

A Case Study from a Gold Mining Company: A call for Leadership
towards more Sustainable Futures

by

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Declaration

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Abstract

Gold mining in South Africa is an industry that is more than a century old. The impact of gold mines on communities and the environment are enormous. This thesis is a case study based in one of the major gold producers in South Africa that has been in operation for more than 50 years and has more than 30 years of life still left. Exploring the impact mining has had on communities and the environment, this thesis is a call for leadership action towards sustainable futures. This call is made through a suggested sustainable development leadership framework.

Georgius Agricola¹ gave a warning regarding the devastating environmental impacts of mining as early as 1556, however mining still has the same negative impacts to the environment and people. The argument in this thesis is that, it is only through genuine leadership that the impacts of mining can be mitigated. However leadership is looked at not from the position of the leader or the leadership style but from the belief system of the leader when it comes to environmental management and community development.

The motivation for the study was based in observing how leadership at our Gold mine rallied behind prevention of mine closure when the mine was faced with electricity crisis in 2008. The electricity crisis demonstrated that it is through genuine and committed leadership that all challenges can be overcome including sustainable development crisis. The call for leadership at our mine is to demonstrate the same leadership commitment in addressing environmental and community development challenges.

The literature review begins by highlighting sustainable development global challenges and initiatives to address them. This is followed by impacts of gold mining on society and the

¹ Agricola, who is often referred to as the "father of mineralogy," was born and spent most of his life in Saxony, which is now part of Germany. Although little is known of his youth, he received a B.A. degree from the University of Leipzig and briefly taught school at Zwickau. He spent all of his spare time examining the mines and mineral deposits of the region. Agricola's two greatest works are *De Natura Fossilium* (1546) and *De Re Metallica* (published posthumously in 1556). The first established claim as the father of mineralogy and included a classification of minerals (then called fossils) based on geometric form. The second was a comprehensive summary of all aspects of mining and metal production (<http://academic.emporia.edu/aberjame/histgeol/agricola/agricola.htm>).

environment around the various regions of the world. Leadership belief systems are then discussed, highlighting, how belief systems influence the way a leader responds to environmental issues.

In developing the sustainable development leadership framework findings from observations, conversations, interviews and focus group discussion that were conducted throughout the mine are presented. The aim of the research was to determine the understanding of employees on the impact of our company on communities, environment and themselves and also the employees' opinions of leadership.

The findings were that the majority of employees believe that leadership is not genuine in addressing community, employee safety and health, and environmental issues at our company and through interviews with leadership, the findings are that, environment and community issues are done for compliance and reputation purposes with no genuine belief that they should be done.

To address this understanding a call to leadership is made through a suggested sustainable development leadership framework that takes into consideration the findings from the case study. The thesis ends by proposing that this suggested framework should be tested further within our company.

Opsomming

Goud mynbou in Suid-Afrika is 'n bedryf wat meer as 'n eeu oud is. Die impak van goudmyne op gemeenskappe en die omgewing is enorm. Hierdie proefskrif is 'n gevallestudie wat gebaseer is op een van die groot goudprodusente in Suid-Afrika wat al vir meer as 50 jaar reeds in werking is en wat 'n veredere lewensverwagting van meer as 30 jaar het. Hierdie tesis is 'n ondersoek na die impak wat mynbou op die omliggende gemeenskappe en omgewing het asook 'n beroep om leierskap optrede vir volhoubare ontwikkeling. Hierdie beroep vir volhoubare ontwikkeling word gemaak deur middel van 'n volhoubare ontwikkeling leierskap raamwerk.

Georgius Agricola het alreeds in 1556 gewaarsku teen die impak wat mynbou op die omgewing en mense sou hê. Vandag het mynbou het egter nog steeds dieselfde negatiewe impak op die omgewing en die mense. Die argument in hierdie tesis is dat dit slegs deur ware leierskap is dat die impak van mynbou versag kan word. Leierskap word egter nie bekyk uit die posisie van die leier of die leierskap-styl nie, maar eerder uit die gewetens oortuiging oogpunt van die leier wanneer dit kom by omgewingsbestuur en ontwikkeling van die gemeenskap.

Die motivering vir hierdie studie is gebaseer op die waarneming van hoe leierskap by ons goudmyn mynsluiting voorkom het gedurende die 2008 elektrisiteitskrisis. Die elektrisiteitskrisis het getoon dat uitdagings sowel as volhoubare ontwikkelings krisisse wel deur ware en toegewyde leierskap oorkom kan word. Die versoek is nou vir ons myn om dieselfde leierskap toewyding toe te pas waar omgewing en gemeenskap ontwikkelings uitdagings aangepak word.

Die literatuur oorsig begin deur die globale uitdagings op volhoubare ontwikkeling onder die vergrootglas te plaas en wys hoe om die uitdagings te adresseer. Dan volg die impak wat die goudmynbedryf het op die omgewing en samelewing van verskeie streke in die wêreld. Leierskap geloof oortuiging word dan bespreek met die klem op hoe geloofsoortuiging 'n invloed het op die manier wat 'n leier reageer op omgewings kwessies.

Die ontwikkeling van die volhoubare ontwikkelings raamwerk is gebaser op obserwasies, gesprekke, onderhoude en fokusgroepsbesprekings van regoor die myn. Die doel van die navorsing was om die begrip van die werknemers te bepaal aangaande die impak wat ons maatskappy het op die gemeenskap, omgewing en hulself en ook om die werknemers se opinies van leierskap te bepaal.

Die bevindinge was dat die meerderheid van die werknemers van mening is dat leierskap by ons maatskappy nie opreg is wanneer dit kom by aanspreek van gemeenskap kwessies, werknemer veiligheid en gesondheid, en omgewingskