance culture
- Make farsighted bets on new technologies
- Bring new mines to market within time and on budget
- Lack of infrastructure
- Managing the ore mix of current operations
- Keeping costs in line on deeper mines.

The employers’ responses to these challenges are to counteract with the anticipated skills shortage (Shah & Burke 2003:5). Furthermore, Shah and Burke (2005) stated that management strategies on skills shortages are important because they often are the main, if not the only, source of data about the existence of a skills shortage in the market. Instead of recruiting new workers, some organisations may react to an increase in the product demand with a range of coping mechanisms that could involve the
reallocation of resources within the internal market, two of which are mentioned below (Shah & Burke 2005). Firstly, an organisation might increase hours of work per employee by reducing short time or increasing overtime or offer to convert part-time contracts to full-time, which incidentally increases capital utilisation. Lastly, an organisation might change the incentive system to increase worker effort and thus improve efficiency. Erasmus (2006:3) argued that an understanding of the reasons for perceived skills shortages will help to determine the appropriate measures needed to alleviate these shortages.

According to Dhladhla (2011:18) the various studies that relate employees’ perceived leader behaviour to a number of organisational outcomes include:

- Mulki, Jaramillo and Locander (2006) stated that leadership style is related to employee attitudes and behaviours, such as role perceptions, job anxiety, job satisfaction, propensity to leave, and turnover;
- Firth et al. (2004) believed that monitoring workloads by management and leader-subordinate relationships might not only reduce stress, but also increase job satisfaction and commitment to the organisation;
- Bertelli (2007) and Dewettinck & Van Ameijde (2007) posited that leadership behaviour relates to employees’ attitudes and organisational outcomes through its impact on employee motivation; and
- Lee (2002) maintained that in the organisational setting, the relationship between the leader and the subordinate is considered to be fundamental to understanding of employee attitudes and behaviours.

It is essential that managers, leaders, and organisations develop professionals that understand factors which may influence organisational outcomes, such as performance, competitive advantage and sustainability and always ensure employees are motivated and prepared for change (Madsen, Miller & John 2005:1).
5.3.3 The modelled influences of skills shortages

The South African mining industry provides a number of economic and other benefits. However, it has a variety of built-in environmental, health and safety hazards owing to chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks, and many psychosocial factors (Oldfield & Mostert 2007:68). The main drivers of departure of skilled workers in the mining industry are related to the work environment, that include low pay, poor working conditions, limited educational and career opportunities, unsafe workplaces and a lack of resources for effective working and socio-economic environment. The elements of the wider socioeconomic environment such as political and economic instability, the impact of the human immunodeficiency virus, or security issues also influence decisions to move but are not discussed in this section (Wiskow, Albreht & De Pietro 2010:1). As a result of the above discussions, the study analyses the effects of four independent variables, namely, working environment, employment conditions, resources for effective working and education and training.

5.3.3.1 Working environment

Working environment, in this study, refers to the collective view of people in the organisation about the characteristics of the environment in which a person is expected to work and these characteristics are useful in differentiating organisations according to the procedures and practices. The degree to which the environment influences the organisation depends largely on the types of business and the goals and objectives of the management. A mining industry decision is different from any other industry (Hoskin et al. 2000:45), in that:

- Unlike manufacturing industry, mining organisations are restricted as to where to operate by the availability of the economic deposits or cannot choose to mine near the market place. A licence is required for opening and operating the mine;
- Unlike other primary industries which can fertilise or restock, mining organisation cannot influence the prime sites for extraction since minerals are limited and irreplaceable;
• Minerals are formed at a rather slower rate (about million years ago) than maize or cotton. It takes about five to eight years from the discovery of the mine to the actual or full production (Lundmark & Warell 2008); and
• Operating units are always wasting concerns. Heaps of mine waste occupy large areas of land and disfigure the landscape, which ends up as a source of dust and water pollution.

Mining by its very nature requires that land, air and water systems be disturbed, and end up becoming pollutants (Hoskin et al. 2000). This entails accusations of environmental damage and risk of working in a mine. The challenge for the mining industry is to find, extract and process mineral resources with the least possible environmental disruption. This impact has led to most of the world's nations adopting regulations to moderate the negative effects of mining operations. For instance, certification of mines with good practices occurs through the International Organisation for Standardisation (ISO) such as ISO 9000 and ISO 14001, which certifies an auditable environmental management system. The issue of current and future acid mine drainage from deserted gold mines across the Witwatersrand area is currently causing major concern. The greatest environmental issue associated with gold mining is the disposal of a significant amount of waste removed from the mines which end up as dust and water pollutants (Robbins & Coulter 2002:98).

The risks of working in a mine are of more concern to the workers in the industry than to the public at large. Dust and noise for example, which are most of the time hazardous hygienically, are produced by the mining activities resulting into occupational illnesses such as tuberculosis and silicosis, to name but few. Consequently, the mine needs to comply with the Health and Safety Act (Mine Health and Safety Act, No. 29 of 1996). This section of the Act states that health and safety working conditions cannot be compromised by appointing an employee who is neither medically fit nor physically or functionally capable to complete the tasks without endangering the health and safety of the employee and co-workers (Heine 2008:36).
When assessing the workplace environment, consideration is given to the physical nature of the working environment and how well the human characteristics match the physical environment, referred to as psycho-social exposures.

(a) **Physical exposure**

The major indicator of a hazardous work environment is the industry's injury and illness rate. Injuries caused by slippery surface, caving in of side walls, struck by an object, or hurt by machinery, are among the common incidents causing work-related injuries and illnesses (Emery 2005:28). Calitz (2004) stated that the consequences of high environmental heat loads can be expressed in terms of impaired work capacity, errors of judgement, and the occurrence of heat disorders, especially heat stroke that is often associated with severe and irreversible tissue damage and high mortality rates.

Awases, Gbary, Nyoni, and Chatora (2004, 54) stated that working conditions have been singled out, along with remuneration, as one of the major de-motivators and are often the reason why skilled people leave their occupation. This view was verified by a report by the Canadian Health Services Research Foundation (HSRF) (2001:1-4) which identified work pressures and safety as some of the issues affecting the mining environment. Following up on this notion, Colley (2005:6) stressed a known fact that mining the industry tends to have a higher rate of workers being terminated and/or compensated on the basis of permanent disability than other industries. A significant concern here is that organisations are reluctant to re-employ those who are less than 100% capable of doing all that the job requires.

(b) **Psycho-social exposures**

Brenner (2004) argued that work environment designed to suit employee's satisfaction and free flow of exchange of ideas is a better medium of motivating employees towards higher productivity. The role of mine managers and supervisors is to foster a work environment that is conducive to attracting and
retaining high quality employees and to providing the necessary training to meet the needs of these highly mechanised and technology-dependent operations. Work environment, when appropriately designed, motivates employees toward higher productivity. Taiwo (2010:302) stated that there are two types of work environments, namely conducive and toxic work environments.

- A conducive work environment gives pleasurable experiences to employees and enables them to actualise their abilities and behaviour. This type of environment also reinforces self-actualising behaviours.

- Toxic work environments give unpleasant experiences and at the same time de-actualise employees' behaviour. This environment reinforces low self-actualising behaviours and it leads to the development of negative traits in the employees' behaviour (Taiwo 2010:301-303).

According to Taylor (2008:18), many workers place a higher value on lifestyle and, among younger generations, there appears to be less tolerance than in the past for employment that involves long working hours, shift-work or work that is of a physical nature. In addition, there appears to be a greater demand for work considered to be ‘meaningful’, as well as for career opportunities and continuous learning. Many current workforce management practices unintentionally exacerbate occupational skill shortages through:

- a lack of flexible working conditions that allows a balance of family/lifestyle and work responsibilities;
- employer reluctance to train workers due to a perceived risk that investing in workforce training will make employees attractive and mobile and/or lead to demands for higher wages; and
- poor quality working conditions and/or environment.

Vermaak (2010:52) concurred with this believe in that one of the main reasons for skills shortage is the lack of a professional working environment where employees may grow,
be better professionals and have a sense of fulfilment. According to the Al-Anzi (2009:3) the quality of the workplace environment mostly impacts on the level of employees' motivation and subsequent performance. How well they engage with the organisation, in particular their immediate environment, influences the extent of their error rate, level of innovation and collaboration with other employees, absenteeism and ultimately how long they are going to stay with the organisation. The employee spends nearly a third of their life at work (including time thinking about or worrying about work). A pleasant workplace enriches their lives, provides a sense of purpose, accomplishment, and a source of friendships and social connections. It is both management’s responsibility, and in its interest, to ensure that employees work in a positive atmosphere because conditions at work can either maximize or minimize productivity and cause or prevent stress and fatigue (Al-Anzi 2009:17).

Peek et al. (2008:24) found that there is a perception among many students that petroleum exploration is not a respectable business to be in, much less so than the computer or biotechnology business. It has a public image as a pollution-prone, risky and harsh industry, wracked by cycles of boom and bust. There is also the notion, unjustified, that the industry is technologically obsolete. Against this background, it is hypothesised that:

**H01**: The working environment does not influence perceptions regarding skills shortages in gold mines.

**5.3.3.2 Employment conditions**

Employment conditions in the mining industry vary by occupation. Scientists and technicians work in office buildings and laboratories, while miners and mining engineers spend much of their time in the mine. Geologists who specialize in the exploration of natural resources may have to travel for extended periods to remote locations, in all types of climates, in order to locate mineral or coal deposits. Mining is still a male-dominated industry and women were employed from the start to do administrative and other menial tasks, such as that of cleaning and sweeping. Although more women were
allowed to work in all aspects of mining since 1996 in South Africa, any increase in female employment is generally from a very low base (Heine 2008:12). The mining industry is also an employer of predominantly full-time workers, an increasing number of whom are contractors for development, production and maintenance.

(a) Work demand

Most underground jobs are physically demanding as they comprise tasks involving strength, mobility and muscular endurance. Physical strength and stamina are necessary, as the work involves standing for long periods, lifting moderately heavy objects, and climbing and stooping to work with tools that often are oily and dirty. Underground mines are damp and dark, and some can be very hot and noisy. Although underground mines have electric lights along main pathways, many tunnels are illuminated only by the lights on miner's hats. Workers in mines with very low roofs may have to work on their hands and knees, backs, or stomachs, in confined spaces. These activities often place great strain on the human musculoskeletal system (Heine 2008:26). Upper extremity musculoskeletal disorders are also highly prevalent in manual-intensive occupations, such as clerical work, postal service, and cleaning, industrial inspection and packaging. Back and lower limb disorders occur disproportionately among truck drivers, warehouse workers, airplane baggage handlers, construction trades, nurses, nursing aides and other patient-care workers, and operators of cranes and other large vehicles.

Arvidsson, Akesson and Hansson (2003) cited the fact that the effects of lumbar curvature on lower back pain are risk factors for repetitive musculoskeletal disorders in the neck and the upper limb are common among industrial workers; it is most pronounced in women. According to Punnet and Wegman (2004:17) several studies have demonstrated that workers who develop musculoskeletal disorders in ergonomically stressful jobs are more likely to be transferred to less exposed positions or to leave the workplace altogether. Jacobs, Tytherleigh, Webb and Cooper (2007:201) claimed that workers who are ill are more likely to take sick
leave and have a reduced capacity to perform successfully at work. Bakker, Demerouti, De Boer & Schaufeli (2003) stated that job demands are the most important predictor of health problems, which in turn are related to sickness absence. Barnes, Smeaton and Taylor (2009:2) pointed out the need for early interventions to prevent problems associated with long-term sickness, which accounts for half of early retirement decisions. Furthermore, absenteeism is generally considered to be an important consequence of burnout at the organisational level (Bakker, et al. 2003). High absentee rates are also associated with increased intentions to leave and subsequent resigning, which has further financial implications for the organisation. Thus, an explanation for absenteeism is that absence behaviour is a reaction to job stress, where stress is conceived as a failure to cope with job demands (Bakker et al. 2003).

Mostert, Rothmann, Mostert and Nell (2008:107) indicated that presenteeism is one of the biggest drains on productivity due to people showing up at the workplace but are unable to perform their duties due to health conditions. Presenteeism appears to be a much costlier problem than absenteeism. Hemp (2004:49) reported that two studies published in the Journal of the American Medical Association found that employees that showed up for work while suffering from pain or depression were three times less productive than people with the same conditions who were absent. According to Ruez (2004), the key drivers of presenteeism are workplace stress, employee health, work–life balance and shortage.

Unsafe working conditions if unchecked may lead to extreme human suffering and negative consequences for continued growth of the economy. This often leads to reduced competitiveness and productivity due to the loss of experienced labour force through occupational injuries and fatalities, damage to equipment associated with loss of production and a tainted image of the organisation to secure capital investment (Department of Minerals and Energy Affairs 2008:5).
Working hours

The remote locations of some sites, such as offshore oil rigs and some mines, require some workers to actually live onsite for weeks at a time, often working long hours, followed by an extended leave period onshore (Singh 2007:1). Miners work an 11 shift fortnight, which means that every second week they have to work a full shift on Saturday (Leger & Nicol 1992:27). The official normal working hours per 11 shift fortnight are 96 hours (8 hours 44 minutes per shift) on the gold mines, and 92 hours (8 hours 22 minutes) on the collieries. The working day varies considerably depending on travelling and waiting times, in practice.

A National Union of Mineworkers (NUM) study of a marginal mine in 1990 revealed that 70% of workers spent between nine and ten hours underground per shift and 26% worked for longer than ten hours underground (National Union of Mineworkers 1990:5). Hermanus (2007:534) concurred with this statement by saying, it is common in older mines for miners to spend 10–11 hours underground, with much of the extra time taken up by journeying to and from their workplaces. Some sites operate 24 hours a day, 7 days a week, particularly in oil and gas extraction as well as, underground mines, creating the opportunity for some mining workers to work long shifts several days in a row, and then have 3 to 5 days off. Furthermore, due to the low gold production management have encouraged workers to work their ‘free’ Saturday shifts.

Colley (2005:1) cited the biggest problem in mining in terms of attracting and retaining skilled people as the working hours, followed closely by remote locations. Something can be done about the former, in respect of the latter, only incentives and compensation can overcome the intrinsic disadvantage of this factor. These long hours lead to (amongst other issues) fatigue, depression and work-stress. Potter, Deshields, Divanbeigi, Berger, Cipriano, Norris and Olsen (2010:57) and other researchers believed that compassion fatigue can take a toll on the mining professional, causing decreased productivity, more sick days used, and higher worker turnover. The risk of fatigue is inherent in any work-time arrangement.

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involving shift work, long hours of work, irregular hours, extended work hours and work that is physically or mentally demanding, repetitive or requires high vigilance. Fatigue can lead to accidents because it affects a number of key mental and physical abilities and can, for example, result in impaired concentration, poor judgement, reduced hand-eye coordination and slower reaction times.

Khalatbari, Ghorbanshirodi, Akhshabi, Mahmoudi, & Nejad (2011:446) claimed that industrial workers that are under thermal stress for extended periods eventually become fatigued. Research shows there is a relationship between depression and work-stress that in turn correlate positively with anxiety, continuance commitment, and intention to leave, and negatively with affective commitment. Physical fatigue has been identified as a causal factor in heat exhaustion and attributed to several physiological disturbances such as excessive cardio-vascular strain and hyperthermia (Theron & Van Heerden 2011:4). Norman (2005:8) believed that a mine worker should be stress-resistant, empathetic, able to work in a team, success-oriented; he/she should also have fast reactions and proactive as well as be able to handle emotional demands.

(c) Remuneration
According to Chew and Chan (2008:5) and Willis (2000:20), remuneration and recognition are the most critical issues in terms of attracting and retaining talent. As a result, some organisations may even provide remuneration packages that are well above the market rate to attract and retain critical talents which often include special pay premiums, allocating shares or bonuses. Pay is an important consideration for most workers in accepting a job, and unfair pay can be a strong de-motivating factor. However, after people have settled down in a job, extrinsic rewards are now less important, as day-to-day motivation is more strongly driven by intrinsic rewards (Ram & Prabhakar 2011:50).

Although pay is recognised as a potential antecedent of organisational commitment and intention to stay, it must also be emphasised that extrinsic
rewards alone are not sufficient. Low pay, for example, might drive an employee out, but high pay might not necessarily keep them. According to Du Toit and Roodt (2008:35) engineering professionals earn less compared to other professions such as medical doctors and chartered accountants. Lower remuneration as well as an apparent lack of glamour associated with engineering are therefore some of the major factors causing skills shortages in the engineering field.

Lawless (2005) reported that low salaries were seen as a key frustration, especially for engineers aged 35 to 55 years in the civil engineering sector. The report findings further showed that salary disparities between civil engineers and other professionals appeared to be most notable in younger groups, which contributes to the movement of young professionals to other industries. Lawless (2005) referred to a recent study by the Higher Education Statistics Agency in the UK that found that more than half of engineering graduates defect to other careers, citing money, status and image as the main reasons. Pay is an important consideration for most workers in accepting a job, and unfair pay can be a strong de-motivating factor. However, after people have settled down in a job, extrinsic rewards become less important as day-to-day motivation is more strongly driven by intrinsic rewards (Ram & Prabhakar 2011:50).

Chew and Chan (2008:5) believed that intrinsic factors such as praise from managers and team members, may influence employees’ decision to exert greater commitment to remain with the employer when they feel that their capabilities, efforts and performance contributions are recognised and appreciated (Ram & Prabhakar 2011:50).

(d) Retirement

Stacey, Hadjigeorgiou, & Potvin (2009:245) claimed that demographically, around the world, workforces are aging, and sectors experiencing steady growth and organisations simply cannot replace retiring workforce fast enough. For instance, in Canada, the Mining Industry Human Resources Council (MIHRC) estimated that 40% of the mining workforce is likely to retire over the next 10 years and that an
additional 81 000 skilled people will be required to meet current and future industry needs owing to retirement. The Institute of Public Affairs in Australia noted that the country’s aging population will create a shortage of 195 000 workers by 2012 while skilled jobs in mining will double in the next 10 years to 215 000.

The executive research organisation, Landelahni, in South Africa, found that the average age of mining professionals is 50 to 55 years. The Landelahni Business Leaders (2010:7) held the view that the South African mining industry has an aging workforce, particularly in respect of engineers and artisans; this current state of skills shortages is likely to become much more acute in the next 10-15 years. The Society of Mining Engineers in USA found that over 58% of industry members were already over the age of 50 back in 2005.

Against this background it is imperative to be mindful that it takes 12-15 years for an engineer to be sufficiently experienced to serve in a substantive managerial capacity. According to Smith (2001:312), employees who leave, take their valuable knowledge, resources, skills and experiences with them. Those who stay may be assigned new jobs and never use their wealth of accumulated knowledge. Consequently, this occupational shortage within the mining industry is stretching the capacity of the existing workforce leading to increased exposure to safety risks, projects being delayed and experiencing escalating costs (Taylor 2008:55).

Based on the above discussion, it is accordingly hypothesised that:

\[ H^0_2: \text{Employment conditions do not influence perceptions regarding skills shortages in gold mines.} \]

5.3.3.3 Resources
According to Rasool and Botha (2011:3) South Africa spends significant amounts of money on education, but still does not provide the right quality of students. Currently, the state’s contribution to public education remains the single largest investment in
public services. A promising development was the expenditure, on further education and training colleges, of over R14 billion for the period ahead and on student financial assistance, which will increase (Budget Speech 2011). Gordhan (2011) indicated that the government has provided R9.5 billion for expanding education and training colleges and further skills development. This spending could help to address the skills shortages that emigration has caused. South Africa just does not produce enough students with HG mathematics and science as subjects to study further in critically scarce occupations such as engineering.

The MMS is dependent on the availability of certain specific professional and technical skills in order to grow. Mine health and safety legislation and regulations set very strict competency requirements for certain positions and without people with the necessary competencies mining operations cannot extend further. The MMS experienced quite severe shortages over the past number of years. The shortages are exacerbated by the lack of HDSAs with the requisite skills amid the drive for transformation (MQA 2011:46).

Mining and engineering organisations globally are competing for skilled human resources to sustain and develop their business to meet the growing demand for commodities from China and India. In addition South African mining organisations have committed to develop, attract and retain experienced candidates to meet their employment equity targets set by the Mining Charter (Van der Merwe, Vegter & Momberg 2008:256).

According to Peek et al. (2008:11-31) training facilities need to be expanded, and not only in Europe and the U.S.A., but also in low-income countries, particularly in those with oil and gas reserves. The low level of skills development in sub-Saharan Africa is no doubt the principal cause for the lack of skilled workers. Some governments in this region do no allocate adequate funds for education and training, as a result there is a lack of infrastructure and qualified teaching personnel. Speaking at the release of the 2008 Landelahni Mining Survey, Sandra Burmeister, Chief executive of the recruitment group Landelahni said that according to the Joint Initiative for Priority Skills Acquisition (JIPSA), at least 12 500 artisans should be produced each year over the next four years.
to meet demand. However, according to her South Africa continues to suffer a severe shortage of well-qualified, competent and experienced artisans (Landelahni Business Leaders 2008:5).

The University of the Witwatersrand (Wits) and the University of Pretoria (UP) are two universities in South Africa, offering mining engineering degrees that are accredited by the Engineering Council of South Africa (ECSA:2007) as fulfilling the academic requirements for registration as a professional engineer. Both have increased the numbers of students graduating with Bachelor’s degrees over the last decade, in an attempt to meet the demand. Wits increased its number of students graduating from 27 in 1999 to 79 in 2010 (Wits 2011). However, at the highest skill level, PhD graduations fell from 4 in 1999 to just 2 in 2010 (Taylor 2008:17). The lack of relevant and responsive education and training opportunities can result in a mismatch between supply and demand and hence contribute to skills shortages.

Along with university education, technical and vocational training, funds allocated to them are equally limited. A recent survey by the African Development Bank and the OECD showed there is a serious lack of such facilities in nearly all the minerals producing countries, and that these institutions were not functioning in an efficient manner (African Development Bank/OECD 2008).

Findings by Black and Lynch (1996) indicated that larger employers, establishments with productive systems, and those that use more physical capital are more likely to train their employees. Nickell and Nicolitsas (2000) were of the opinion that investments in skills development have a cumulative effect. They found that skilled labour shortages at industry level were significantly and negatively associated with subsequent reductions in investments in physical capital and Research and Development (R&D) at organisation level in industries concerned. Moreover, Wiens-Tuers (2001) express the notion that organisations that provide more benefits and have innovative work practices are more likely to invest in their employees.
According to Stacey et al. (2009:247), if there is no investment in research by an industry, there is no long-term future for that industry. Investment in research is an investment in the long-term success of an industry, and decisions on such investments must therefore be strategic decisions. This implies a need for funding from a National Skills Fund (NSF) for bursaries, work experience learning and internships. NSF is therefore a national resource which can be used to both initiate as well as to respond to national skills priorities. It can be used to target gaps and compliment resource shortages for national priorities (MQA 2011:112).

Based on the literature findings reported above, it is hypothesised that:

**H0^3: Availability of resources does not influence perceptions regarding skills shortages in gold mines.**

### 5.3.3.4 Education and training

According to some employers and industry associations, the vocational education and training system of the country has been labelled as the main contributor to the national skills crisis and difficulties in supplying the skilled workers needed by the South African mining industry (Rasool & Botha 2011:6). They also believed that university education does not produce commercially or workplace able and ready graduates that would, firstly, keep pace with the technological changes occurring as a result of innovation and extensive research and development outcome; and secondly, the education and training system does not meet the growing demands of local organisations for skilled graduates (Rasool & Botha 2011:2).

According to Taylor (2008:17) the lack of relevant and responsive education and training opportunities can result in a mismatch between supply and demand and hence contribute to skills shortages. This situation renders education and training packages to be no longer relevant to the working environment. Consequently, two to three years of experience and additional training on the job is required until graduates are considered viable. Industry also suggests that training has reached its capacity and it is difficult to increase the current numbers being trained due to the need for experienced employees.
to supervise and mentor apprentices, trainees or graduates and the limitations this place on the number of new entrants that can be trained (Taylor 2008:17). This phenomenon is exacerbated by the decline of student enrolment in mining related courses. Although the level of enrolment has picked up somewhat in the last 2-3 years, it is still well below that of the early 1980s.

According to Quintini (2011:28) there is some evidence that developing existing employees with work-related training could alleviate the skills mismatch. This is of vital importance to mining workers (unskilled and semi-skilled) that would see it as a means of acquiring the competencies they lack in order to earn a wage commensurate with the type of work they perform. On the other hand, for workers who begin employment with the required level of skills or with more skills than necessary, training could help avoid or “repair” skill obsolescence caused by human capital depreciation. Skill obsolescence is particularly relevant, for both over-skilled and under-skilled workers, in the context of technological change when old skills become obsolete and new skills are acquired slowly. In this situation, training can narrow the gap between skills acquired at schools and skills required for the job (Arulampalam, Booth, & Bryan 2004) and contribute to the resolution of skills mismatch (van Smoorenburg & van der Velden 2000).

Chew and Chan (2008:6) disagreed with conventional studies that state that trained individuals become more marketable and consequently might leave the organisation at the first instance. However, they agreed with contemporary studies that training and development affect job attitudes such as organisational commitment. Consistent with this finding, in a study of Bassi and Van Buren (1999) that involved a manufacturing plant, it was found that internal mobility and promotion from within, organisation sponsored training and development, as well as job security were important influencers of employee commitment. Therefore, when the training and development needs of employees and employers are met, the more likely it is that employees will remain with the organisation.

Based on these arguments, it is hypothesised that:
According to Canterford (2006:11) the perceptions of skilled workers and employers can both have an impact on skills shortages, particularly within regional areas. Many skilled workers view experience in rural areas as inferior to urban areas, despite evidence to the contrary. The perception of some employers that workers will remain in a position for life, means that appropriate succession planning is not undertaken (Miles, Marshall, Rolfe & Noonan 2004). There is also a perception among employers that skills shortages and training are not their problem, and can only be fixed by governments (Office of Regional Affairs 2005). Government perceptions, based on traditional economics, additionally assume that workers will move to another area to gain employment opportunities.

5.5 CONCLUSION
This chapter provided an insight into the influence of organisational outcomes, more specifically on performance, propensity to leave, competitive advantage and sustainability. Various discussions in respect of the independent variables demonstrated a need to retest their influence on the dependent variables, using management support as the mediating variable. Consequently, various hypotheses that express a relationship between the variables are discussed theoretically and would be tested empirically in Chapter Six.

The aim of Chapter Six is to empirically validate the proposed model and to test a moderating and mediating role of human capital management practices. The discussion elucidates the research methods and instruments developed to collect and analyse the data collected for this research.
CHAPTER SIX

RESEARCH METHODOLOGY OF THIS STUDY

6.1 INTRODUCTION

A comprehensive literature review was conducted and discussed in the previous chapters of this study. The aim was to gain the necessary background to the factors that influence skills shortages and in turn affect the performance of mining organisations. The literature review facilitated the setting of parameters for the problem and to synthesise the knowledge base that underpinned the need for this empirical study. The logical chain of reasoning, opinions and studies of various researchers were applied in Chapter Five to support the arguments in respect of the identification of the research problem, assertions, and knowledge claims regarding factors that have positive and negative impacts on organisational performance, propensity to leave, competitive advantage and sustainability. According to Knobloch (2003:1) and Dewey (1916), cautioned against the tendency of prematurely accepting assertions that have not been tested thoroughly and grounded in theory that is accurate, comprehensive, and rigorous. This study relied heavily on the various published methods to find solutions to the research problem and to test research hypotheses, as well as the careful application of these methods. Moreover, since these methods are borrowed for the most part from established disciplines, such as mathematics and natural science, the issue of appropriate and skilful application becomes a key concern in this study (Dandekar 1986:42). This is especially the case in survey research where the basic methods used have been known since the 1950s, but where the application thereof in many fields continues to fall short of the theoretical ideal. Dewey (1916) suggested the use of science as the medium of investigation through which special applications and methods were used to obtain accurate knowledgeable claims.

A methodology that best assesses the current factors influencing the state of skills shortage in the gold mines, and identify the impact of these variables on organisational performance, propensity to leave, competitive advantage and sustainability has to be determined. Research methodology sheds light on the various steps that are adopted
by the researcher in investigating the research problem along with the logic behind choosing a particular method or technique so that the research results would be reliable and validated (Kothari 2006:8). The current research section has sequential characteristics (Degu & Yigzaw 2006:1) that are listed below.

- It demands a clear statement of the hypothesis
- It requires a plan (research design)
- New data should be collected as required and
- Collected data should be organised and analysed

This chapter intends to justify the choice of methods that are most suitable and adopted to test the hypothesised relationships of management perceptions with skills shortage in order to find a solution to the problem being researched. The research hypotheses would first be expanded to remind the reader of the intended research problems that the study wants to address, followed by a discussion on the positioning of this research within the overall philosophical continuum. This chapter includes the description of the population and sample as well as the reasons for the appropriateness of a sampling approach. Furthermore, the tools used to collect data, how data was collected, pilot study and validity and reliability of the instruments are explained. The chapter concludes with the presentation of the data analysis procedure.

6.2. RESEARCH HYPOTHESES

The research hypotheses presented in Chapter One is reviewed again (1) to provide a clear framework and guidelines for collecting, analysing and interpreting the data; and (2) to serve as a testing tool of the relationship between independent, mediating and dependent variables. A detailed analysis of these hypotheses would be presented in Chapter Seven and conclusions on the findings presented in Chapter Eight. The following section explains the reasons why a particular hypothesis has to be tested.
Hypothesis one (H01) is setup to explore the respondents’ views of whether there is a relationship between working environment and skills shortages in gold mines in relation to safety, health, occupational fatalities and physical surroundings. The purpose is to examine whether the working environment has an influence on skills shortages.

\[ H^0_1: \text{Working environment does not influence perceptions regarding skills shortages in gold mines.} \]
\[ H^a_1: \text{Working environment does influence perceptions regarding skills shortages in gold mines.} \]

Hypothesis two (H02) is setup to investigate the respondents’ views of whether there is a relationship between employment conditions and skills shortages in gold mines in relation to retirement, recruitment or head-hunting, contracts, rewards, fringe benefits and placements. The purpose is to examine whether employment conditions has an influence on skills shortages.

\[ H^0_2: \text{Employment conditions do not influence perceptions regarding skills shortages in gold mines.} \]
\[ H^a_2: \text{Employment conditions do influence perceptions regarding skills shortages in gold mines.} \]

Hypothesis three (H03) examines the respondents’ views of whether there is a relationship between resources and skills shortages in gold mines in terms of funds or costs to hire, educational qualification, competency levels and infrastructure or accessibility to technology. The purpose is to investigate whether availability of resources has an influence on skills shortage.

\[ H^0_3: \text{Availability of resources does not influence perceptions regarding skills shortages in gold mines.} \]
\[ H^a_3: \text{Availability of resources does influence perceptions regarding skills shortages in gold mines.} \]
Hypothesis four (H0⁴) is setup to scrutinise the respondents’ views of whether there is a relationship between education and training and skills shortages in gold mines relative to technical or engineering skills, experience, training institutions, literacy levels and on and off-the job training. The purpose is to examine whether education and training have an influence on skills shortage.

*H0⁴: Education and training do not influence perceptions regarding skills shortages in gold mines.*

*Ha⁴: Education and training do influence perceptions regarding skills shortages in gold mines.*

Hypothesis five (H0⁵) explores the respondents’ views of whether perceived skills shortages relate to an insufficient number of qualified people to meet performance demand or whether qualified people are available but do not meet the standard of performance demand in gold mines. The purpose is to investigate whether management perceptions of skills shortage has an influence on performance.

*H0⁵: Management perceptions of skills shortages do not influence organisational performance in gold mines.*

*Ha⁵: Management perceptions of skills shortages do influence organisational performance in gold mines.*

Hypothesis six (H0⁶) is setup to investigate the respondents’ views of whether management perceptions of skills shortages relate to organisational support that would be positively correlated with job satisfaction, organisational commitment and employee performance ratings and negatively correlated with propensity to leave in gold mines. The purpose is to examine whether management perceptions of skills shortages have an influence on propensity to leave.

*H0⁶: Management perceptions of skills shortages do not influence propensity to leave in gold mines.*
Ha$^6$: Management perceptions of skills shortages do influence propensity to leave in gold mines.

Hypothesis seven (H$^7_0$) studies the respondents’ views as to whether management perceptions of skills shortages relate to the ability to identify and develop personnel on core competencies that would make growth possible in gold mines through cost reduction or differentiation, leading to higher production volumes or increase in market share value. The purpose is to probe whether management perceptions of skills shortage has an influence on competitive advantage.

$H^7_0$: Management perceptions of skills shortages do not influence the competitive advantage of gold mines.
$Ha^7$: Management perceptions of skills shortages do influence the competitive advantage of gold mines.

Hypothesis eight (H$^8_0$) explores the respondents’ views of whether management perceptions of skills shortages relate to the ability to enhance financial growth, protect the environment and develop corporate social responsibility in gold mining areas. The purpose is to probe whether management perceptions of skills shortages have an influence on sustainability.

$H^8_0$: Management perceptions of skills shortages do not influence sustainability of gold mines.
$Ha^8$: Management perceptions of skills shortages do influence sustainability of gold mines.

Deductive reasoning is more narrow-minded and is generally used to test or confirm hypotheses. According to Knox (2004:119) deduction reasoning is associated with quantitative methods while inductive reasoning is associated with qualitative methods. Therefore, the current study is based on deductive reasoning.
6.3  RESEARCH DESIGN

Nyembezi (2009:43-44) and Collis and Hussey (2003:46) mentioned that an empirical research may adopt either a qualitative or a quantitative approach, although it is possible to use both approaches in the same research project. Welman, Kruger and Mitchell (2005:6) defined quantitative research as the numerical presentation and testing of theory and hypotheses for the purpose of describing and explaining the phenomena that those observations reflect. A qualitative research may be referred to as a study in which the investigator attempts to gain insight into a particular phenomenon, understand behaviour by making extensive use of the personal experiences of participants, using interviews, observations, and research (Stephens 2007:41). Payne and Payne (2004:175) argued that the qualitative research method is subjective, value-laden, biased, and is an ad-hoc process that seeks to interpret the meanings people make of their lives in natural settings, on the assumptions that social interactions form an integrated set of relationships in an environment. The current study applied a quantitative research approach.

The empirical study was carried out in fulfilment of an academic course and therefore the time allocated was constrained, hence, the study performed a cross-sectional survey. Cross-sectional surveys are used to gather information and produce unbiased estimates on a population at a single point in time. Data may be collected using instruments other than questionnaires, such as pedometers, which measure distance walked, or scales, which measure weight (Surju 2009:37). Most cross-sectional studies (including this study) collect some data using questionnaires (Olsen & George 2004:8).

Management research is entrenched in the branch of philosophy known as logic. Logic is the study of the methods of reasoning and argumentation. A study of logic may help researchers to better construct their own arguments and assess the arguments of others. The two commonly used methods of reasoning are inductive and deductive reasoning (Rothchild 2006:2). Inductive reasoning is when data is collected first and then theories developed as a result of the data analysis. Deductive reasoning is applied to develop theory and sample design to test the hypothesis and then generalised to the
sampled population (Saunders, Lewis & Thornhill 2003:85). Borrego, Douglas and Amelink (2009:54) held the view that quantitative methods are a good fit for deductive approaches in which hypotheses justify the variables identified in the model, the purpose statement of the study, and the direction of the narrowly defined research questions. For this reason the current study started with a broad spectrum of information about skills shortages, divided this information into more specific hypotheses that can be tested, would test the hypotheses with the collected data in chapter seven, and then confirm (or not) the original theory and lastly, arrive at a conclusion.

6.4 SAMPLING PROCEDURE
The basic idea of sampling design is to generalise the characteristics of the sample to the population. This sample must have been chosen to fairly represent the population. The method to draw a representative sample involves the use of probability sampling methods that would minimise the subjective judgment in the choice of units to survey. The methods used to extrapolate from a probability sample to the population takes into account the unit analysis, target population, sampling methods and sampling size.

6.4.1 Unit of analysis
The unit of analysis of this study is the managers in gold mines of three provinces in South Africa, investigating perceptions regarding skills shortages. The findings of this study would be generalised to all management levels of the South African gold mining industry as stated in Chapter One. The variables of this study incorporate independent, mediating and dependent variables. Independent variables comprise the working environment, employment conditions, availability of resources and education and training. The mediating variable is the skills shortage. Dependent variables are performance, competitive advantage, propensity to leave and sustainability.

6.4.2 Population of the study.
The population comprises all the individuals, objects, subjects, phenomena, cases, events or activities from which the sample was drawn and the researcher was interested
in describing and making statistical inferences about, and to whom the findings of this study would be generalised (Heldal & Jentoft 2011:19). The population of this study includes all people employed in the South African gold mines, while the target population only includes all managers employed in the three largest gold producing mining houses in South Africa, namely AngloGold Ashanti, Goldfields and Harmony. These mines are situated in the Free State, North West and Gauteng Provinces. The main reason why these mines were chosen is because the researcher is based in South Africa and has background knowledge of the gold mining industry. A questionnaire was developed to collect information from the respondents based on a sample of three companies with a sample size of three hundred.

AngloGold Ashanti Company has operations in ten countries around the globe. As at the end of 2004, it employed 65 400 people, including contractors, of which 69.4 per cent were people residing in South Africa. Goldfields Company has operations in South Africa, Ghana and Australia. As at the end of 2005, it employed 43 942 people (excluding contractors) across its operations, 94 per cent of which are residing in South Africa. Harmony Company has operations and projects in South Africa, Australia and Papua New Guinea. It employed 53 588 people (including contractors) at the end of June 2005, 95 per cent of which are residing in South Africa (Virtual Metals Research, 2006:28-30).

The rationale for choosing these three gold mines is that they produce the same commodity (gold), they are price-takers (price of gold is determined by global supply and demand market mechanisms), and they have well-established infrastructures for factors of production. In addition they are core members of the South African Chamber of Mines and Wage Bargaining Committee, are listed on the Johannesburg Stock Exchange and are the largest and ranked the top three gold producers in South Africa. Lastly, they are mostly stuck to the old conventional mining methods due to a narrow reef band with little change in the mining process in the direction of mechanisation (Pickering 2007:557). Overall, they are homogeneous in the way they operate.
6.4.3 Sampling frame

The sampling frame is the actual list of sampling units, elements, objects or materials from which the sample is actually drawn (Heng, Yeong, Siong, Shi, & Kuan 2011:25). Although the sampling frame should ideally include all members of the target population, it is not always practically possible for various reasons; for example, the target population might be out-dated. According to Turner (2003:4) a perfect sample frame is one that is complete, accurate and up-to-date.

The sampling frame consists of all employees at management levels of AngloGold Ashanti, Goldfields and Harmony. The sample of the study was drawn from three levels of management; lower, middle and top as well as from professionals. The sample frame is shown in Table 6.1 that provides the demographic composition of the respondents.

Table 6.1: Sampling frame

<table>
<thead>
<tr>
<th>Sample Frame</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisors and Foremen</td>
<td>204</td>
</tr>
<tr>
<td>Middle management</td>
<td>61</td>
</tr>
<tr>
<td>Top management</td>
<td>1</td>
</tr>
<tr>
<td>Professionals</td>
<td>33</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

Table 6.1 indicates that out of 300 people that completed the questionnaires, two hundred and four (n = 204) respondents were drawn from supervisors, sixty one (n = 61) respondents from middle management, one from top management, thirty three (n = 33) from professionals and one from other. A total of 343 questionnaires were administered in person to the respondents and only 300 were usable. Caution was taken that all members of the target population were covered by the frame, members participate once and only once and that they were currently employed in those mines.
A sample is the representative part of the population involved in a study. The process of selecting the sample is called sampling (Yount 2006:7-1). Sampling is the act, process, or technique of selecting a suitable sample or a representative part of a population and the conclusions from the sample may be extended to that about the entire population within the limits of error (Bryman 2001:85). The advantage of using sampling instead of census is that: the costs of sampling are much lower than that on census, sampling possesses the possibility of better testing, more thorough investigation of missing, wrong, or suspicious information, better supervision, and better processing than is possible with complete coverage, and sampling saves time.

Although the intention of the study is to obtain information about the population, it is usually too expensive and time consuming to question everyone. Zikmund (2003) pointed out that the choice of the target population of the sample is important for the study because of constraints of time and budget in conducting the academic research. Tseng (2010:85) stressed that collecting data from every member of the target population is neither feasible nor practical. As a result, a conclusion was made that it is not necessary to question all the workers but devise some way of selecting a representative sample.

6.4.4 Selection of sampling method

There are various methods meant to collect information, ranging from the experimental designs used in the physical sciences through to the surveys more common in the social sciences. The survey as the method of gathering information in this study also involves a choice of sample subject, to whom the questionnaire would be directed.

Sampling theory also distinguishes between probability and non-probability sampling (Bryman 2001:88-99). When using probability sampling, every element in the population has an equal chance of being included in the sample. Probability sampling includes techniques that select samples through the concept of random selection. The requirements for probability sampling are that each element must have a known mathematical chance of being selected and that chance must be greater than zero and
numerically calculable (Turner 2003:2-3). The probability method includes simple random, stratified, and systematic and cluster sampling methods. In contrast, when using non-probability every element in the population does not have an equal chance of being included in the sample. The probability of a manager’s participation in this survey is unknown. The non-probability method includes purpose, quota and judgment sampling methods.

As stated in Chapter one, the sample method used in this research study is a purposeful (non-probability) sampling method. Gray (2004:404) and Babbie (1998:195) indicated that in certain instances it is appropriate for a researcher to select a sample on the basis of knowledge of the population, its elements, and subjective judgement, as well as the purpose of the study. This sampling selection process is called purposeful sampling. Subsequently, the study could use only those respondents who are at management level, literate and able to read and understand the questions posed to them, as a sample. According to David and Sutton (2004:152), it is also possible for a researcher to study a small subset of a larger population in which many members of the subsets are easily identified, and would suffice for general comparative purposes. This was done, for example, by exploring management’s perception regarding skills shortages and its impact on the research outcomes. The views of these miners may be inferred as the opinion upheld throughout the industry or by the entire population. Even if it were possible, it is not necessary to collect data from everyone in mining in order to get valid findings. According to Gray (2004:83) a typical human trait is to generalise from limited information or experiences.

6.4.5 Sampling size

According to Bartlett, Kotrlik and Higgins (2001:43), the criticisms of business research regarding the sampling methods, state that the most common flaws of sampling is the disregarding of sampling error, response rate and bias when determining sample size. Heng et al. (2011:27) referred to sampling size as the acceptable number of elements that must be included in the study. It must be noted that the precision of sample estimates depends very much on sample size and not on the size of the population.
sampled. Thus, with the bigger sampling size one can reduce sampling error and estimate more accurately the actual population parameters than small sampling size. Proctor, Allan and Lacey (2010) stated that in quantitative research the size of the sample should be calculated at the planning stage of the research. There are many formal equations to assist in this regard, details of which will not be given here. There are three fundamental approaches that must be considered when calculating the sample size, which is:

- The level of precision: The basic issues of this variable are either precision or margin of error. The higher the level of precision specified in advance, the larger would be the sample size needed;
- The level of confidence and adequate probability of detecting a given magnitude of effect: This variable would need specification of the significance level, power and target difference. One used for this study is the significance level of more than 7% alpha and the sample size necessary to achieve it is calculated accordingly; and
- The degree of variability in the attributes being measured: A calculated target difference is specified, beyond which the researcher would no longer accept the results as equivalent.

Sample size depends also on the target population that the survey will cover. The researcher planned to use a seven-point scale as the primary instrument to measure continuous variables. Bartlett et al. (2001:44) contended that the use of demography as the primary variable would result in a substantially larger sample size than if the researcher used the seven-point scale as the primary variable of measure.

Van Voorhis and Morgan (2007:48) estimated sampling size with this equation model; \( n = 50 + 8(m) \), which "m" is the number of independent variables. This study has four independent variables: the working environment, employment conditions, resources and education and training and thus \( m \) is equal to 4. So that, \( n = 50 + 8(4) = 82 \), which means that at least 82 respondents must be targeted. However, 343 questionnaires were distributed, with 300 found to be usable. According to Williams,
Onsman and Brown (2010:4) citing Van Voorhis and Morgan (2007:49) and Tabachnick and Fidell (2007), a sample size of 300 is considered to be good for factor analysis and a minimum of around 150 participants is required to get a reliable solution.

A key requirement in this regard was to aim for homogeneity in the sample, since more variance would necessitate larger samples. An economic approach that would meet the requirements for internal and external validity as suggested by Thiétart (2001:164) is to do a small sample first and test for significance, thereafter, follow up with more small samples, as long as either location or population changes.

6.5 DATA COLLECTION

The main prerequisite of data collection for this study was to investigate, analyse, evaluate and provide useful insight into key aspects related to skills shortages and to provide useful strategies to build human capacity in gold mines. This information should enable the researcher to identify the state of existing management practices; planning processes; management deficiencies; knowledge and competencies of management with respect to the requirements of the comprehensive, practical and integrated management methods to arrive at meaningful judgements and conclusions in respect of building human capacity in gold mines. The concept of data collection simply refers to how the researcher obtains data to be used to find solutions to the problem statement or answer the research questions of this study. This section highlights the kind of data used in this study, followed by the discussion, testing and measurement of the data collection instrument. This study is designed to take into account both the primary and secondary data collecting methods to produce a holistic and balanced view of the problem being studied.

6.5.1 Secondary data

When undertaking a research project, one of the first considerations to be faced by the researcher is the existing body of knowledge in a particular field. This was used as a source of reference of research previously conducted in the field of human capacity, as well as a source of the body of theory which pertains to the skills shortage area. The
rationale for employing a literature study is to incorporate and embed the researcher’s study into the body of knowledge that is relevant to the research problem being addressed (Marrelli, 2005:43). The approach of collecting secondary data for this thesis was to conduct a thorough literature search in monographs, journals, manuals, magazines, Internet, dissertations and theses of previous theoretical works that particularly address the problem of skills shortages. Randolph (2009:2) argued that the literature review has a role to play in:

- delimiting the research problem; this was identified in Chapters 2, 3 and 4;
- seeking new lines of inquiry and demonstrate that the knowledge of the chosen area is up-to-date; this was described in Chapters 2, 3 and 4;
- avoiding fruitless approaches and identify relationships between ideas and practices, as was shown in Chapter 5;
- gaining methodological insights of the strengths and weaknesses of previous work including omissions or bias taking these into account in the discussions; this is discussed in Chapters 6 and 7; and
- identifying recommendations for further research; as identified in chapter 8.

The literature review is important for this study in that, firstly, it serves as a map of the research terrain, which shows the route other researchers have “travelled”. Secondly, it provides guidelines on the design of the researcher’s project. Finally, it yields various kinds of resources, such as explanations and definitions of key concepts. The researcher critically appraised the literature for the purpose of detecting a link between the current study and the accumulated knowledge in the field of this research (Sefularo 2007:14).

6.5.2 Primary data

The survey method was chosen as a research technique in this study to gather primary data about the management perception of skills shortage in South African gold mines. Zikmund (2000:58) defined primary data as data gathered and assembled specifically for the project at hand. Primary data was collected by means of a survey using self-
administered questionnaires. A survey is a means of collecting data about the characteristics, actions, or opinions of a large group of people (Kasunic 2005:1). As such, there are many data collection and measurement processes that are called surveys, marketing surveys, opinion surveys, and political polls to name some of the most common. Almost everyone has had experience with surveys. Market surveys ask respondents whether they recognize products and their feelings about them. Opinion polls use survey methods to identify the needs of groups. Evaluations often use surveys to assess the extent to which programs achieve their goals. Political polls ask questions about candidates for political office or opinions related to political and social issues (Bethlehem 2009:20).

6.5.3 Procedure for research permission
An initial letter, accompanied by a questionnaire, outlining the research project and intention of the questionnaire was handed to the Senior Human Resource Manager of various mines in person. The researcher and manager agreed on the time and date in which permission could be obtained from the management regarding the research project. The location, time and distribution of questionnaires were agreed upon between the researcher and Human Resource Manager. In accordance with the research plan in Chapter One, primary data in the present research was collected with aid of a questionnaire.

6.5.4 Questionnaire as data collecting method
The use of questionnaires often seems a logical and convenient option of collecting information from respondents, it is however relatively difficult to design a questionnaire that would ensure high response rate. The response rate invariably is problematic in terms of the completion of questionnaires. Other than those that were distributed through the network mail, most of the questionnaires were handed to respondents personally. Gray (2004:187) and Buckingham and Saunders (2004:294) mentioned that a questionnaire is a research data collecting instrument through which people are asked to respond to the same set of written questions in a predetermined order. Questionnaires are a cost-effective way of collecting data from a large number of widely
dispersed participants that cannot be reached through personal interviews. Although the information generated by a questionnaire is limited, it is still very useful to initially gain information and then follow it up by making use of an interview to gain clarity on some issues pertaining to the responses from the questionnaire (Koshy 2005:87).

There are three main reasons why a questionnaire was used in this research study. According to Bryman (2001:438-439) the main reasons are:

- its flexibility features allows the investigator to adapt and make changes to the study where and when necessary;
- it allows the investigator to have some idea of the relative frequency of the impact, such as frequency of certain incidents, words and phrases that form a theme or impact; and
- it would give the reader guidance as to the frequency of the issue to which the anecdote refers.

For the purposes of this research, the questionnaire was used to gather the necessary information. This method of data collection was utilised in order to overcome issues of cost and time. In an attempt to make it beneficial for both the researcher and the mines, and so as not to disrupt operations at the mines, the mines’ Human Resource Department distributed the questionnaires through the internal mailing system in an attempt to ensure that the respondents would receive the documents in the shortest possible time.

6.5.5 Questionnaire design

When designing a questionnaire, it is very important that it reflects the research problem and overall plan of the study. Thus, a questionnaire was designed to gather information in order to find a solution to the problem statement and within the specified research framework.

A questionnaire may be defined as a list of structured questions chosen after testing, with the view of eliciting reliable responses from a chosen sample (Ludidi 2009:5). The
aim of the questionnaire used in this study was to find out what a selected group of
participants do, think or feel about the impact of skills shortages on the organisational
performances.

A questionnaire has a combination of closed and open-ended questions. Closed-ended
questions limit the respondents in that they all answer the same questions or are
provided with the same options of answers in which the most appropriate answer would
be selected. A Likert-type scale was used, where respondents were requested to
indicate how strongly they agreed or disagreed with each statement on the Likert scale
of 1 (strongly disagree) to 7 (strongly agree). In total, 55 items were used to measure
the four items that influence skills shortage and 21 items used to measure the impact of
skills shortage on performance outcomes. On the other hand, should the researcher not
want to limit the respondents to a specific set of answers, and would like to explore new
phenomena, open-ended questions would be appropriate.

However, in order to quantify certain opinions and analyse the extent of a phenomena
using a seven-point Likert scale, only closed-ended questions were used for the current
study. A self-administered questionnaire consisting of five sections as outlined in the
following sub-sections was used:

- Section A entailed general perceptions regarding factors influencing skills
  shortage, that is: workplace environment, employment conditions, resources and
  level of education in the mining industry.
- Section B was designed to obtain information relating to management perceptions
  in respect of skills shortages in the mining industry.
- Section C focuses on skills levels in mining occupations.
- Section D concentrates on the impact of skills shortages on performance
  outcomes, and
- Section E elicits biographical information of the respondents.
An instrument is thoroughly tested before being utilised in the laboratory, likewise, a good questionnaire should have be tested before being used in the fieldwork and this is done through pilot testing.

6.5.6 The pilot study

Cucerzan (2006:4) believed that in most cases researchers are so closely focused and absorbed with the research project that they overlook the errors that are linked to the construction of the questionnaire. Pilot testing allows a researcher the opportunity to correct errors and to redesign problematic elements of the questionnaire before the main study is conducted. The pilot study is an important activity in the development of the questionnaire and it is intended to explore areas of the instrument that need more development and refinement (Kumar 2005:10).

In this study, the pilot study was conducted on a small sample (10%) of the actual sample size in the same manner as the main study. The purpose of a pilot study was summarised by Welman et al. (2005:148) as to:

- give the researcher the opportunity of testing whether the respondents understand the questions in the same way, whether all questions are relevant and if all the instructions are clear.
- identify flaws in the questionnaire, such as the length and structure of the questionnaire that would determine the time required by a respondent to complete the questionnaire, and
- pre-test validity and reliability of the questionnaire to identify and rectify problem areas.

Thirty one respondents were chosen in the same manner as the subjects for the main study. The pilot participants were briefed beforehand to check for problems with the questionnaire and issues concerning it as the structure and content of the questionnaire would be amended accordingly. The researcher used the data collected in the pilot study to generate mock data for 350 participants in order to run a trial test on the
selected method of data analysis. Care was taken that the participants in the pilot study would be excluded from the main study and that details of the study were not passed on to the main study participants.

There were various ways in which the researcher checked the instrument. Firstly, the researcher read the questionnaire over and over to identify any uncertain and vague questions. Secondly, after the pre-check, a trial run of a questionnaire was conducted, with thirty one supervisors and middle managers approached to take part. The pilot study was meant to determine whether the data collection instrument is appropriate, easy to understand and easy to complete. The pilot study indicated that changes need to be done to the questionnaire, as result, it was revised.

In this study, the following three steps were undertaken:

- the questionnaire was circulated to the promoters and three peers in the human resources field, who were requested to make recommendation for amendments in the layout, contents and instructions;
- the questionnaire was then pilot tested on a representative sample of 31 lower and middle managers. Respondents were asked to complete the questionnaire based on their experiences; a five-point Likert scale measurement was used. Based on the feedback obtained from the respondents the necessary changes were made to the questionnaire; and
- a statistician’s assessment of the feasibility of the questionnaire design was obtained.

The pre-test feedback indicated that some of the respondents were not willing to divulge their age and educational levels. The respondents did not understand some of the concepts and questions in the questionnaire and this resulted in the researcher providing an explanatory note to some questions. Furthermore, the arrangements of some of the questions were faulty. The result of the pre-test, consequently, led to some amendments of which the notable one was the move from the five-point Likert-scale to
the seven-point scale questionnaire. This was because the South African miners were generally more conservative and were quite reluctant to express their attitudes and feelings on critical issues.

6.6 CRITERIA FOR EVALUATING THE INSTRUMENT

The most important consideration in the design and administration of a questionnaire is that it must consistently measure accurately what it is designed to measure and the results obtained must be valuable and relevant to the population studied. When considering the accuracy of the data obtained from a questionnaire, it is necessary that the questionnaire consistently measure what it is intended to measure when properly administered; meaning it must be valid and reliable (Radhakrishna 2007).

6.6.1 Reliability

Reliability is the term used to validate the use of a data collecting instrument in that the truth of the findings has been established by ensuring that it is supported by sufficient and compelling evidence. According to Parahoo (2006) reliability is a necessary, but not sufficient condition for validity. In qualitative research, it refers specifically to a measurement repeatedly giving the same result under the same conditions. In quantitative research, reliability is a matter of whether a particular technique, applied repeatedly to the same object, would yield the same result each time. However, reliability does not ensure accuracy any more than precision ensures it (Somekh & Lewin 2005:348-349). According to Polit and Beck (2010) reliability for quantitative research focuses mainly on stability and consistency.

(a) Stability

The stability of a questionnaire is the degree to which it produces similar results on being administered twice. As recommended by Polit and Beck (2010) the researcher proposes doing a stability test using the test-retest method on a small population. The questionnaire will be administered on two occasions, two weeks apart and the results compared. A reliability coefficient will be calculated on the two sets of data for each part of the questionnaire. Reliability coefficients range from 0.00 to 1.00, with higher values
indicating greater reliability. According to Jones and Rattray (2010) good reliability is indicated by a coefficient > 0.8, thus the researcher attempted to achieve a reliability of this level or greater.

**(b) Consistency**

Reliability of the instrument responses towards the dependent variable is established by determining the consistency with which responses are made on the dependent variable. The thought of questions measuring the same concept is checked by its internal consistency (Jones & Rattray 2010) by splitting the data from the questionnaire into equal halves and then checked for similarity. Consistency will be checked by Cronbach’s alpha as described by Polit and Beck (2010). Cronbach’s alpha ranges in value between 0.00 and 1.00 and if a value of 0.7 or higher is obtained, reliability would be acceptable for this study. Coefficient Alpha compares the sum of the variances for each item with the total variance for all items taken together. If there is high internal consistency, coefficient alpha produces a strong positive correlation coefficient (Welman & Kruger 2001:141).

According to Robson (2002:231), the reliability of responses can also be proved if all respondents are presented with the same structured questions that are carefully worded, after piloting.

**6.6.2 Validity**

Validity is the extent to which the research instrument actually measures what it is intended to measure (Burton & Mazerolle 2011:28 and Kumar 2005:153). O’Leary (2004:61) further elaborated that validity is constructed on the assumption that what was being studied can be measured or captured, it seeks to confirm the truth and accuracy of any findings or conclusions drawn from the data, indicates that the conclusions drawn were trustworthy and indicates that the methods warrant the conclusions. There are two objectives of validity that are meant for this study. Firstly, the discussion about validity would illustrate that the design of a research study was a good test of the hypothesis or appropriate to answer the research question. Secondly,
the discussion about validity would illustrate whether or not research findings can be
generalised beyond the immediate study sample and setting (Twycross & Shields
2004:28). There are numerous yardsticks for determining validity, and they are face,
content and construct validity (Somekh & Lewin 2005:348-349). Validity of the
instrument was assessed with face, content and construct validity.

- **Face validity**: Face validity basically checks whether the questionnaire really
measures the concept being tested (Lobiondo-Wood & Haber 2010) and this was
assessed by getting colleagues to test-run the instrument to see if the questions
appear to be relevant, clear and unambiguous as outlined by Jones and Rattray
(2010).

- **Content validity**: Assessment of the content validity test is meant to check whether
there are enough relevant questions covering all aspects being studied and that
irrelevant questions are not asked (Parahoo 2006). The test is based on judgement
as no objective method exists. A panel of experts (statistician and promoters) were
used to evaluate the content validity of the questionnaire of this study (Polit & Beck
2010).

- **Construct validity**: Evaluation of construct validity is meant to establish the relation
of a variable to other variables with which it may correlate positively, negatively, or
not at all, as well as the relative magnitude of those correlations. It is mostly used
where measures of individual differences of hypothesised constructs are the end
results of the study (Westen & Rosenthal 2003:608).

Construct validity is the heart of this study because if a test lacks construct validity,
results obtained using this test or procedure would be difficult to interpret and cannot be
generalised further (Westen & Rosenthal 2003:608). Generally, construct validity is
established when correlations between a construct and other measures that should be
associated with it (convergent validity) or vary independently of it (discriminant validity)
is assessed (Burton & Mazerolle 2011:34). Convergent validity is used to assess the
degree of association to which two or more survey measures that theoretically are
deemed to measure the same construct are in fact observed to be related to each other.
In contrast, discriminant validity is used to evaluate the degree of association to which
two or more measures that conceptually are deemed to be different are in fact observed
not to be related to each other. Construct validity was done by multi-factor analysis. The multi-factor analysis identifies: that there are multiple dimensions underlying the seven-point scale of the questionnaire; and that items that were not associated with identified factors were eliminated from the measure because they were irrelevant (Fan & Lê 2011:370).

6.7 DATA ANALYSIS

After data have been collected, the onus is on the investigator to make sure that the data capturing process is quality controlled and prepared for the actual data analysis.

6.7.1 Preparing data for analysis

Following the task of collecting data, the researcher gets the opportunity of finding the answers to the research questions. If the data do not provide answers to the questions, that by itself presents an opportunity for creativity or finding out what is amiss with the data. Before investing significant time in analysis, a considerable amount of preparatory work of review and data cleaning is performed in order to evaluate the impact of missing values in the completed questionnaire.

6.7.1.1 Missing data

Missing data is one of the persistent problems in a quantitative data analysis, and its direct impact is that it reduces the sample size available for analysis, in turn, potentially damaging the validity of a statistical analysis (Enders 2010:2). Indirectly, any statistical results based on data analysis with missing data could be biased, leading to erroneous results (Dhladhla 2011:56). According to Acock (2005:1012), there are several classifications of missing values; three are relevant for this study, that is:

- **Missing completely at random**: Individuals in a minority group, people with high incomes or those with little education are less likely to answer every item in the questionnaire.
- **Missing at random**: Individual working in a dangerous environment is less likely to answer all questions regarding the safety issues in the working place.
• Non-ignorable missing value: Individuals with low education are most likely to score less in questions requiring the use of academic acumen.

In this study, missing values may have occurred due to respondents' refusal to answer survey questions, skipped questions, illegible responses or some questions might be irrelevant to some respondents. It is common for studies to have missing data and some precautionary measures were prescribed in the planning stage of the study in order to minimise missing values. It was decided to remove partially filled questionnaires. The analysis databases included 300 usable questionnaires from the initial response of 343 questionnaires.

6.7.1.2 Cleaning of data
In addition to visual checks done in the data file, the data was further subjected to a series of computer checks after being imported into STATISTICA (version 10) for analysis. A complete data cleaning was done by the computer, as it is quicker and less prone to errors in picking up inaccuracies and inconsistencies than human editing. The data was cleaned using a median replacement for zero entries in sections A, B and D (Seven-point Likert scale) and not for section C and E (categorical variables) since the program indicated a large volume of missing data. The main reason was that it is not feasible to use median replacement for the categorical variables since these variables would be used further in ANOVA.

6.7.1.3 Reduction of data
The systematic relation and correlation among the exogenous and endogenous variables were projected roughly at the initial stage of this project. The confirmation of this projection became complicated when a large number of scores were collected and the researcher could not make sense of these scores. The researcher had to reduce the information to a more manageable amount of data by organising the raw data into a distribution of scores, such as central tendency and dispersion. In the current study, the collected data were reduced through descriptive summaries such as the mean and
standard deviation or correlation or graphical representation such as charts and histograms.

An explanation of how a decision was made by evaluating more than hundred separate characteristics or develop an action plan of these separate characteristics has been a concerned issue of validity and reliability. The main goal of reducing data in this study was to aggregate the information contained in large data sets into a manageable number of common underlying dimensions for modelling purposes and justifying the few hypothesis tests administered, a process known as factor analysis. It involves summarising the information contained in a number of original variables into a smaller set of dimensions with a minimum loss of information. The scores of 300 people are cumbersome to handle, descriptively or analytically. The management, analysis, and understanding of such data are facilitated by reducing them to their common characteristics or properties.

Once invalid questionnaires were sorted out, data were coded, computed, and analysed using the STATISTICA (version 10). According to Partington (2002:101-102) quantitative research analysis involves the numerical analysis of data through simple production of tables, charts and graphs to more advanced multivariate statistics. A brief discussion of data analysis is outlined in the following three paragraphs.

Firstly, a simplified description of some phenomenon would be facilitated by using numbers by means of descriptive statistics such as the mean, mode, median and standard deviation and frequencies. Secondly, statistical comparison of data between the dependent and independent variables would be made. Thirdly, the inferences objective would be embedded in the multiple regression analysis. Therefore, data analysis is an integrated part of the research design that is aimed at managing the collected data, making sense of the evidence and presenting the results in an understandable manner (Ritchie & Lewis 2005:219 and Parahoo 2006:375).
6.7.2 Descriptive statistics analysis

The study uses an information-extraction model whereby the researcher assumes the active role of question-asker with the use of a questionnaire. The data on the four dependent variables (outcomes) included in the model were collected. The relationships between the variables are analysed in chapter seven to test the weakness and strength of the model. The data collected include:

- **Performance**: quantifying financial returns, productivity, efficiency, effectiveness;
- **Competitive advantage**: identifying the factor staff competency and excellence, value creation, cost effectiveness and technological support;
- **Propensity to leave**: quantifying the risk of attracting, developing and retaining skilled employees; and
- **Sustainability**: quantifying the financial, environmental and social risk of mining operations.

Descriptive statistics include the numbers, tables, charts, and graphs used to describe, organise, summarise, and present the raw data. Descriptive statistics are most often used to examine:

- **Central tendency of data**: where data tend to fall, as measured by the mean, median, and mode.
- **Dispersion of data**: how spread out the data are, as measured by the variance and its square root, the standard deviation.
- **Skewness of data**: how concentrated data are at the low or high end of the scale, as measured by the skew index.
- **Kurtosis of data**: how concentrated data are around a single value, as measured by the kurtosis index.

Any description of a data set should include examination of the above. Descriptive analysis was carried out on the data collected with the use of numbers. Thus, the reply to each question of Sections A, B and D of the questionnaire were coded using
numbers on an ordinal scale of 1 to 7. Numbers on an ordinal scale were in descending order, with 7 denoting strongly agree and 1 for strongly disagree. The reply to each question of Sections A, B, C, D and E of the questionnaire was coded using numbers and arranged and organised in a database summary. The services of a statistician were used to input the data from the database directly to the computer package STATISTICA (version 10) and to analyse the data. The computer described the data (cf. Chapter Seven) using frequency in the form of a percentage to be illustrated by tables and figures. Secondly, the computer calculated central tendency in the form of mean response and normal distribution for Sections A, B, and D, while frequency percentages were calculated in the case of Sections C and E. At the end, the researcher would check the format and relevance of the tables, graphs and charts provided by the computer analysis.

In data analysis, descriptive statistics was used to describe the basic features and gain an initial impression of the data collected. Descriptive statistics were calculated from research data (n = 300) for the demographical (Table 6.2) and level of skills (Table 6.3). The report is followed by a brief description of the most noticeable sample characteristics. The purpose of including these demographical characteristics is to provide an overall profile of the respondents.

Table 6.2: Demographical representation of respondents

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Range</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21-30</td>
<td>42</td>
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</tr>
<tr>
<td></td>
<td>31-40</td>
<td>94</td>
<td>31.33</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>104</td>
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</tr>
<tr>
<td></td>
<td>51-60</td>
<td>56</td>
<td>18.67</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>4</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>300</td>
<td>100</td>
</tr>
</tbody>
</table>

<p>| Gender       | Female  | 37     | 12.34      |
|              | Male    | 262    | 87.33      |
|              | Missing | 1      | 0.33       |
|              | TOTAL   | 300    | 100        |</p>
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</tr>
<tr>
<td></td>
<td>Indian</td>
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<td></td>
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<td>0</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td>300</td>
<td>100.00</td>
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<table>
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</tr>
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<td>Diploma/ National cert.</td>
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<td></td>
<td>Post graduate degree</td>
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<td>Other</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
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<td>300</td>
<td>100.00</td>
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<table>
<thead>
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<th>Position in organisation</th>
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<th>68.00</th>
</tr>
</thead>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>Professional</td>
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<td>11.00</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>300</td>
<td>100.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of Current employment</th>
<th>1-5 years</th>
<th>68</th>
<th>22.67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6-10 years</td>
<td>93</td>
<td>31.00</td>
</tr>
<tr>
<td></td>
<td>11-15 years</td>
<td>48</td>
<td>16.00</td>
</tr>
<tr>
<td></td>
<td>16-20 years</td>
<td>29</td>
<td>9.66</td>
</tr>
<tr>
<td></td>
<td>21 years+</td>
<td>62</td>
<td>20.67</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>300</td>
<td>100.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Employment size</th>
<th>1-5000</th>
<th>48</th>
<th>16.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 001-10 000</td>
<td>144</td>
<td>48.00</td>
</tr>
<tr>
<td></td>
<td>10 001-15 000</td>
<td>89</td>
<td>29.67</td>
</tr>
<tr>
<td></td>
<td>15 001-20 000</td>
<td>15</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>20 001+</td>
<td>4</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>Blank</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>300</td>
<td>100.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years in existence</th>
<th>1-5 years</th>
<th>24</th>
<th>8.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6-10 years</td>
<td>43</td>
<td>14.33</td>
</tr>
<tr>
<td></td>
<td>11-15 years</td>
<td>24</td>
<td>8.00</td>
</tr>
<tr>
<td></td>
<td>16 years+</td>
<td>208</td>
<td>69.34</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>300</td>
<td>100.00</td>
</tr>
</tbody>
</table>

| Level of monthly income     | Less than R5 000 | 15   | 5.00  |
Table 6.2 indicates that twelve (12%) of respondents are female and most (53.34%) of them are in the age group of 41-60. Seventy (70%) of respondents are Africans, while fifty six (56 %) per cent have either completed their Grade 12 or lower. Sixty eight (68%) per cent of the respondents were supervisors, while one person falling in the category of top management completed a questionnaire. Fifty four per cent (54%) of the respondents have been employed in their current position between 1 and 10 years, while 21% of them have been with their organisation for more than 21 years. Forty eight per cent of respondents are working in an organisation with an employment size of 5001 to 10 000, while sixty nine per cent (69%) of people that completed questionnaires were with an organisation that has been in existence for more than 16 years. Lastly, the table also show that thirty eight (38%) per cent of respondents are earning less than R15 000, while 35% of the total respondents earn more than R20 000. Table 6.3 shows the frequency distribution results of skills per occupational category from the designated sample.

Table 6.3: Level of skills in the gold mining sector

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Skilled</th>
<th></th>
<th>Semi-skilled</th>
<th></th>
<th>Unskilled</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Drillers</td>
<td>80</td>
<td>26.67</td>
<td>84</td>
<td>28.00</td>
<td>136</td>
<td>45.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Miners</td>
<td>87</td>
<td>29.00</td>
<td>192</td>
<td>64.00</td>
<td>21</td>
<td>7.00</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Administrative Staff</td>
<td>83</td>
<td>27.67</td>
<td>152</td>
<td>50.67</td>
<td>65</td>
<td>21.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Artisans</td>
<td>163</td>
<td>54.34</td>
<td>130</td>
<td>43.33</td>
<td>7</td>
<td>2.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Technicians</td>
<td>205</td>
<td>68.34</td>
<td>88</td>
<td>29.33</td>
<td>7</td>
<td>2.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Engineers</td>
<td>262</td>
<td>87.33</td>
<td>30</td>
<td>10.33</td>
<td>8</td>
<td>2.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Professionals</td>
<td>244</td>
<td>81.33</td>
<td>42</td>
<td>14.33</td>
<td>14</td>
<td>4.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Managers</td>
<td>227</td>
<td>75.67</td>
<td>55</td>
<td>18.33</td>
<td>18</td>
<td>6.00</td>
<td>300</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 6.3 indicates that the majority of respondents (45.33%) claimed that Rock Drill Operators (RDO's) are classified as unskilled, sixty four per cent (64%) of them believed that miners are semi-skilled, about fifty one per cent (50.67%) claimed that administrative staff are semi-skilled. The majority of respondents believe that artisans (54.34 %), technicians (68.34%), engineers (87.33%), professionals (81.33%) and managers (75.67%) are classified as skilled personnel.

6.7.3 Factor and multiple regression analyses

The means to analyse the cause-effect relationship between independent and research outcomes (dependent variables) are factor (Huh 2002:25), and multiple regression analyses. These statistical techniques were used according to the respective objectives of this study.

A factor analysis was conducted to create correlated variable composites from the original 75 attributes and then reduced to a smaller set of dimensions or factors that explained the variances between the attributes. The derived smaller factor scores were then applied in subsequent regression analyses. Factors that were retained were only those that had values greater than or equal to 1.0 of Eigen value and a factor loading greater than 0.5. Multiple regression analysis was used to examine managements' overall levels of satisfaction with the skills shortage destination. The dependent variables (performance, competitive advantage, propensity to leave and sustainability destination) were regressed against each of the factor scores of the independent variables (working environment, employment conditions, availability of resources and education and training).

Tests of significance was designed in order to apply theory to sample data and then make judgements as to whether characteristics, differences or relationships found in the sample can be expected to have occurred naturally or by chance in the population from which the sample was drawn (Blaikie 2001:207).
6.6.4 Inferential statistics analysis

The issue of drawing inferences from the collected data and critical reviewing of statistical inferences from research studies is a common feature in everyday life. According to Zieffler, Garfield, Delmas and Reading, (2008:41) statistical inference may be defined in terms of determining a pattern distribution of the data as attributed to the real effect of the outcomes, and to determine whether a relationship exists between different sets of statistical results and generalisation from a small sample to the population.

Inferential data analysis was done once enough data was gathered for hypothesis testing. Usually, this data, as in this study, required statistical formulations to analyse a set of numerical data. Generally, throughout the discussion above, the true value of a population was not known, and with the samples selected, attempts were made to find the true value of the population. Thus, with the constructed hypotheses, the true value of the variables was identified. The major purpose of hypothesis testing was to choose between two null and alternate hypotheses about the value of a population. The null hypothesis was the one tested and assumed to be true unless strong evidence appeared to the contrary. Mathematically, the null hypothesis would be denoted by an equal sign, while alternate would be less or greater than sign, as shown below.

\[ H_0: \mu = 100, \quad \text{and} \]
\[ H_A: \mu \neq 100 \]

In summary, there would be eight hypotheses that will be tested in this study. The first four hypotheses were developed to test the influence of four independent variables (working environment, employment conditions, resources, education and training) on skills shortages. The last four hypotheses were constructed to examine the effects of the mediating variable (skills shortages) on organisational outcomes (performance, propensity to leave, competitive advantage and sustainability).

A number of correlations were calculated for testing the relationship between the criterion and predictors. With correlation coefficients, the intensity and direction of the association was evaluated against significant effect \( p \leq 0.001 \) and Pearson's
correlation test ($\alpha = 0.05$) to be considered statistically significant. The direction of the correlation may range from -1.0 for negative relationships, through 0.0 to +1.0 for positive relationships. The data analysis records will be stored on a computer data-base and would always be available on request, and the completed questionnaires will be stored in a secured place as this is vital for both back-up and security reasons.

6.8 CONCLUSION

In this chapter the problem statement and research methodology used in this study were examined. The first section discussed the research paradigm within which the study was undertaken. The distinction was made between the quantitative and qualitative research approach. Furthermore, the rationale for choosing certain quantitative methods, techniques and instruments used in research design, data collection and statistical analysis were discussed. It is imperative for a researcher to design a methodology for the problem chosen; because, even if the method considered in two problems might be the same, the methodology may be different. The above description of the research philosophy directed the selection of an appropriate methodology, and the right choice of suitable instruments for data collection and analysis was made in order to satisfy the information needs of the current study.

The results of the data collected through the questionnaire would be presented and interpreted in Chapter 7. Furthermore, descriptive statistics and regression analysis would be used to examine the properties and characteristics of the data, followed by a detailed discussion.
CHAPTER SEVEN

DATA ANALYSIS AND INTERPRETATION OF THE EMPIRICAL RESULTS

7.1 INTRODUCTION

Chapter Six was devoted to research methodology and explaining how the research inquiry was carefully applied to provide meaningful and presentable evidence for addressing the research problem. A major element of the research methodology in chapter six was the construction and distribution of the reliable and valid questionnaire, targeting people working at various management levels in the gold mining industry. After completing the data collection stage in chapter six, the task of statistically analysing and interpreting all the information received has to be done and is presented in this chapter.

This chapter begins with precisely defining the hypotheses and model that the study is intended to test. Next, this research identifies nine clusters of items from the empirical results and subjecting these subsets of items to exploratory factor analysis. This involves choosing the methods to obtain the estimates of factor loading and examine the patterns of correlation or covariance. Lastly the discussion would be on how consistent the model is with the data to minimise the discrepancy between the hypotheses implied at the beginning of the study and the actual observed matrix.

7.2 REALISATION OF THE RESEARCH OBJECTIVES AND TESTING OF HYPOTHESES

The main goal of this chapter is two-fold; firstly, it reports and discusses the results in line with the questionnaire structure. The focus of the questionnaire was to collect data pertaining to management perception regarding skills shortage in respect of the following exogenous latent variables; working environment, employment conditions, availability of resources and education and training as well as the impact of these variables on organisational performance, competitive advantage, propensity to leave and sustainability. Secondly, it analyses data generated by the estimated statistical models in order to generate meaningful and presentable results.
It is more fitting to present again the proposed hypotheses and conceptual model to provide the correct context in which the testing and analysis is done in line with the objective of the study and the results are interpreted and credible conclusions may be drawn.

**First set of hypotheses: Influence of independent variables on skills shortage**

H0\(^1\): *The working environment does not influence perceptions regarding skills shortages in gold mines.*

H0\(^2\): *Employment conditions do not influence perceptions regarding skills shortages in gold mines.*

H0\(^3\): *Availability of resources does not influence perceptions regarding skills shortages in gold mines.*

H0\(^4\): *Education and training do not influence perceptions regarding skills shortages in gold mines.*

**Second set of hypotheses: Impact of management perceptions regarding skills shortages on outcomes**

H0\(^5\): *Perceptions regarding skills shortages do not influence organisational performance in gold mines.*

H0\(^6\): *Perceptions regarding skills shortages do not influence propensity to leave in gold mines.*

H0\(^7\): *Perceptions regarding skills shortages do not influence the competitive advantage of gold mines.*

H0\(^8\): *Perceptions regarding skills shortages do not influence the sustainability of gold mines.*

After estimating a factor loading and examining patterns of correlation or covariance the next step would be to assess how well the theoretical model in Figure 7.1 matches the
observed data. A large class of omnibus tests exists for determining overall model fit (Albright & Park 2009:6).

**Figure 7.1: Theoretical model of management’s perceptions of skills shortage**

The prominent requirement for this mediating model is to establish the extent to which it illustrates and explains the mediating mechanism that underlies observed relationships between independent and dependent variables through the introduction of an explanatory variable (Hayes 2012:3). Figure 7.1 indicates that instead of hypothesising a direct causal relationship between the independent and dependent variables, the model is also aimed at describing and empirically quantifying the extent to which an independent variables influence some dependent variables through one mediator (skills shortage).

**7.3 DATA ANALYSIS RESULTS**

Theoretically, this research is aimed at studying the relationship between factors and a set of covariates to understand the outcomes measurement invariance so that the
findings may be generalised not only to the target population, but to other populations, across time and space. This illustrates the confirmatory nature of data analysis since it depends on the availability of hypotheses as patterns of relatedness (Schreiner & Schweizer 2011:4).

Data analysis of this study consists of five distinct phases and ordered as follows:

- **Descriptive statistics:** The basic features of the data collected, such as mean and standard deviations, are described. The raw data collected is ordered and organised so as to discover the variation in each independent variable of interest and verify the mediating role of management perception regarding skills shortage in organisational performance, competitive advantage, propensity to leave and sustainability.

- **Credibility of data collected:** The discussion is on the presentation of evidence that the manifest indicators are valid and reliable measures of the latent variables they are linked to. Thus, methods used to assess the validity and reliability of the instrument is reviewed.

- **Factor analysis:** In this section, patterns of correlation amongst the observed variables are summarised and reduction of numerous variable items to a few factors that would in turn assist in describing these factors in groups.

- **Regression analysis:** The discussion is on the employment of regression to firstly, estimate or predict the quantitative effect of the manifest variable upon the dependent variable that they influence and, secondly, determine the statistical significance of the estimated relationships.

- **Hypothesis testing:** A set of research hypotheses would be tested using outputs of the factor analysis. The hypothesis testing determines statistically whether or not the samples' outputs indeed support the hypothesised structure of loading about the population from which these samples were drawn. The inferences from the samples data to the population are made.
Table 7.1 provides the variables used of the study and the abbreviations used for each variable in the analysis of the results.

Table 7.1: Abbreviations of variables used in the study

<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE</td>
<td>Working Environment</td>
</tr>
<tr>
<td>EC</td>
<td>Employment conditions</td>
</tr>
<tr>
<td>RE</td>
<td>Resources</td>
</tr>
<tr>
<td>ET</td>
<td>Education and Training</td>
</tr>
<tr>
<td>SS</td>
<td>Skills Shortages</td>
</tr>
<tr>
<td>OP</td>
<td>Organisational performance</td>
</tr>
<tr>
<td>PL</td>
<td>Propensity to leave</td>
</tr>
<tr>
<td>CA</td>
<td>Competitive advantage</td>
</tr>
<tr>
<td>SU</td>
<td>Sustainability</td>
</tr>
</tbody>
</table>

The next section outlines the descriptive statistic results of the empirical study.

**7.4 DESCRIPTIVE STATISTICS AND FREQUENCY DISTRIBUTION RESULTS**

Analysis of quantitative data would be carried out using numbers to describe the properties of the data on an ordinal scale of 1 to 7. A frequency distribution is simply the collection of all ratings or scores of a particular item, and ordering them from the lowest (1) to the highest (7) value, with neutral response implied in between (4). There are two types of measures that descriptive statistics in this study is concerned with; central tendency (mean) and dispersion (standard deviation) as depicted in Table 7.2. Central tendency determines the centre in the sample’s data distribution while dispersion provides information about the distribution of values around the measures central tendency (Dhladhla 2011:58-60).

The descriptive statistic provides the summary of variables in the form of mean and standard deviation as shown in Table 7.2. Considering that in most cases, there is a
large number of items under each variable, not every single value listed is needed as this may constitute hundreds of values. This is the reason why it is presented in a summary form.

Table 7.2: Descriptive statistics for each factor

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE</td>
<td>4.66</td>
<td>1.089</td>
</tr>
<tr>
<td>EC</td>
<td>4.87</td>
<td>1.134</td>
</tr>
<tr>
<td>RE</td>
<td>4.47</td>
<td>1.144</td>
</tr>
<tr>
<td>ET</td>
<td>5.97</td>
<td>0.997</td>
</tr>
<tr>
<td>SS</td>
<td>4.57</td>
<td>1.296</td>
</tr>
<tr>
<td>PL</td>
<td>4.95</td>
<td>1.185</td>
</tr>
<tr>
<td>CA</td>
<td>4.84</td>
<td>1.293</td>
</tr>
<tr>
<td>SU</td>
<td>4.79</td>
<td>1.117</td>
</tr>
</tbody>
</table>

Table 7.2 summarised the scores for each of the research variables. For example, in the case of Education and Training (ET), the score obtained from 300 respondents shows a mean of 5.97 and standard deviation of 1.00. Overall, the variable scores are generally centrally distributed as all the scores are close to average (agree somewhat), except one variable (Resources), score which is average (neutral) with the mean value of 4.47. It also indicates that all the variables’ scores lie within ± 1 standard deviation from the mean. Table 7.3 outlines the frequency distribution results of levels of skills in the mining sector.
Table 7.3  Frequency distribution of level of skills per occupational category in the gold mining sector

<table>
<thead>
<tr>
<th></th>
<th>SKILLED</th>
<th></th>
<th>SEMI-SKILLED</th>
<th></th>
<th>UNSKILLED</th>
<th></th>
<th>TOTAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Drillers</td>
<td>80</td>
<td>26.67</td>
<td>84</td>
<td>28.00</td>
<td>136</td>
<td>45.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Miners</td>
<td>87</td>
<td>29.00</td>
<td>192</td>
<td>64.00</td>
<td>21</td>
<td>7.00</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Administrative Staff</td>
<td>83</td>
<td>27.67</td>
<td>152</td>
<td>50.67</td>
<td>65</td>
<td>21.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Artisans</td>
<td>163</td>
<td>54.34</td>
<td>130</td>
<td>43.33</td>
<td>7</td>
<td>2.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Technicians</td>
<td>205</td>
<td>68.34</td>
<td>88</td>
<td>29.33</td>
<td>7</td>
<td>2.33</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Engineers</td>
<td>262</td>
<td>87.33</td>
<td>30</td>
<td>10.33</td>
<td>8</td>
<td>2.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Professionals</td>
<td>244</td>
<td>81.33</td>
<td>42</td>
<td>14.33</td>
<td>14</td>
<td>4.67</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Managers</td>
<td>227</td>
<td>75.67</td>
<td>55</td>
<td>18.33</td>
<td>18</td>
<td>6.00</td>
<td>300</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 7.3 indicates that the majority of respondents (45%) claim that Rock Drill Operators (RDO’s) are classified as unskilled; sixty four per cent (64%) of them believed that miners are semi-skilled; fifty one per cent (51%) claimed that administrative staff are semi-skilled. The majority of respondents believe that artisans (54%), technicians (68%), engineers (87%), professionals (81%) and managers (76%) are classified as skilled personnel.

The following section describes the factor analysis results of the study.

7.5 EXPLORATORY FACTOR ANALYSIS

Factor analysis is used in this study to explore the data for patterns that would support hypothetical constructs mentioned at the beginning of the chapter. In order to create confidence on the operational measures of this study, factor analysis was deemed appropriate and had to be developed. However, since factor analysis is based on the correlation matrix of the variables involved, it performs much better with a large size of samples. The sample size of this study is 300 participants. According to Van Voorhis and Morgan (2007:49), citing Tabachnick and Fidell (2007), a sample size of 300 is considered to be good for factor analysis and a minimum of around 150 participants is required to get a reliable solution. Data was analysed using Microsoft Excel, STATISTICA (Version 10.0) and Analysis of Moments Structure (AMOS) Version 19.
According to Vinayan, Jayashree and Marthandan (2012:36) a cut-off point of 0.5 is recommended and in general the cut-off line of 3 items loading per factor were used as the threshold to ensure practical significance for further analysis and to confirm convergent validity as loadings greater than 0.4 is considered significant (Johari, Yahya & Omar 2011:140).

7.5.1 Perceptions of management towards working environment in gold mines
Table 7.4 indicates that eight of the ten items expected to measure 'working environment' (WE1, WE2, WE3, WE4, WE5, WE8, WE9 and WE10) loaded onto factor one (1). This means that respondents view 'working environment' as a single construct. Only two items (WE6, WE7) did not demonstrate sufficient convergent validity and was thus deleted.

<table>
<thead>
<tr>
<th>Working environment</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE1</td>
<td>0.529</td>
</tr>
<tr>
<td>WE2</td>
<td>0.736</td>
</tr>
<tr>
<td>WE3</td>
<td>0.682</td>
</tr>
<tr>
<td>WE4</td>
<td>0.550</td>
</tr>
<tr>
<td>WE5</td>
<td>0.564</td>
</tr>
<tr>
<td>WE6</td>
<td>0.085</td>
</tr>
<tr>
<td>WE7</td>
<td>0.468</td>
</tr>
<tr>
<td>WE8</td>
<td>0.527</td>
</tr>
<tr>
<td>WE9</td>
<td>0.615</td>
</tr>
<tr>
<td>WE10</td>
<td>0.667</td>
</tr>
</tbody>
</table>

Given a set of 10 items that are theorised to represent a working environment in Table 7.4, the low score in adequate rest room and cafeteria (WE6) as well as layout and placement of equipment (WE7) items, indicates that they are not strongly related to this variable. What it means is that respondents believed that these two items cannot make a notable contribution to the construct for influencing skills shortage in the gold mining industry. The mine layout is designed with the production and ventilation requirements in mind as changing its layout infrastructure after development is very costly and
nothing can be done about it. Table 7.4 also indicates that all other items are related and represent the view that environmental conditions do influence skills shortages (loadings greater than the 0.5 cut-off limit were considered significant). The factor loadings provide sufficient evidence of convergent validity as all the items loaded onto one factor with relatively high loadings.

Considering that mine health and safety issues are the main concerns of every mine employee, it is not surprising to find that WE2 obtained the highest score of 0.736. Respondents are of the view that health and safety issues are the main contributors to environmental conditions that would in turn influence skills shortage. A clear example is an overall wildcat strike that occurred during the months of August, September and October 2012, predominantly in platinum and gold mining sectors, whereby the miners felt that their occupations have high health and safety risks, and therefore need to be paid high wages. It is these kinds of relativities that need to change to provide potential miners to move to those mining sectors where their health and safety would be taken care of.

7.5.2 Perceptions of management towards the employment conditions in gold mines

Table 7.5 shows that eleven of the twelve items that are expected to measure ‘employment conditions’ within a mining industry (EC1, EC2, EC3, EC4, EC5, EC6, EC7, EC9, EC10, EC11 and EC12) loaded onto factor one (1). This means that respondents view the ‘employment conditions’ as a single construct. Only one item (EC8) expected to measure ‘employment conditions’ was deleted as this item did not load to a significant extent on factor one (1).
Table 7.5: Factor loadings: perceptions of management towards employment conditions in gold mines

<table>
<thead>
<tr>
<th>Employment conditions</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC1</td>
<td>0.719</td>
</tr>
<tr>
<td>EC2</td>
<td>0.603</td>
</tr>
<tr>
<td>EC3</td>
<td>0.682</td>
</tr>
<tr>
<td>EC4</td>
<td>0.655</td>
</tr>
<tr>
<td>EC5</td>
<td>0.741</td>
</tr>
<tr>
<td>EC6</td>
<td>0.596</td>
</tr>
<tr>
<td>EC7</td>
<td>0.736</td>
</tr>
<tr>
<td>EC8</td>
<td>0.385</td>
</tr>
<tr>
<td>EC9</td>
<td>0.640</td>
</tr>
<tr>
<td>EC10</td>
<td>0.526</td>
</tr>
<tr>
<td>EC11</td>
<td>0.714</td>
</tr>
<tr>
<td>EC12</td>
<td>0.589</td>
</tr>
</tbody>
</table>

Table 7.5 indicates that all respondents could not come to an agreement that they are satisfied with their employment contract resulting into EC8 scoring a low value well below the 0.5 cut-off, thus, considered insignificant. As all the items loaded onto one factor with relatively high factor loadings it is indicative of convergent validity.

Workers always want some improvement to their underground, skills and housing allowances, want to be paid competitive salaries, want to be provided with additional benefits such medical aids and life assurances and pension fund. Overall, there is unanimous agreement that employment conditions do influence skills shortage. The other issue that must be acknowledged by the mining houses, as influencing the decision making of a potential candidate in determining their career choice and future employment option in the gold mining sector, is the nature of work that employees would be doing. Usually, it is those occupations in the mining industry that are manual, physical (blue shirt), undertaken during unsatisfactory working hours and location of the mining organisation that provide challenges to the mining houses in attracting, recruiting and retaining people in the workplace. This perception would project a negative image.
about the gold mining sector to the public and may have adverse effects on the future supply of skilled labour to the sector.

### 7.5.3 Perceptions of management towards the availability of resources in gold mines

Table 7.6 shows that nine of the twelve items that are expected to measure ‘resources’ in the mining industry (RE1, RE2, RE4, RE5, RE6, RE7, RE8, RE9 and RE10,) loaded onto factor one (1). This means that respondents view the ‘resources’ as a single construct. The other three items (RE3, RE11, RE12) expected to measure ‘resources’ were deleted as they did not load to a significant extent on factor one (1).

**Table 7.6: Factor loadings: perceptions of management towards availability of resources in gold mines**

<table>
<thead>
<tr>
<th>Resources</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE1</td>
<td>0.688</td>
</tr>
<tr>
<td>RE2</td>
<td>0.560</td>
</tr>
<tr>
<td>RE3</td>
<td>0.375</td>
</tr>
<tr>
<td>RE4</td>
<td>0.670</td>
</tr>
<tr>
<td>RE5</td>
<td>0.677</td>
</tr>
<tr>
<td>RE6</td>
<td>0.646</td>
</tr>
<tr>
<td>RE7</td>
<td>0.739</td>
</tr>
<tr>
<td>RE8</td>
<td>0.614</td>
</tr>
<tr>
<td>RE9</td>
<td>0.580</td>
</tr>
<tr>
<td>RE10</td>
<td>0.559</td>
</tr>
<tr>
<td>RE11</td>
<td>0.288</td>
</tr>
<tr>
<td>RE12</td>
<td>0.467</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5, were considered significant.

The availability of suitably qualified employees has been the number one constraint to the safe production in the gold mining industry. According to Table 7.6, respondents believed that the organisation has adequate resources to limit the employment of low-cost unskilled labour, hire people with scarce skills, introduce modern equipment and machinery for conducting mining operations (RE11), encourage and develop their current staff to improve their qualifications. This would create a pool of competent
people who will be able to fill scarce skills positions (RE3) and adapt well to the setup of mining operations. The gold mining sector, like any other mining sector, has to comply with strict health and safety requirements, meaning that operations can only be performed if certain people in possession of occupational or professional registration or specific qualifications (in particular, government certificate of competency) are available. This, according to respondents would limit the pool of skilled people from which employers can recruit people from, and contribute to, scarce skills. The elementary workers, machine operators and locomotive/winch drivers are the occupations that experience a high replacement demand due to fatalities related to occupational diseases and accidents. The items measuring availability of resources loaded onto one factor with relative high values and indicate convergent validity.

7.5.4 Perceptions of management towards education and training in gold mines

Table 7.7 shows that eight of the ten items that are expected to measure ‘education and training’ in the mining industry (ET1, ET2, ET4, ET5, ET6, ET7, ET8 and ET10) loaded onto factor one (1). This means that respondents view the ‘education and training’ as a single construct. The other two items (ET3, ET9) expected to measure ‘education and training’ were deleted as they did not load to a significant extent on factor one (1). There were no cross-loadings of items as all loaded onto one factor with relatively high factor loadings indicating convergent validity.
Table 7.7: Factor loadings: perceptions of management towards education and training in gold mines

<table>
<thead>
<tr>
<th>Education and Training</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET1</td>
<td>0.542</td>
</tr>
<tr>
<td>ET2</td>
<td>0.547</td>
</tr>
<tr>
<td>ET3</td>
<td>0.424</td>
</tr>
<tr>
<td>ET4</td>
<td>0.654</td>
</tr>
<tr>
<td>ET5</td>
<td>0.604</td>
</tr>
<tr>
<td>ET6</td>
<td>0.675</td>
</tr>
<tr>
<td>ET7</td>
<td>0.590</td>
</tr>
<tr>
<td>ET8</td>
<td>0.675</td>
</tr>
<tr>
<td>ET9</td>
<td>0.400</td>
</tr>
<tr>
<td>ET10</td>
<td>0.544</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

A qualified person in mining does not mean someone who holds an academic qualification. It is the combination of qualification, experience and willingness to start from the bottom. A weak response to ET3 in Table 7.7 shows that respondents are of the view that employees might have the required qualifications but are not well experienced for the job they are doing. Almost all mining companies have in-house training centres to keep the workforce updated with the highest quality standards required. Only potential candidates are allowed to partake in these programmes, which may account for the poor response to ET9 in Table 7.7.

The South African mines are known to be large, deeper and more labour intensive than their counterparts in Australia, USA and Canada, to name but a few, and have a record of recurring accidents (Cameron & Goldsmith 2004:25). The high level of accidents is traced back to the quality of education and training in the country. A very large portion of the workforce work as machine operators, winch and locomotive drivers and elementary workers and their wide range of specific occupations are linked to the technology and equipment handling in the sector. Training of these workers is shorter than those of artisans, technicians, professionals and engineers, and is mostly done in mining training.
centres. Provision is made for quality education and training through the partnership with tertiary educational institutions. Considering the importance of literacy in the mining industry, the MQA was tasked with the improvement of the Occupational Health and Safety (OHS) skills capacity in the industry, by reducing the rate of illiteracy and increasing the human resources supply in scarce skills areas that are critical to OHS. In the case of literacy, the mining and mineral sector have been assigned the responsibility of Adult Basic Education and Training (ABET) and Recognition of Prior Learning (RPL) in terms of how best to deal with the problem of language diversity. This is to ensure employees at lower levels or with less experience are provided with adequate education and training opportunities.

Skills transformation for all of its employees is ensured through in-house training using coaching and a mentoring framework of senior staff members and skills development facilitators. The respondents believed that the gold mining sector has well-developed internal training centres that would assist with offering of skills development programmes. These skills programmes are meant for the training and development of the occupational groups such as machinery operators and drivers, and elementary workers.

7.5.5 Perceptions of management towards skills shortages in gold mines

Table 7.8 shows that three of the ten items that are expected to measure ‘skills shortages’ within gold mines (SS3, SS6 and SS8) loaded onto factor one (1). This means that respondents view the ‘skills shortages’ as a single construct. The other seven items are expected to measure management perceptions of ‘skills shortages’ in gold mines had p-values <0.05 which did not demonstrate sufficient validity and were thus deleted as they did not load to a significant extent on factor one (1). The three remaining factors all have relatively high factor loadings and provide sufficient evidence of convergent validity.
Table 7.8: Factor loadings: perceptions of management towards the skills shortages in the gold mines

<table>
<thead>
<tr>
<th>Skills shortages</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1</td>
<td>0.156</td>
</tr>
<tr>
<td>SS2</td>
<td>0.457</td>
</tr>
<tr>
<td>SS3</td>
<td>0.738</td>
</tr>
<tr>
<td>SS4</td>
<td>0.120</td>
</tr>
<tr>
<td>SS5</td>
<td>0.151</td>
</tr>
<tr>
<td>SS6</td>
<td>0.568</td>
</tr>
<tr>
<td>SS7</td>
<td>0.175</td>
</tr>
<tr>
<td>SS8</td>
<td>0.605</td>
</tr>
<tr>
<td>SS9</td>
<td>0.351</td>
</tr>
<tr>
<td>SS10</td>
<td>0.271</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

Table 7.8 indicates that respondents have a strong believe (0.738) that many trained and experienced miners had sought greener pastures in other industries. As a result additional staff is required to meet business operational requirements and growth opportunities. They are still not sure why many trainees left on completion of their qualification since the location of the mines is conducive to attract scarce skilled workers. Overall the respondents believe that even though a great number of people are about to retire, there are still skilled people available to do the job. They also believe that foreigners and migrants are not taking positions that could have been occupied by the locals. Respondents think machinery sophistication and automation are kept at the minimal level since they are still using the old machines of the 1980’s as a result a high level of technical skills for many positions are not required.

In conclusion, Table 7.9 depicts all items that were considered significant to influence management perceptions of skills shortages in gold mines.
Table 7.9: Empirical factor structure: influences of management perceptions of skills shortages in gold mines

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>INDIVIDUAL ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Environment</td>
<td>WE1, WE2, WE3, WE4, WE5, WE8, WE9, WE10</td>
</tr>
<tr>
<td>Employment Conditions</td>
<td>EC1, EC2, EC3, EC4, EC5, EC6, EC7, EC9, EC10, EC11, EC12</td>
</tr>
<tr>
<td>Resources</td>
<td>RE1, RE2, RE4, RE5, RE6, RE7, RE8, RE9, RE10,</td>
</tr>
<tr>
<td>Education and training</td>
<td>ET1, ET2, ET4, ET5, ET6, ET7, ET8, ET10</td>
</tr>
<tr>
<td>Skills Shortages</td>
<td>SS3, SS6, SS8</td>
</tr>
</tbody>
</table>

These are all items that scored well above the 0.5 cut-off line.

7.5.6 Outcomes of the skills shortages in gold mines

- Organisational performance

Table 7.10 shows that four items (OP1, OP3, OP5, and OP6) that were expected to measure ‘organisational performance’ did not load and were thus considered unacceptable for further analysis. Table 7.9 further indicates that two items of the six items expected to measure ‘organisational performance’ (OP2, OP4) loaded onto factor one (1). This means that these loadings were unacceptable for further analysis as they were less than three items per factor loading. As mentioned before, the cut off number for items per factor loading in this study was three (3). This variable was thus deleted from the study as the factor loadings were insignificant and did not provide evidence of convergent validity.
Table 7.10: Factor loadings: Organisational Performance

<table>
<thead>
<tr>
<th>Organisational Performance</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP1</td>
<td>0.316</td>
</tr>
<tr>
<td>OP2</td>
<td>0.643</td>
</tr>
<tr>
<td>OP3</td>
<td>0.309</td>
</tr>
<tr>
<td>OP4</td>
<td>0.692</td>
</tr>
<tr>
<td>OP5</td>
<td>-0.387</td>
</tr>
<tr>
<td>OP6</td>
<td>0.477</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

- **Propensity to leave**

Table 7.11 indicates that all five items expected to measure ‘propensity to leave’ (PL1, PL2, PL3, PL4 and PL5) loaded on factor one (1) as expected with relatively high factor loadings indicating convergent validity.

Table 7.11: Factor loadings: Propensity to leave

<table>
<thead>
<tr>
<th>Propensity to leave</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL1</td>
<td>0.634</td>
</tr>
<tr>
<td>PL2</td>
<td>0.691</td>
</tr>
<tr>
<td>PL3</td>
<td>0.791</td>
</tr>
<tr>
<td>PL4</td>
<td>0.829</td>
</tr>
<tr>
<td>PL5</td>
<td>0.800</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

Table 7.11 indicates that respondents are of the view that they were confident that they will still be working at this sector in five years from now. If there is a reason to leave this company, it would be for another company in another sector. They felt that all gold mining companies are the same and would not leave due to safety reasons but for better fringe benefits.
• **Competitive Advantage**

Table 7.12 indicates that four of the five items expected to measure ‘competitive advantage’ (CA2, CA3, CA4 and CA5) loaded on factor one (1). Only one item (CA1) could not load, hence no further analysis of this item was considered and subsequently deleted. The high factor loading on this one factor is indicative of convergent validity.

**Table 7.12: Factor loadings: Competitive advantage**

<table>
<thead>
<tr>
<th>Competitive Advantage</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA1</td>
<td>0.446</td>
</tr>
<tr>
<td>CA2</td>
<td>0.825</td>
</tr>
<tr>
<td>CA3</td>
<td>0.654</td>
</tr>
<tr>
<td>CA4</td>
<td>0.548</td>
</tr>
<tr>
<td>CA5</td>
<td>0.825</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

Table 7.12 indicates that competition is not based on how advanced the mine is with technology, but how to maintain operations in a cost effective, environmentally acceptable and socially supportive way. It can be argued that while mining companies sought competitive advantage in differentiation, there is a need to develop an understanding of the individual relationships between mining companies and their various stakeholders. Mining companies have begun to acknowledge the critical importance of reputation in gaining access to the necessary resources of ore bodies, capital and labour. The respondents believed that they possess valuable core competencies and skills required in the mining for the company to have competitive advantage over their competitors. This has made the organisation a leader in the development of human capital in the mining industry.

• **Sustainability**

Table 7.13 indicates that four of the five items expected to measure ‘sustainability’ (SU1, SU2, SU4 and SU5) loaded on factor one (1). Only one item (SU3) could not load to a significant extent, hence no further analysis of this item was considered and was
deleted. The other items indicated high factor loadings on this one factor and are thus indicative of convergent validity.

Table 7.13: Factor loadings: Sustainability

<table>
<thead>
<tr>
<th>Sustainability</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SU1</td>
<td>0.624</td>
</tr>
<tr>
<td>SU2</td>
<td>0.761</td>
</tr>
<tr>
<td>SU3</td>
<td>-0.238</td>
</tr>
<tr>
<td>SU4</td>
<td>0.607</td>
</tr>
<tr>
<td>SU5</td>
<td>0.655</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.

In Table 7.13 respondents believed that it is very important for the mining company to engage the trust of communities, governments and investors to gain their sustainability in minimising their operation on the environment, and embracing risk management policies and programmes. This would ensure the company remains profitable to sustain the organisation’s long-term survival.

It is therefore concluded that respondents perceived all items expected to measure outcomes of skills shortages as three constructs, termed ‘propensity to leave’, ‘competitive advantage’ and ‘sustainability’ as summarised in Table 7.14.

Table 7.14: Empirical factor structure: outcomes

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>INDIVIDUAL ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propensity to leave</td>
<td>PL1, PL2, PL3, PL4, PL5</td>
</tr>
<tr>
<td>Competitive advantage</td>
<td>CA2, CA3, CA4, CA5</td>
</tr>
<tr>
<td>Sustainability</td>
<td>SU1, SU2, SU4, SU5</td>
</tr>
</tbody>
</table>

Loadings greater than 0.5 were considered significant.
Table 7.10 shows that as a result of the exploratory factor analysis, the dependant variable (organisational performance) has been deleted as the factor loadings were insignificant. Based on this findings, the original hypotheses had to be reformulated and the theoretical model had to be adapted. Table 7.15 outlines the empirical factor structure to be used for further analysis in this study.

Table 7.15: Empirical factor structure: influences and outcomes

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>INDIVIDUAL ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Environment</td>
<td>WE1, WE2, WE3, WE4, WE5, WE8, WE9, WE10</td>
</tr>
<tr>
<td>Employment Conditions</td>
<td>EC1, EC2, EC3, EC4, EC5, EC6, EC7, EC9, EC10, EC11, EC12</td>
</tr>
<tr>
<td>Resources</td>
<td>RE1, RE2, RE4, RE5, RE6, RE7, RE8, RE9, RE10, RE11, RE12</td>
</tr>
<tr>
<td>Education and training</td>
<td>ET1, ET2, ET4, ET5, ET6, ET7, ET8, ET10</td>
</tr>
<tr>
<td>Skills Shortages</td>
<td>SS3, SS6, SS8</td>
</tr>
<tr>
<td>Propensity to leave</td>
<td>PL1, PL2, PL3, PL4, PL5</td>
</tr>
<tr>
<td>Competitive advantage</td>
<td>CA2, CA3, CA4, CA5</td>
</tr>
<tr>
<td>Sustainability</td>
<td>SU1, SU2, SU4, SU5</td>
</tr>
</tbody>
</table>

The empirical factor structure as summarised in Table 7.14 is therefore subjected to regression analysis. As a result of the formulation of the adapted model the hypotheses tested had to be reformulated.

7.6 REFORMULATION OF HYPOTHESES AND ADAPTED HYPOTHETICAL MODEL

Based on the factor analysis results the hypothetical model had to be adapted and the hypotheses reformulated.

7.6.1 First set of hypotheses subjected to empirical verification

H01: Perceptions regarding the working environment do not influence skills shortages in gold mines.
H0²: Perceptions regarding employment conditions do not influence skills shortages in gold mines.

H0³: Perceptions regarding availability of resources do not influence skills shortages in gold mines.

H0⁴: Perceptions regarding education and training do not influence skills shortages in gold mines.

7.6.2 Second set of hypotheses subjected to empirical verification

H0⁶: Perceptions regarding skills shortages do not influence propensity to leave in gold mines.

H0⁷: Perceptions regarding skills shortages do not influence the competitive advantage of gold mines.

H0⁸: Perceptions regarding skills shortages do not influence the sustainability of gold mines.

Since organisational performance (OP) did not load as a factor, the hypothesis, H0⁵ was not tested as the modified model (Figure 7.2) did not include OP as a variable. Figure 7.2 shows the adapted model.
Figure 7.2: The adapted model of the relationships among variables based on perceptions of management and effects of the skills shortage.
The next section deals with the reliability and validity of the measuring instrument.

### 7.7 ESTABLISHING RELIABILITY AND VALIDITY OF MEASURING INSTRUMENT

Since the main concerns in reliability measurements are stability over time or variability of conditions and internal consistency, a common way to estimate reliability was with a measure of association and the correlation coefficient (Drost 2011:108). Only internal consistency is discussed in this section. According Drost (2011:111) internal consistency measures the consistency within the instrument and how well a set of items measure a particular behaviour or characteristic within the variable. Thus, the estimates of reliability are based on the average inter-correlations or measurements of association among all the single items within a test. Therefore, the correlation coefficient is one of the techniques used to estimate reliability of this study and its objective is to measure the correlation between two or more variables that are intended to measure the same thing.

Generally, there are many statistical indexes that are used to measure internal reliability, but one that is commonly used to evaluate internal reliability is Cronbach’s alpha. Cronbach’s alpha is used to estimate the average reliability coefficient that can be attributed to a group of items from all possible splits (Boermans & Kattenberg 2011:2). One way of estimating the internal consistency of the questionnaire is the item analysis in which Cronbach’s alpha ($\alpha$) coefficient is the common statistical gauge of significance and effect. The $\alpha$ coefficient provides an indication of the correlation that exists amongst the items tested on a seven-point scale and its value ranges from 0 to 1, while 0.7 was determined as the cut-off point for this study (Webb, Shavelson & Haertel 2006:1). Values that are close to one indicate high reliability of the scale, while values close to zero happen by chance and indicate low reliability of the scale and negative values indicate agreement less than chance (Viera & Garrett 2005:361).

According to Wells and Wollack (2003:5) professionally developed high-stakes standardised tests should have internal consistency coefficients of at least 0.90, lower-stakes standardised tests (0.80 or 0.85), while it is desirable to have a reliability
coefficient of 0.70 or higher. Table 7.16 shows the Cronbach’s alpha values between 0.7 and 0.8. The Cronbach’s alpha coefficient was used to assess the internal reliability and consistency of the measuring instruments and STATISTICA (Version 10) computer package was used for this purpose. The internal consistency of each of the factors was assessed by calculating Cronbach’s alpha; the value >0.7 was considered to represent an adequate standard of reliability in this study. The variable, organisational performance, was deleted because not enough items loaded onto this factor during exploratory factor analysis.

Table 7.16: Cronbach’s alpha values of measuring instruments: Theoretical model

<table>
<thead>
<tr>
<th>Measuring instrument</th>
<th>Initial value</th>
<th>Final value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working environment (WE)</td>
<td>0.824</td>
<td>0.824</td>
</tr>
<tr>
<td>Employment conditions (EC)</td>
<td>0.891</td>
<td>0.891</td>
</tr>
<tr>
<td>Resources (RE)</td>
<td>0.858</td>
<td>0.858</td>
</tr>
<tr>
<td>Education and training (ET)</td>
<td>0.817</td>
<td>0.817</td>
</tr>
<tr>
<td>Skills shortages (SS)</td>
<td>0.711</td>
<td>0.711</td>
</tr>
<tr>
<td>Organisational performance (OP)</td>
<td>Did not load</td>
<td>Deleted</td>
</tr>
<tr>
<td>Propensity to leave (PL)</td>
<td>0.865</td>
<td>0.865</td>
</tr>
<tr>
<td>Competitive Advantage (CA)</td>
<td>0.812</td>
<td>0.812</td>
</tr>
<tr>
<td>Sustainability (SU)</td>
<td>0.756</td>
<td>0.756</td>
</tr>
</tbody>
</table>

In conclusion, the study retains WE, EC, RE, ET, SS, PL, CA and SU, since their Cronbach alphas were above the cut-off point of 0.7, while OP was deleted due to insufficient scores.

Although evidence of validity may be assessed in many ways, validity refers to the degree to which evidence and theory is accumulated to support the interpretations of
test scores as well as inferences that were drawn about the target population (Avalos 2012:11 & Lyrén 2009:13). This implies that there is a ‘gold standard’ against which the current measurements are compared. This involves the degree to which relationships among variable items within a test are consistent with the intended meaning of scores for those variables (Toro, Nester & Farren 2003:139). There are various types of validities assessed in this study, namely face, content and construct validity (Drost 2011:115).

Face and content validity was assured by means of expert judgement and a pilot study conducted. When assessing construct validity for this study, it was necessary to first to measure multiple traits of each variable using correlation and regression analyses and then look for evidence of convergent and discriminant validity to come to a conclusion of whether or not to accept or reject the hypothesis (Schimmack 2010:242). According to Guo, Aveyard and Fielding (2008:288) convergent validity (high correlations) may be defined as an agreement between measures of the same construct assessed by different methods, while discriminant validity (low or no correlations) refers to the distinctiveness of different constructs. To establish evidence of convergent and discriminant validity was to demonstrate that multiple measures of a construct (Lehmann 1988:411) are:

- In the case of correlation coefficient – related and are more related to each other than to measures of other constructs, even when the two measurement methods are similar.
- In the case of regression analysis – the ability to predict the outcome of interest. That is, a construct has more impact on a relation than does a common measurement method.

In this study validity is viewed as a hypothesis for which evidence is collected in support of proposed inferences mentioned in the introductory chapter. The use of convergent and discriminant validity would determine whether the hypothesis is null or alternate. For example, if a small p-value suggests the rejection of the null hypothesis then there is sufficient evidence of discriminant validity. In addition, discriminant validity examined
the extent to which an independent variable is truly different from other independent variables in predicting the dependent variable. This was done by comparing the values of average variance extracted between dimensions to the squared multiple correlations.

Convergent validity was assessed by observing the variance of the factor values, constructs reliability, and standardised factor loadings in the test model (Johari, Yahya & Omar 2011). All items that were classified as insignificant and not associated with identified factors were eliminated from the measure because they were irrelevant. The assessment of convergent validity is based on the view that only constructs that are expected to be related are not deleted. Convergent validity tests that constructs have relationship that are in fact related.

The next section covers the regression analysis results of the study.

## 7.8 REGRESSION ANALYSIS

Regression analysis allows the researcher to assess the predictive ability of an independent variable on a continuous dependent variable. Multiple regression analysis was performed to determine the extent to which the continuous variables of working environment, employment conditions, availability of resources and education and training would explain the variance in terms of propensity to leave, competitive advantage and sustainability, and management perception as the mediating variable.

### 7.8.1 Influence of working environment, employment conditions, resources and education and training on skills shortages in gold mines

Table 7.17 shows that the $R^2$ of 0.470 indicates that 47% of the variability in the model is explained by the variables WE, RE and ET. This means that ‘working environment’ ($b = 0.311$, $p < 0.001$), ‘resources’ ($b = 0.228$ $p < 0.017$), and ‘education and training’ ($b = 0.399$ $p < 0.001$) have a positive relationship with the perceptions of management on skills shortages in gold mines. However, Table 7.17 further indicates that ‘employment conditions’ does not exert a significant influence on ‘skills shortages’.
Table 7.17: Regression analysis: Influence of working environment, employment conditions, resources and education and training on skills shortages

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std Error</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working environment (WE)</td>
<td>0.311</td>
<td>0.087</td>
<td>3.574</td>
<td>0.001***</td>
</tr>
<tr>
<td>Employment conditions (EC)</td>
<td>-0.034</td>
<td>0.085</td>
<td>-0.397</td>
<td>0.691</td>
</tr>
<tr>
<td>Resources (RE)</td>
<td>0.228</td>
<td>0.096</td>
<td>2.379</td>
<td>0.017**</td>
</tr>
<tr>
<td>Education and training (ET)</td>
<td>0.399</td>
<td>0.100</td>
<td>3.993</td>
<td>0.001***</td>
</tr>
</tbody>
</table>

R² = 0.4703, F = 65.484, Std Error of P estimate = 0.9497, p < 0.00000

* = p < 0.05  
** = p < 0.01  
*** = p < 0.001

Table 7.17 indicates that all variables are able to predict management perceptions on skills shortages, except employment conditions that are classified as statistically insignificant. This view is based on the reason that when all other variables command positive values, it scored some negative values (b = -0.033757 and t = -0.397076) variable, so it is not commendable to let it pass on to the next stage of analysis, hence, this variable was withdrawn for further analysis.

### 7.8.2 Influence of skills shortages on propensity to leave

Table 7.18 shows that the R² of 0.431 indicates that 43% of the variability in the model is explained by the variable PL. This means that ‘propensity to leave’ (b = 0.601, p < 0.001) have a positive relationship with perceptions regarding skills shortages in gold mines.
Table 7.18: Regression analysis: the influence of skills shortages on propensity to leave

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std Error</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propensity to leave</td>
<td>0.601</td>
<td>0.039</td>
<td>15.036</td>
<td>0.001***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>Std Error of P estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>65%</td>
<td>0.4314</td>
<td>226.07</td>
<td>0.8954 p&lt;0 .00000</td>
</tr>
</tbody>
</table>

* = p < 0.05  
** = p < 0.01  
*** = p < 0.001

7.8.3 Influence of skills shortages on competitive advantage

Table 7.19 shows that the R² of 0.336 indicates that 34% of the variability in the model is explained by the variable CA. This means that 'competitive advantage' (b = 0.578, p < 0.001) have a positive relationship with perceptions regarding skills shortages in gold mines.

Table 7.19: Regression analysis: the influence of skills shortages on competitive advantage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std Error</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive advantage (CA)</td>
<td>0.578</td>
<td>0.047</td>
<td>12.293</td>
<td>0.001***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>Std Error of P estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>58%</td>
<td>0.3365</td>
<td>151.13</td>
<td>1.0551 p&lt;0 .00000</td>
</tr>
</tbody>
</table>

* = p < 0.05  
** = p < 0.01  
*** = p < 0.001
7.8.4 Influence of skills shortages on sustainability

Table 7.20 shows that the $R^2$ of 0.393 indicates that 40% of the variability in the model is explained by the variable SU. This means that ‘sustainability’ ($b = 0.466$, $p < 0.001$) have a positive relationship with perceptions regarding skills shortages in gold mines.

Table 7.20: Regression analysis: the influence of skills shortages on sustainability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std Error</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability(SU)</td>
<td>0.466</td>
<td>0.042</td>
<td>11.122</td>
<td>0.001***</td>
</tr>
</tbody>
</table>

The $R$, $R^2$, $F$, and Std Error of P estimate are as follows:

- $R = 554\%$
- $R^2 = 0.393$
- $F = 123.70$
- Std Error of P estimate = 0.94087

$p < 0.00000$

The t-values reported in Tables 7.17, 7.18, 7.19 and 7.20 need to be interpreted; the higher the t-values, the stronger the impact of the independent variables on ‘skills shortages’. The dependent variables have a strong impact on skills shortages, ‘propensity to leave’ with a high t-value ($t = 15.035$) as indicated in Table 7.18; ‘competitive advantage’ with a high t-value ($t = 12.293$) as indicated in Table 7.19; and ‘sustainability’ with a high t-value ($t = 11.121$) as indicated in Table 7.20.

Table 7.17 shows that the independent variables have moderate to low impact on skills shortages, ‘education and training’ with a t–value ($t = 3.993$), ‘working environment’ with a t-value ($t = 3.574$). Table 7.17 also indicates that ‘resources’ has a low impact on skills shortages with a low t-value ($t = 2.379$). Variables with low t-values indicate the weakest relationships with the dependent and moderating variables.

The following section highlights the correlation analysis results of the study.
7.9 CORRELATION ANALYSIS OF THE HYPOTHESES

In the item analysis section above, the term association was used often to refer to the relationship between two variables (Mukaka 2012:69). It is imperative to determine the nature of this relationship, that is, the level of significance and strength of this association between the two variables. According to O'Neil (2009:18), the significance and strength of a relationship is indicated by a correlation coefficient. A correlation coefficient is a numerical index (between 0 and 1) that indicates the strength of the relationship between two continuous variables. A correlation coefficient of 0 indicates no relationship and 1 indicates a perfect fit. The main aim of correlation coefficient is that the underlying relationship between the two variables under consideration must be linear. This means the direction of the relationship would be either positive or negative (Mukaka 2012:69).

Correlation analysis is one of the most widely used and reported statistical methods in summarising quantitative research data (Williams 2007:67). In this study the basic aspects of correlation analysis would be reviewed with emphasis placed upon the interpretations of the correlation coefficient matrix. Variables that are not associated with at least some of the other variables would not contribute to the analysis. Those are variables that were identified as having low correlations of less than a threshold value of 0.5 and were eliminated from further analysis.
Table 7.21: Correlation matrix of the variables

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std dev</th>
<th>WE</th>
<th>EC</th>
<th>RE</th>
<th>ET</th>
<th>SS</th>
<th>PL</th>
<th>CA</th>
<th>SU</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE</td>
<td>4.662</td>
<td>1.089</td>
<td>1.000</td>
<td>0.734</td>
<td>0.738</td>
<td>0.757</td>
<td>0.622</td>
<td>0.644</td>
<td>0.530</td>
<td>0.581</td>
</tr>
<tr>
<td>EC</td>
<td>4.869</td>
<td>1.135</td>
<td>0.734</td>
<td>1.000</td>
<td>0.792</td>
<td>0.686</td>
<td>0.534</td>
<td>0.505</td>
<td>0.437</td>
<td>0.581</td>
</tr>
<tr>
<td>RE</td>
<td>4.470</td>
<td>1.144</td>
<td>0.738</td>
<td>0.792</td>
<td>1.000</td>
<td>0.796</td>
<td>0.617</td>
<td>0.677</td>
<td>0.569</td>
<td>0.679</td>
</tr>
<tr>
<td>ET</td>
<td>4.972</td>
<td>0.997</td>
<td>0.757</td>
<td>0.686</td>
<td>0.796</td>
<td>1.000</td>
<td>0.646</td>
<td>0.701</td>
<td>0.555</td>
<td>0.658</td>
</tr>
<tr>
<td>SS</td>
<td>4.567</td>
<td>1.296</td>
<td>0.622</td>
<td>0.534</td>
<td>0.617</td>
<td>0.646</td>
<td>1.000</td>
<td>0.657</td>
<td>0.580</td>
<td>0.542</td>
</tr>
<tr>
<td>PL</td>
<td>4.945</td>
<td>1.186</td>
<td>0.644</td>
<td>0.505</td>
<td>0.677</td>
<td>0.701</td>
<td>0.657</td>
<td>1.000</td>
<td>0.717</td>
<td>0.735</td>
</tr>
<tr>
<td>CA</td>
<td>4.840</td>
<td>1.293</td>
<td>0.530</td>
<td>0.437</td>
<td>0.569</td>
<td>0.555</td>
<td>0.580</td>
<td>0.717</td>
<td>1.000</td>
<td>0.683</td>
</tr>
<tr>
<td>SU</td>
<td>4.798</td>
<td>1.117</td>
<td>0.580</td>
<td>0.581</td>
<td>0.679</td>
<td>0.658</td>
<td>0.542</td>
<td>0.735</td>
<td>0.683</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 7.21 indicates that, among other, WE is positively correlated to SS with a coefficient of 0.622. Table 7.21 further shows that SS is positively correlated to EC with a coefficient of 0.534 and is also positively correlated to RE with a coefficient of 0.617. According to Table 7.21, ET is positively related to SS with a coefficient of 0.646. Table 7.21 indicates that PL and SS have a significant positive correlation with a coefficient of 0.657, and that SS is positively correlated to CA with a coefficient of a 0.580. Furthermore, SS is positively correlated to SU with a coefficient of 0.542. The only correlation value below 0.05 is between EC and CA (0.437). These correlation coefficients indicate that most of the items are indeed highly correlated (above 0.05) and thus also indicating convergent validity. Figure 7.3 illustrates the hypothesised model of skills shortages in gold mines.
Figure 7.3: Hypothesised model of skills shortages in gold mines

- **Skills shortages**
  - Working environment: $b = 0.311, p < 0.01$
  - Employment conditions: $N/S$
  - Resources: $b = 0.228, p < 0.05$
  - Education and training: $b = 0.399, p < 0.01$

- **Propensity to leave**
  - **Competitive advantage**
    - $b = 0.601, p < 0.01$
  - **Sustainability**
    - **Profitability**
    - $b = 0.578, p < 0.01$
    - $b = 0.466, p < 0.01$

- Variables:
  - WE1, WE2, WE3, WE4, WE5, WE6, WE7, WE8, WE9, WE10
  - EC1, EC2, EC3, EC4, EC5, EC6, EC7, EC8, EC9, EC10, EC11, EC12
  - RE1, RE2, RE3, RE4, RE5, RE6, RE7, RE8, RE9, RE10
  - ET1, ET2, ET3, ET4, ET5, ET6, ET7, ET8, ET9, ET10
  - PL1, PL2, PL3, PL4, PL5
  - CA1, CA2, CA3, CA4, CA5
  - SU1, SU2, SU3, SU4, SU5

- Additional notes:
  - $b = 0.578, p < 0.01$
  - $b = 0.466, p < 0.01$
  - $b = 0.311, p < 0.01$
  - $b = 0.228, p < 0.05$
  - $b = 0.399, p < 0.01$
7.9.1 Findings on the first set of hypotheses

**H0\(^1\):** Perceptions regarding the working environment do not influence skills shortages in gold mines.

Tables 7.17 and 7.21 reported a statistically significant positive relationship between the working environment and skills shortages (p < 0.001). This means that the perception regarding the working environment in gold mines positively influences skills shortages with a correlation coefficient of 0.622. Therefore, H\(_0\)^1 is rejected. The alternative hypothesis is thus accepted. It thus appears that there is sufficient evidence that the discriminant validity of the working environment scale with respect to the skills shortage scale is acceptable.

**H0\(^2\):** Perceptions regarding employment conditions do not influence skills shortages in gold mines.

Tables 7.17 and 7.21 indicated that employment conditions is not significantly related to skills shortages (p > = 0.691, NS) despite the correlation coefficient of 0.534. This means that perceptions regarding employment conditions in gold mines do not influence skills shortages. Therefore, H\(_0\)^2 is thus accepted. The larger p-value thus suggested that there is not sufficient evidence that the discriminant validity of the employment conditions scale with respect to the skills shortage scale is acceptable.

**H0\(^3\):** Perceptions regarding availability of resources do not influence skills shortages in gold mines.

Tables 7.17 and 7.21 reported a statistically significant positive relationship between the availability of resources and skills shortages (p < 0.017). This means that the perceptions regarding availability of resources influence skills shortages in gold mines with a correlation coefficient of 0.617. Therefore, H\(_0\)^3 is rejected. The alternative hypothesis is thus accepted. It thus appears that there is sufficient evidence that the discriminant validity of the availability of resources scale with respect to the skills shortage scale is acceptable.
H0^4:  *Perceptions regarding education and training do not influence skills shortages in gold mines.*

Tables 7.17 and 7.21 reflected a statistically significant positive relationship between perceptions regarding education and training and skills shortages in goldmines (p < 0.001). This means that perceptions regarding education and training influence skills shortages with a correlation coefficient of 0.646. Thus, Ho^4 is rejected. The alternative hypothesis is thus accepted and there is therefore sufficient evidence that the discriminant validity of the education and training scale with respect to the skills shortage scale is acceptable.

### 7.9.2 Findings on the second set of hypotheses

H0^6:  *Perceptions regarding skills shortages do not influence propensity to leave in gold mines.*

Tables 7.18 and 7.21 revealed a statistically significant positive relationship between the perceptions regarding skills shortages in gold mines and propensity to leave (p < 0.001). This means that perceptions regarding skills shortages influence propensity to leave in gold mines with a correlation coefficient of 0.657. Therefore, Ho^6 is rejected. The alternative hypothesis is thus accepted. It thus appears that there is sufficient evidence that the discriminant validity of the skills shortage scale with respect to the ‘propensity to leave’ scale is acceptable.

H0^7:  *Perceptions regarding skills shortages do not influence the competitive advantage of gold mines.*

Tables 7.19 and 7.21 reported a statistically significant positive relationship between the perceptions regarding skills shortages in gold mines and competitive advantage (p < 0.001). This means that perceptions regarding skills shortages in gold mines influence competitive advantage with a correlation coefficient of 0.580. Thus, Ho^7 is rejected. The
alternative hypothesis is thus accepted and there is therefore sufficient evidence that
the discriminant validity of the skills shortage scale with respect to the competitive
advantage scale is acceptable.

Ho\(^8\): *Perceptions regarding skills shortages do not influence sustainability of
gold mines.*

Tables 7.20 and 7.21 reported a statistically significant positive relationship between the
perceptions regarding skills shortages in gold mines and sustainability (p < 0.001). This
means that perceptions regarding skills shortages in the gold mine influence
sustainability with a correlation coefficient of 0.542. Thus, Ho\(^8\) is rejected. The
alternative hypothesis is thus accepted. It thus appears that there is sufficient evidence
that the discriminant validity of the skills shortage scale with respect to the sustainability
scale is acceptable.

7.10 CONCLUSION

This chapter provided results on a questionnaire section-by-section basis as measured
on the seven-point Likert scale, for the total sample. Factor analysis was performed on
four independent variables, the mediating variable and four dependent variables. The
discussion of each question included descriptive, correlation and regression analyses.
After statistical analyses were applied six hypotheses were correlated against the
findings of this empirical study. Hypotheses 2 and 5 could not be conclusively supported
while hypotheses 1, 3, 4, 6, 7, 8 were supported from the list of the main findings.

Chapter 8 will provide conclusions and recommendations based on the major findings
presented in this chapter.
CHAPTER EIGHT

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION
The main objective of this study was to explain the nature of skills shortage and to identify suitable strategies of human capacity building to manage skills shortages in gold mines. This has so far been achieved through a literature review of skills shortage, proposal of a hypothesised model, exposition of research methods used in the empirical study as well as the analysis of data collected. In this chapter, the discussion would be on the summaries and findings of all the chapters and then provide conclusions and recommendations as well as outlining areas for further study and limitations of the study.

8.2 SUMMARY OF OBJECTIVES AND FINDINGS OF THE CHAPTERS
While the South African gold mining sector is universally acknowledged for being instrumental to the development of the country's infrastructure and would continue to generate wealth and employment opportunities on a large scale, its production performance, staff turnover, competitive advantage and sustainability have of late become a cause of concern. There have been a number of theories that have traditionally been forthcoming, explaining that there is a positive relationship between skills shortage and the research outcomes. Yet, these research studies were uncoordinated, disparate and therefore failed to give a holistic picture of the true state of the skills shortage in the country, let alone the gold mining sector. Accordingly, the objective of this study is outlined in terms of the chapters summarised below.

Chapter One provided a background statement of the study, the problem statement, the research objectives and a brief overview of the literature review and research methodology applied in this study. The hypotheses, limitations of the study and how the study was organised was also discussed in Chapter one.
Chapter Two described the external and internal factors of the business environment, in which the mine operates, that are associated with the probability of encountering complex and dynamic skills shortages arising from multiple causes. Amidst this complex environment, the mining organisation has to face the reality of global involvement (markets, production and competition) and the struggle to create a sustainable competitive advantage. These two issues have placed enormous pressure on mining organisations to recruit skilled workers from local and global markets. Broadly speaking, there are factors across and between local and global industries that impact directly or indirectly on the need and nature of skills.

The literature on skills shortages reported that internationally, the mining industry is facing a critical skills shortage. South Africa, for example, lost a third of its artisans and engineers that left the country over the past 40 years to markets like Canada and Australia. Nationally, mining organisations are competing for scarce skills with manufacturing, major engineering and construction projects in South Africa. Literature studies also reported that businesses that operate in more competitive environments are more likely to encounter complex skills shortages for sustainability. This is further exacerbated by the mobility and transferability of some occupations such as engineers and artisans, to name but a few. Therefore, it can be said that there was a need to examine the business environment attributes (organisational performance and sustainable competitive advantage) that the gold mining sector had adopted as a result of external changes experienced. The reason being that the capacity to deal with environmental uncertainty and competencies that individuals need to meet their goals, have become more complex, requiring more than just mastering certain narrowly defined skills.

Chapter Three reviewed the available literature for the nature and drivers of skills shortages in the gold mining sector. A shortage of skills is a source of aggravation to organisations, and when acute, it is likely to hamper the quality and quantity of their output.
Literature studies report that South Africa’s mining industry is experiencing a high shortage of skills, with factors like poor education standards, structural changes in the economy, emigration and crime as being amongst the factors that contribute to this skills crisis. According to these reports, there is some dispute as to the nature and extent of these shortages in the mining industry, given the fact that the country also has a large pool of unemployed people or graduates. A point of contest is based on confusing and varied suggestions around the identification, estimation and successful ways to address these skills needs Discussions of problems caused by skill shortages are regularly highlighted in the media, which draws comments from governments, organisation and household to find solutions to overcome the skills shortages. Based on numerous concerns surrounding skills shortages there was a need for further analysis to be undertaken to identify skills gaps.

Chapter Four made provision for both quality of the skills and numeric imbalances in employment that created a number of human capacity building issues in order to assist in mapping out relevant interventions needed at all levels.

Literature studies reported that there are a number of ways to approach the problem of skills shortage; two are mentioned in this study. Firstly, when mining organisations are unable to recruit the skills workers they need overwhelmingly they work to up-skill their existing workers. Secondly, the investment in skills development becomes a shared responsibility between public and private sectors. As private companies are giving high priority to managing the risk of skills shortage, the government is expected to create an environment that is conducive to supporting these efforts, that is, policy reforms. Thus, the need to address the problem of skills shortage is going to require some fundamental changes being made not just by the mining industry, but by the community, academia and government. Fundamental to resolving this is addressing and changing long held attitudes and dismantling well entrenched barriers to employment of women in the industry. With mining companies slashing jobs, postponing projects and shutting down mines, the industry is asking whether the widely publicised skills shortage in the mining sector will continue to be a problem.
Chapter Five developed a conceptual framework that showed the independent, mediating and dependent variables that are based on the aims of this study.

All the variables in the study were clearly defined. This was followed by operationalization of these variables. Psychometric measurements of valid and reliable constructs that were sourced from various measuring instruments used in other similar studies were used in the operationalization of these variables. Also discussed in chapter five were eight hypotheses of association that stated that a correlation exists in the population from which the sample was drawn.

Literature reviewed provided an insight into the independent variables (working environment, employment conditions, availability of resources and training and development) influencing organisational outcomes, more specifically on performance, propensity to leave, competitive advantage and sustainability. The report stated that a correlation may exist between different measures of constructs based on the same or different variables. Thus, testing the hypothesis for association would require different statistical tests.

Chapter six provided an overview of the research methodology used in this study. When undertaking a quantitative research study to find some answers to the research questions, it was important that the process was undertaken within a framework of a quantitative approach; and used a valid and reliable instrument and methods of data collection and analysis.
Chapter Seven presented data collected and empirically tested the relationship between independent, mediating and dependent variables. The data was presented systematically as outlined in questionnaire attached in the appendix and conceptual framework of this study. The following was used to analyse data: descriptive statistics, factor analysis and presentations of the results.

Literature reviewed, stated that the presentation of the data should synchronize with the questions asked in the statement of the problem and hypotheses. The data were presented in a clear and concise form, most of which were in the form of tables and all variables had a score of more than neutral (Mean = 4). It is not surprising to learn that Education and Training obtaining the highest mean score of 5.97 and standard deviation of 0.997 for influenced skills shortage. On the other hand, factor analysis of the seven point Likert scale showed that all variables were correlated to each other except Employment Condition which was lost because it was unable to predict the dependent variable and Organisational performance for not loading significantly.

According to inferential statistics, the summary of results of the eight hypotheses are presented below, with hypotheses 2 and 5 being rejected while hypotheses 1, 3, 4, 6, 7 and 8 were accepted.

In this Chapter, a summary of the main findings are provided, the main conclusions identified and recommendations given as to address skills shortages in gold mines.

The next section provides a summary of the hypotheses testing.
8.3 SUMMARY OF HYPOTHESES TESTING

According to inferential statistics, the summary of results of the eight hypotheses are presented below, with null hypotheses 2 being accepted while null hypotheses 1, 3, 4, 6, 7 and 8 were rejected.

Hypothesis one (H₀¹) was setup to explore the respondents’ views of whether there is a relationship between perceptions regarding the working environment and skills shortages in gold mines in relation to safety, health, occupational fatalities and physical surroundings. The purpose was to examine whether the working environment has an influence on skills shortages in gold mines.

H₀¹: Perceptions regarding the working environment do not influence perceptions regarding skills shortages in gold mines.

Tables 7.16 and 7.20 reported a statistically significant positive relationship between the perceptions regarding the working environment and skills shortages in gold mines (p < 0.001). This means that the working environment positively influences skills shortages with a correlation coefficient of 0.622. Therefore, H₀¹ is rejected. The alternative hypothesis is thus accepted:

Hᵃ¹: Perceptions regarding the working environment do influence skills shortages in gold mines.

Hypothesis two (H₀²) was formulated to investigate the respondents’ views of whether there is a relationship between perceptions regarding employment conditions in gold mines and skills shortages in relation to retirement, recruitment or head-hunting, contracts, rewards, fringe benefits and placements. The purpose is to examine whether employment conditions have an influence on skills shortages:
H0²: *Perceptions regarding employment conditions do not influence perceptions regarding skills shortages in gold mines.*

Tables 7.16 and 7.20 indicated that the relationships of employment conditions were positive and significant except it is not significantly related to skills shortages (p > 0.691, NS) despite the correlation coefficient of 0.534. This means that the employment conditions were unrelated to skills shortages. Therefore, Ho² is thus accepted.

Hypothesis three (H0³) was setup to examine the respondents’ views of whether there is a relationship between perceptions regarding the availability of resources and skills shortages in gold mines in terms of funds or costs to hire, educational qualification, labour, competency level and infrastructure or accessibility to technology. The purpose was to investigate whether availability of resources has an influence on skills shortages in gold mines.

H0³: *Perceptions regarding the availability of resources do not influence skills shortages in gold mines.*

Tables 7.16 and 7.20 reported a statistically significant positive relationship between the availability of resources and skills shortages (p < 0.017). This means that the availability of resources influences skills shortages with a correlation coefficient of 0.677. Therefore, Ho³ is rejected. The alternative hypothesis is thus accepted:

Ha³: *Perceptions regarding the availability of resources do influence skills shortages in gold mines.*

Hypothesis four (Ho⁴) was setup to scrutinise the respondents’ views of whether there is a relationship between perceptions regarding education and training and skills shortages in gold mines relative to technical or engineering skills, experience, training institutions, literacy levels and on and off-the job training. The purpose was to examine whether education and training have an influence on skills shortages in gold mines.
**H0⁴**: Perceptions regarding education and training do not influence skills shortages in gold mines.

Tables 7.16 and 7.20 reported a statistically significant positive relationship between the perceptions regarding education and training and skills shortages ($p < 0.001$). This means that education and training influences skills shortages in gold mines with a correlation coefficient of 0.646. Thus, Ho⁴ is rejected. The alternative hypothesis is therefore accepted:

**Ha⁴**: Perceptions regarding education and training do influence skills shortages in gold mines.

Hypothesis six (Ho⁶) was intended to investigate the respondents’ views of whether management perceptions of skills shortages, related to organisational support that would be positively correlated with job satisfaction, organisational commitment and employee performance ratings, and negatively correlated with propensity to leave in gold mines. The purpose was to examine whether management perceptions of skills shortages have an influence on the *propensity to leave* in gold mines.

**H0⁶**: Management perceptions of skills shortages do not influence propensity to leave in gold mines.

Tables 7.17 and 7.20 revealed a statistically significant positive relationship between the skills shortages and propensity to leave ($p < 0.001$). This means that skills shortage influences propensity to leave with a correlation coefficient of 0.657. Therefore, Ho⁶ is rejected. The alternative hypothesis is thus accepted:

**Ha⁶**: Management perceptions of skills shortages do influence propensity to leave in gold mines.
Hypothesis seven (H07) was formulated to study the respondents’ views of whether management perceptions of skills shortages relate to the ability to identify and develop personnel in terms of core competencies that would make growth possible in gold mines through cost reduction, or differentiation leading to higher production volumes, or an increase in market share value. The purpose was to probe whether management perceptions of skills shortage has an influence on competitive advantage.

H07: Management perceptions of skills shortages do not influence the competitive advantage of gold mines.

Hypothesis eight (H08) is setup to explore the respondents’ views of whether management perceptions of skills shortages relate to the ability to enhance financial growth, protect the environment and develop corporate social responsibility in gold mining areas. The purpose is to probe whether management perceptions of skills shortages have an influence on the sustainability of gold mines.

Ho8: Management perceptions of skills shortages do not influence sustainability of gold mines.

Tables 7.19 and 7.20 reported a statistically significant positive relationship between the perceptions regarding skills shortages and sustainability of gold mines (p < 0.001). This means that perceptions regarding skills shortages influence the sustainability of gold mines with a correlation coefficient of 0.542. Thus, Ho8 is rejected. The alternative hypothesis is thus accepted:

Ha8: Management perceptions of skills shortages do influence sustainability of gold mines.

The revised hypothetical model of this study is presented in Figure 8.1 below.
Figure 8.1: The hypothetical model of management’s perceptions regarding skills shortages in gold mines

Independent variables

- Working Environment
- Employment conditions
- Resources
- Education and Training

Dependent variables

- Management perceptions of skills shortages in gold mines
- Propensity to leave
- Competitive advantage
- Sustainability

Source: Researcher's own construct

Figure 8.1 clearly indicates that out of the seven null-hypotheses tested in this study, six were rejected and one was accepted.

8.4 CONCLUSIONS ON RESEARCH PROBLEMS

Based on the findings, the following conclusions were drawn in line with the three research problems. Discussions are based on both the literature review and empirical results.

8.4.1 Conclusions on research problem one: Demand for replacement of employees with relevant skills and experience in gold mines

Despite high profile jobs in the South African gold mining sector, mining companies’ optimism remains steady and there continues to be strong demand for engineering skills and professions. Gold mining companies are experiencing difficulties in filling vacancies because of a shortage of people with the relevant skills and experience. The first research problem was based on the replacement demand, that is, the demand for skills
arising from growth, decline in occupational employment or people leaving the mining company through retirement and study, sick and maternity leave. There is a strong argument that a major challenge for the gold mining sector comes from people leaving the company rather than attracting new talent.

The shape and structure of the mining industry has changed in many ways which have implications for skilled labour. There are now fewer large gold mining companies because of mergers, takeovers, downsizing and outsourcing some occupations. This resulted into jobs becoming more demanding at all levels and moving towards more highly skilled and educated workers. From the empirical study, the respondents felt that the organisations do not have skilled people available to do their jobs, as they are unable to attract new entrants to the industry in order to meet business growth opportunities. Despite the location of the mines being conducive to attract scarce skilled labour, foreigners and migrant workers are not allowed to occupy positions that could have been occupied by locals since there is now increased machinery sophistication and automation that might require high levels of technical skills.

The gold mining sector, like any other sector, has to comply with strict health and safety requirements, meaning that operations can only be performed if certain people in possession of occupational or professional registration or specific qualifications (in particular, government certificate of competency) are available. The elementary workers, machine operators and locomotive/winch drivers are the occupations that experience a high replacement demand due to fatalities related to occupational diseases and accidents. When the total replacement demand of retirement or leave is added to growth demand, an estimate of the expected net requirements for each occupation is obtained. This measurement is an indication of how many newly qualified entrants are required in each occupation group over a period of time.

A key limitation of early projections of skills shortages in the gold mining sector was too much emphasis on qualification levels and changes of skills requirements of the occupation rather than replacement demands. Rock drill operators and miners are in
great demand; occupations that basically do not need any formal training except shop-
floor training and possession of a Blasting Certificate of Competency. A qualified person
in mining does not mean someone who holds an academic qualification. It is the
combination of qualification, experience and willingness to start from the bottom.
According to the empirical study, 56% of the managers who completed the
questionnaire have obtained grade 12 or below. When thinking about the link between
employers’ future skills needs and probable consequent skills shortages in the
marketplace, it is necessary to consider not just expansion demand for workers by
occupation, but also replacement demand.

According to the empirical study, most of the managers and professionals (53.3%) that
completed questionnaires are in the age group 41-60 years old. This might indicate that
the average age of professionals and managers in the mining industry is one of the
highest of any industry, with many people intending to retire in the next few years. The
other issue is that mining has an image problem. Student enrolment in mining technical
courses has been on the decline for many years; neither young people nor career
changers perceive the industry as attractive.

8.4.2 Conclusions on research problem two: Effectiveness of addressing skills
shortages in gold mines

The second problem dealt with the effectiveness of the management in addressing the
problem of skills shortages in the gold mining industry. The urgency to address skills
shortages in the South African mining industry is hampered by two main schools of
thought on skills, namely perceptions relating to management decisions and business
growth or expansion. The empirical findings suggested that respondents are sceptical
about managements’ commitment to meeting skills needs as there are adequate funds
available to hire employees with scarce skills. Even though there are attempts to limit
the employment of low-cost unskilled labour, respondents are critical about
managements’ ability to effectively plan for the skills as it is easy to attract low-cost
unskilled labour. The respondents saw these as serious problems that would hamper an
ability to meet future skills requirements.
One of the most significant obstructions to attracting people to study and work in the gold mining industry is its poor image. A common misconception is that the industry is made up of uneducated employees who do not care about sustainability and are not protecting the environment through poor land and water management practices. The respondents believe that waste recycling and slime dams are there to minimise an impact on the environment and there are strategies to mitigate and adapt to the potential effects of climate change. According to (Hoskin et al. 2000), mining by its very nature requires that land, air and water systems be disturbed, and end up becoming pollutants. The greatest environmental issue associated with gold mining is the disposal of a significant amount of waste removed from the mines which end up as dust and water pollutants (Robbins & Coulter 2002:98).

The challenge for the mining industry is to find, extract and process mineral resources with the least possible environmental disruption. The gold mining sector is perceived to be an industry which is prone to accidents and occupational diseases such as silicosis and tuberculosis. The empirical results showed that the respondents are of the view that there are sufficient policies and procedures in place regarding safety of miners in terms of possible ground fall, fires and explosions. It enjoys low prestige due to the common belief that mining employment is necessarily manual labour with limited (if any) skill requirements, that may not provide secure on-going work or opportunities to develop and advance careers. Respondents stated that provision is made for quality education and training through partnerships with tertiary educational institutions; there is collaboration with training institutions to offer skills training programmes, and employees with less experience are provided with adequate education and training opportunities.

8.4.3 Conclusions on research problem three: Assessing the impact of external factors on skills shortages in gold mines

The third problem deals with the surge of global competition in the labour markets, sweeping technological change, and impending shifts in the demographic mix of the labour force, calling for a national campaign to improve the skills and professionalism of the South African workforce. Skills are an important determinant of the economic
performance of people, organisations, industries and economies. Shortages of skilled labour directly constrain production and prevent firms from meeting demand and using available inputs efficiently. Indirectly, skill shortages inhibit innovation and the use of new technologies. This may have longer-term impacts on the way firms do business, in terms of their location, size, structure, production methods and product strategy (Stevens 2012:1).

Respondents believe that many trained and experienced miners sought greener pastures in other industries. As a result additional staff is required to meet business operational requirements and growth opportunities. They are still not sure why many trainees left on completion of their qualification since the location of the mines is conducive to attract scarce skilled labour. Overall the respondents believe that even though a great number of people are about to retire, there are still skilled people available to do the job. They also believe that a skill shortage in gold mining companies has not reached the state whereby there is a need to utilise foreigners and migrants for specialised positions that could have been occupied by the locals. Respondents think machinery sophistication and automation are kept at the minimal level since they are still using the old machines of the 1980’s as a result a high level of technical skills for many positions is not required.

8.5 ANSWERS TO THE RESEARCH QUESTIONS

On the basis of the purpose and objectives of the research, the following is a summary of answers gathered for this study’s research questions and is outlined in Table 8.1 below.
Table 8.1: Conclusions based on research questions of the study

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<tr>
<th>RESEARCH QUESTIONS</th>
<th>ATTEMPTS MADE / RESOLUTIONS</th>
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<tr>
<td><strong>RQ1:</strong> Is the work environment provided with efficient facilities to control skills shortages in the gold mines?</td>
<td>The survey results revealed that the work environment constitutes an important factor in the recruitment and retention of skilled people in the gold mining sector. Elements of working environments such as adequate ventilation, medical facilities, annual check-up for occupational diseases or illnesses, protective personal equipment (PPE’s), policies and procedures that ensure and inform workers of their right to health and safety in the workplace, and social facilities are perceived to be created by mines’ integrated and cost efficient infrastructure that provide attractive and supportive environments. Providing an attractive and supportive environment creates incentives for talent to be recruited and retained and working effectively. This view is supported by Wiskow et al. 2010:1-4) when they maintained that “Push factors” that would influence the decisions to move are firstly, related to work environment which includes low pay, poor working conditions, limited educational and career opportunities, unsafe workplaces and a lack of resources for effective working. The mine needs to comply with the Health and Safety Act (MHSA No. 29 of 1996), appointing legally competent person and employ a person who is neither medically fit nor physically or functionally capable to complete the tasks without endangering the health and safety of the employee and co-workers (Heine 2008:36).</td>
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<tr>
<td><strong>RQ2:</strong> How does management control employment conditions in gold mines to improve skills development?</td>
<td>The literature review revealed that there is no doubt there is improvement in skills development leading to health and safety knowledge and this would contribute greatly to the reduction of injuries and deaths at the mines (Vuma 2004:2). The survey results revealed that gold mines have clear and transparent recruitment policies and procedures that attract suitable candidates for the right positions. In the case of existing employees, employees are encouraged to have individual development plans (IDP’s) to fit into succession plans that are in place to manage employee retirement. The mine management have to comply with the Mining Charter and contribute to the levy grant scheme in terms of the Skills Development Levies Act of 1999. South African managers, employees and training providers are</td>
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committed to addressing the areas of redress, equity, cultural integration, capacity building, access, special needs, human rights, technology and skilling a largely unskilled labour force (Bisschoff and Govender, 2004: 70).

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<th>RQ3: Which resources in the gold mines need to improve so as to sustain skills development?</th>
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| The survey results revealed that there is an attempt to limit the employment of low-cost unskilled labour as a result in-house training centres have been established and provision is made for quality education and training through partnership with tertiary education, vocational and training institutions. This emphasises the point that gold mines need to ensure that there are well-developed internal training centres or facilities to assist with offering skills development programmes, so that there are adequate qualified employees to fill available job positions.

Gichoya (2005:179) claimed that lack of infrastructure (institutions, lack of financial resources, poor data systems and lack of compatibility, skilled personnel (experienced staff, Instructors or educators) to impart knowledge, leadership styles, culture and bureaucracy, and attitudes would hinder the successful implementation of skills development programmes. Therefore, these resources need to be improved.

Funds allocated to university education, technical and vocational training and in-house training needs to be increased. A recent survey by the African Development Bank and the OECD showed there is a serious lack of such facilities in nearly all the minerals producing countries, and that these institutions were not functioning in an efficient manner (African Development Bank/OECD, 2008). |

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<th>RQ4: Which dimensions of education and training management need to achieve so as to control skills shortages in the gold mines?</th>
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<td>Survey results revealed that although all employees undergo formal job training prior to placement underground, it takes time to know ground formations, identify safe and unsafe conditions and internalise the ‘unwritten rules’ of working underground. As a consequence, this means that, an employee becomes proficient in a particular skill only after performing on the job for an extended period of time (Nel &amp; Pienaar 2006).</td>
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Meyer and Botha (2004:172-173) believed that the current problems relating to skills development in the mining industry may be addressed if management focuses on the following three dimensions of education, namely: (1) developing skills of existing employees; (2) adequate on-the-job training to complement formal education (Hofmeyer 2000:7); and (3) increase in other career pathways involving vocational education such learnership and apprenticeship.

According to Inyang (2011:144) the means to enhance performance, avoid human obsolescence and staff turnover are considered along four dimensions, namely, employee training, organizational development, management development and career development.

Therefore, Adeyeye (2008: 492) stated that the market-driven worker requires continuous knowledge empowerment which can only be effected through deliberate, sustained and continuous training.

**RQ5: What capacity building initiatives management need to perform to control skills shortages and improve performance, in the gold mines?**

The survey results revealed that gold mines may initiate capacity building through social functions at the workplace, finding solutions to workplace conflict, job involvement, working from a solution focused approach.

Acute skills shortages have led management to be directly involved with education and training of their workers through partnership with both VET and HE providers. These initiatives appeared to be successful in building engineering capacity in gold mining sector.

An effective human capacity development that would keep employees aligned with the values and mission of an organisation by developing a culture that encourages employees to focus on a higher purpose for their work.

The mining companies must develop human resources strategies that will recruit, develop and retain skilled, committed and accountable individuals. Thus, professional development of existing employees would ensure the enhancement of personnel working in professional and related occupations by providing them with new skills, knowledge and attitudes for performing new tasks strictly related to mining industry.
RQ6: How do management control skills shortages to improve sustainability, competitive advantage and performance in the gold mines?

Gold mining companies have accelerated their investment to address skills shortages by actively engaging in social responsibility initiatives that involve the training of community members in mining related skills and investing in environmental awareness. The mining industry perhaps has greater immediate pressure to address the issue of sustainability as a result of its dependency on maintaining a social license to operate. The ‘social license to operate’ is maintained through good community relations and being good stewards of the resources impacted by the mining operation (EYGM 2010:15). This initiative would ensure that the mining company remains profitable to sustain itself in the long-run.

Descovich and Norris (2012:20) believed that maximising the retention in the workforce may be achieved by matching people’s skills, aptitude and attitude to the workplace environment. This is aimed at building on the strengths of existing staff and recognised their desire to remain with, and their loyalty to the company. In the case of students, improving and expanding school to industry pathways would provide students with opportunities to further their careers within the mine’s in-house training centres.

The survey results revealed that mining companies gave formal recognition to skilled staff while addressing discrepancies in the occupational levels, gaps in Occupational Health and Safety compliance and issues of numeracy and literacy. This initiative is aimed at removing obstacles to career progression resulting from a lack of formal qualification and available training, improve flexibility across the civil works employees, and improve the overall skills base. Thus, gold mining sector is regarded as a leader in the development of human capital in the mining industry. The gold mining company might have sustainable competitive advantage but to grow and improve its performance, it must have the right skilled employees, who are able to utilise resources optimally and achieve their objectives.

RQ7: How do management improve skills development so as to control the literature on the link between skills development and propensity to leave has found that companies that enhance the skills of the existing employees experienced lower turnover rates. However, turnover is higher when an employee is trained to be multi-skilled, which may
**propensity to leave and labour turnover in the gold mines?**

 imply that this type of training enhances the prospect of the worker to find work elsewhere, where there are better fringe benefits.

The literature on the link between training and mobility found that the training that is off-the-job and wholly sponsored by the individual increases the likelihood of mobility; while formal on-the-job training and training that is sponsored by the employer would decrease the likelihood of mobility (Srinivas 2008:90).

Human resource mechanism such as recruitment policy and succession planning can be used to control propensity to leave and staff turnover (Mbah & Ikemefuna 2012:277).

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<th>RQ8: Which capacity building initiatives management need to implement to control labour turnover and propensity to leave in the gold mines?</th>
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| There is a renewed interest to establish why people leave or intend to leave the organisation and what may be done to retain them. In agreement with this, the literature regarding labour turnover reported that attention must be given to the organisational culture and job satisfaction as a means of predicting employee’s commitment to and satisfaction with the organisation. Another prominent issue that must be focused at is the leadership ability, preferred style and competence of senior managers, because of growing evidence that they exert a significant influence on productivity, satisfaction and general employee behaviour (Martins & Coetzee 2007:20).

There are different methods that may be used to control labour turnover and propensity to leave; they include job satisfaction and involvement, assessing the physical working surroundings, sufficient socialisation practice and compensation practices (Abdali 2011:10-14).

Turnover could be minimised through considering different preventive measures by the management. These may include providing training to the line managers for effective supervision before appointing or upgrading them, providing security of jobs with good working environments. |

The next section highlights the main conclusions and recommendations of the study, based on the significant relationships of this study.
8.6 CONCLUSIONS, RECOMMENDATIONS AND PRACTICAL IMPLICATIONS OF THE STUDY

The discussion on conclusions, recommendations and practical implications of this study is based on the three independent variables and three outcomes variables of the study as depicted in final revised hypothetical model (see Figure 8.1) as well as the levels of skills (as indicated in Table 7.3).

8.6.1 Influence of working environment on skills shortages in gold mines

The results clearly show that there is a positive relationship between the perceptions regarding the working environment and skills shortages in gold mines. Any negative assumptions and evaluations of the working environment could thus impact skills shortages in gold mines. The working environment refers to the collective view of employees about the characteristics of the environment in which a person is expected to work as reflected by various procedures and practices.

Mining organisations are restricted as to where to operate and by the availability of the economic deposits and thus a licence is required for opening and operating the mine. Mining organisations cannot influence the prime sites for extraction since minerals are limited and irreplaceable. Mining also requires that land, air and water systems be disturbed, and end up becoming pollutants entailing accusations of environmental damage and risk of working in a mine. The risk of working in a mine through dust and noise could result into occupational illnesses such as tuberculosis and silicosis.

Working conditions have been singled out, along with remuneration, as one of the major de-motivators and are often the reason why skilled people leave their professions. The main reasons for skills shortages are the lack of a professional working environment where employees may grow and have a sense of fulfilment and the quality of the workplace environment mostly impacts on the level of employee’s motivation and subsequent performance.

It is thus recommended that:

- The mining industry needs to comply with the Health and Safety Act (MHSA No. 29 of 1996) implying that healthy and safe working conditions should not be
compromised by appointing employees who are neither medically fit nor physically or functionally capable to complete their tasks.

- The mining industry needs to find, extract and process mineral resources with the least possible environmental disruption.
- There is adequate operation of air, ventilation, and lightning for miners.
- There are adequate first aid facilities available for occupational illnesses caused by exposure to heat, dust, noise and harmful gases.
- There are safety measures in place to protect miners from environmental incidents (e.g. slime dams collapsing, cyanide or other chemicals spillage).
- There are sufficient policies and procedures in place regarding safety of miners (e.g. possibility of rock fall, fires and explosions).
- High quality state-of-the-art equipment and machinery are used that could reduce mine accidents.
- There are adequate rest rooms and cafeteria facilities available to miners.
- The layout and placement of equipment and machinery should be conducive to effective mining operations.
- Miners are checked on a regular basis and always be encouraged to wear protective clothing.
- Miners should feel safe to operate the machinery and equipment that they use during mining operations.

8.6.2 Influence of the availability of resources on skills shortages in gold mines

The results of the study clearly show that there is a positive relationship between the perceptions regarding the availability of resources and skills shortages in gold mines. Any negative assumptions and evaluations regarding the availability of resources could thus impact skills shortages in gold mines.

The mining industry has experienced quite severe shortages over the last number of years. The shortages are exacerbated by the lack of HDSAs with the requisite skills amid the drive for transformation. Mining organisations globally are competing for skilled human resources to sustain and develop their business to meet the growing demand for
commodities from China and India. It appears that the low level of skills development in sub-Saharan Africa is no doubt the principal cause for the lack of skilled workers. Skilled labour shortages at industry level are often significantly and negatively associated with subsequent reductions in investments in physical capital and research and development (R&D).

It is therefore recommended that:

- Investment in research and development should be seen as an investment in the long-term success of an industry, and decisions on such investments must therefore be strategic decisions.
- The National Skills Fund (NSF) should make financial resources available for bursaries, work experience learning and internships.
- The NSF is should be used as a national resource which can be used to both initiate as well as to respond to national skill priorities. It can be used to target gaps and compliment resource shortages for national priorities.
- Very strict competency requirements are set for certain positions based on health and safety regulations.
- There should be adequate funds available to hire employees with scarce skills.
- Advanced technology is made available for conducting mining operations.
- Miners should have access to relevant and modern equipment and machinery for conducting mining operations.
- Employees are always encouraged to improve their qualifications by offering them study leave and funds for further studies.
- There should be a sufficient level of technology in terms of communication, equipment and machinery to conduct mining operations.
- There is adequate infrastructure available for safe mining, processing and ore recovery, such as water-supply, waste-management facilities and accessible location with regard to work and basic facilities.

8.6.3 Influence of education and training on skills shortages in gold mines

The results of this study indicate that there is a positive relationship between the perceptions regarding education and training and skills shortages in gold mines. Any
negative assumptions and evaluations regarding education and training could thus impact skills shortages in gold mines.

The vocational education and training system of the country has been labelled as the main contributor to the national skills crisis and difficulties in supplying the skilled workers needed by the South African mining industry. It is further postulated that university education does not produce commercially or workplace ready and able graduates that are able to keep pace with technological changes. The lack of relevant and responsive education and training opportunities can result in a mismatch between labour supply and demand and hence contribute to skill shortages. It also appears that there is a decline of student enrolment in mine related courses.

It is recommended that:

• Two to three years of experience and additional training on the job should be provided until graduates are considered viable.
• By developing existing employees with work-related training could alleviate skills mismatch.
• Skills obsolescence caused by human capital depreciation should be proactively managed, through continuous upgrading of skills through training and refreshing programmes.
• Regular technical skills training programmes should be provided to all employees.
• There should be adequate levels of people with engineering skills required in the mining industry.
• Provision is made for quality education and training through partnerships with tertiary educational institutions.
• There is collaboration with training institutions to offer skills training programmes.
• Regular literacy training programmes are offered to employees at lower levels.
• In-house training/apprenticeship programmes should be offered.
• There is a well-developed internal training centre or facility to assist with offering skills development programmes.
8.6.4 Influence of skills shortages on propensity to leave in gold mines

After examining the patterns of skills shortage for interrelationship between skills shortage and the propensity to leave, it has been shown that ‘propensity to leave’ have a positive correlation with skills shortages. What this statement means is that for any increase in skills shortage there is likelihood that the propensity to leave would increase.

Propensity to leave could be defined as the degree of employee’s desire or perceived likelihood that they do not want to stay with their employer due to various antecedents. Workers claim that if there is a reason to leave, it would be for another company in another sector and only for better fringe benefits. The gold mining sector is at a mature/declining stage. It appears that intention to leave is a strong predictor of actual turnover rates among staff members, employees who are more engaged trust their employer and therefore reported more positive attitudes and intentions towards the organisation. There is no standard framework for understanding the employees turnover process as a whole, and a wide range of factors have been found useful in interpreting employee turnover.

It is recommended that:

- Management should actively monitor workloads and maintain a good working relation between supervisors as not to only reduce stress, but also increase job satisfaction and commitment to the organisation.
- Managers need to monitor both the extrinsic and intrinsic sources of job satisfaction available to employees to assist in retaining talented employees and reducing labour turnover.
- When intention to leave has been identified, corrective measures to prevent turnover should be taken in advance.

8.6.5 Influence of skills shortages on competitive advantage in gold mines

The results of this study indicate that there is a positive relationship between the perceptions regarding skills shortages and competitive advantage in gold mines. Any
negative assumptions and evaluations regarding skills shortages could thus impact the competitive advantage of gold mines.

Competitive advantage is defined in terms of attributes and resources of an organisation that creates value either by generating greater-than-expected returns from available resources or by allowing an organisation to outperform its rivals. It is thus an organisational capability to perform in one or many ways that competitors find difficult to imitate. The mining industry is driven by consumer consumption while continually facing tough economic pressures of low commodity market prices and high operating costs that in turn make the mining operational decisions more complex. Competitive advantage means having low costs, differentiation advantage, or a successful focus strategy. Human capital may be the most important and critical factor for competitive advantage in the organisation because it is the most difficult to imitate.

It is recommend that:

- Much attention should be given to internal resources and particularly human capital as it could be an important source of competitive advantage.
- Mining houses compete on the basis of possessing state-of-the-art technology.
- Mining houses strive to be a cost effective leader in the mining industry.
- Mining employees possess valuable core competencies and skills required in the mining industry.
- Competition in the mining industry should be on the basis of differentiation, such as exceptional quality and superior service.

### 8.6.6 Influence of skills shortages on sustainability in gold mines

While assessing the interrelationships between skills shortage and sustainability, the research findings showed that sustainability have a positive relationship with skills shortages. Mining has often been associated with positive economic benefits; however, it may also create some major problems for the environment and human health. Consequently, the economic globalisation and various state institutions have made it vital for mining companies to fulfil their social responsibilities, communicate with stakeholders, and strike a balance between economic growth and environmental
protection. In order for this to be achieved, sufficient and competent technical skills, in the form of artisans, technicians and engineers are required. The mine has a responsibility to provide sustainable socio-economic development of mining communities in which it is situated by minimising the impacts of mining practices on biodiversity. Mines in particular, are the main contributors to the many environmental problems that the community is facing and therefore need to play a critical role in addressing such issues. Availability of a highly skilled professional workforce is critical to South African mines’ ability to meet its longer term economic, social and environmental objectives.

It is recommended that:

- Emphasis should be put on balancing economic benefits with social and environmental needs without compromising future generations in the process of using these natural resources.
- There should be waste recycling and recovery facilities to minimise impact on the environment.
- There are strategies to mitigate and adapt to the potential effects of climate change by adhering to the guidelines of ISO 9000 and ISO 14001.
- Mining houses engage in social responsibility initiatives.
- Mining houses remain profitable to sustain the organisation’s long-term survival.
- There are risk-management policies and programmes in place to ensure the prosperity of mines.

8.6.7 Perceptions regarding actual skills levels per occupational category in gold mines

Table 7.3 of the results indicated the frequency distributions of perceptions regarding levels of skills per occupational category, in terms of skilled, semi-skilled and unskilled. The highest skilled occupational categories were managers, professionals, engineers, technicians and artisans. The highest semi-skilled occupational categories were miners, administrative staff and artisans. The highest unskilled occupational categories were drillers and administrative staff. The perceived relative high levels of skilled (29%) and
semi-skilled (64%) miners were surprising. The high level of perceived unskilled labour (45%) in the driller occupational category needs to be addressed. Although it is commendable that only 7% of miners are perceived to be unskilled, based on the perceptions of this sample, it might not be representative of other population groups. Serious attention needs to be paid to the 22% perceived of unskilled administrative staff employed in these mining organisations (only 51% is semi-skilled). Based on the fact that only 43% and 29% of the respondents are of the opinion that artisans and technicians employed at these mining organisations are semi-skilled, implies that interventions are required to improve skills levels in these occupational categories. Interventions are put in place to increase the skilled levels of engineers and professionals with at least 10% and 14% respectively (increased from semi-skilled levels). The skilled levels of managers are put under the spotlight as it appears that almost one quarter (25%) of perceived managerial positions are occupied by semi-skilled and unskilled employees.

It is recommended that:

- Mining employees’ daily activities should be aligned to the organisation’s core business competencies and strategy, while improving upon those skills lacking.
- A regulatory framework for skills development in the mining sector should be based on the Skill Development Act where the emphasis is placed on training people in such a way that they become fully equipped to do a specific job.
- Training and development programmes together with the improvement of industry standards for the development of necessary industry knowledge and skills should be a priority.
- Organisations should develop human resources strategies to recruit, develop and retain skilled, committed and accountable individuals.
- When developing talent pools organisations should combine internal development and external recruitment in filling talent pools.
- Talent management (also known as human capital management) in the mining industry should focus on attracting highly skilled workers, integrating new workers,
and developing and retaining current workers to meet current and future business objectives.

- Management must evaluate employees’ knowledge, skills and competencies as these talent attributes are an important competitive weapon, hence talent needs to be maximised and recognised as one of the discrete sources of organisational competitive advantage.
- Career development training should be offered as a form of in-service training designed to upgrade the knowledge, skills and ability of employees to help them assume greater responsibility in higher positions. In-service training should be viewed as a process of staff development for the purpose of improving the performance of an incumbent holding a position with assigned job responsibilities by promoting the professional growth of individuals.

The following section highlights the major contributions of this study.

8.7 CONTRIBUTIONS OF THE STUDY

Skills shortages have a widespread effect on the South African economy. It affects the level of economic productivity and reduces the country’s capacity to develop a knowledge-based society. This, in turn, affects the country’s functioning in the global economy. There has been acknowledgement and consistent call for collaboration by various stakeholders in the past to capture, coordinate and enhance existing efforts to address the problem of skills shortages. However, to date an all-inclusive approach in addressing these challenges is a far more considered approach; in future and currently it remains to be merely a ‘blame gaming’ and shifting of responsibility across the stakeholder or sectorial boundaries. Numerous attempts were made for these collaborative efforts but were simply not sustainable as they were not based on stakeholders’ needs, contributions and cultures. As a result, they were not as effective as they should be. Perhaps the most important contribution of this study is that it provides insight into the way management perceive skills shortages in the gold mining industry.
The study developed hypothesised models that describe the nature of the relationship between factors that influence skills shortages and the impact that skills shortages have on propensity to leave, competitive advantage and sustainability of mining houses. These models can be extensively used in the mining industry in South Africa and the rest of the mining countries as an integral part of the overall strategy to minimise staff turnover and enhance competitive advantage and sustainability.

Furthermore, the study made a contribution to the research body by developing instruments that are appropriate for measuring the factors that influence skills shortages in South African gold mines. With slight changes to the angle of the wording and research outcomes, these instruments can be used to measure the factors that influence skills shortages and related variables such as labour turnover in other sectors.

The rising skills shortages have become one of the main problems facing the mining and minerals sector throughout the world. There are a number of causes of skill shortages, and the relevance of these causes varies across industries and regions. Many case studies have identified one or two key causes impacting on a region. However, the cause of a particular shortage is often a combination of many factors. The diversity of causes of shortages means that the treatment that work in one case will not necessarily work in another. The forward looking projections of skills shortage have to be based on macroeconomic forecasts that link changes in aggregate demand and its determinants (such as exchange rates and interest rates) to trends in sectoral output, productivity and employment. The application of advance multivariate statistical techniques like factor, correlation and regression analyses and a relatively large sample size may be used to generate occupational and qualifications forecasts, using trends in those relationships. Finally, this study provides opportunities and flexibility for the mining companies to adapt to a complex and dynamic environment, with a view to enhancing their sustainable competitive advantage locally and globally. Hence this study would contribute to the economic development of South Africa.

Some other general contributions of the study are outlined below:
The results of these participating mining houses aimed at investigating management perceptions regarding skills shortages in gold mines could also be replicated by other mining industries specifically and any other industry.

The findings of the study can inform strategic policy formulation and implementation for the mining industry in dealing with skills shortages.

The measuring instrument developed can be used by other mining organisations and with few adaptations also by other institutions that want to manage skills shortages.

It was clear in the study that the nurturing of human capital is critical if mining organisations wish to successfully manage skills shortages.

This study provided useful and very practical guidelines to mining organisations as to ensure effective strategizing and management of skills shortages that could enhance their local and global competitiveness and long term sustainability.

The study used a sound and well-developed research design and methodology which have been critically justified and applied. This could also be used by other similar studies to conduct empirical research.

8.8 LIMITATIONS OF THE STUDY

The following limitations of the study must be noted:

The focus of the study was on the South African gold mining sector, with only the top three gold producers and Johannesburg Stock Exchange listed companies. The ability of the study to be generalised in terms of wider South African mining industries and in general, is therefore listed.

Due to time and costs constraint, only people within the radius of 200 km were selected. Therefore, not all companies could be reached.

The close ended type of questionnaires administered, limits the views and expressions of the respondents.

The research methodology was only based on the survey method using questionnaires. It could have included documentary sources or interviews which could have enrich the data.
8.9 RECOMMENDATIONS FOR FURTHER STUDIES

Even though there is widespread recognition that South Africa has severe skills shortages in certain key sectors, it is problematic to define skills shortage based upon perceptions within the organisation, there is still dispute as to the nature, extent and sometimes the existence of this shortage. For example, it is not known what the current skills shortage would be like without migrant workers. In addition to that, the monitoring series currently available in South Africa are incomplete, not always comparable overtime, and seldom available in detail in industrial level.

On the basis of findings and conclusions taken from the study, the following recommendations are given for consideration.

- A similar study can be replicated on skills shortages with different demographic characteristics in different settings to determine whether there are similarities with the findings of this study.
- A comparative study that includes organisational performance and employment conditions, the two variables that were lost during data analysis, can be done in other mining sectors.
- A study can be conducted with larger sample covering a larger area.

8.10 CONCLUDING REMARKS

The primary objective and motivation for conducting this study was to identify management perceptions regarding skills shortages in gold mines. Based on the summary of the chapters, practical implications and recommendations derived from the empirical study, as discussed in this chapter, it can be accepted that both primary and secondary objectives constructed for the study were achieved. Therefore it can be mentioned that the results of this study contribute to the body of knowledge on business management, strategic management and knowledge of the South African gold mining sector.
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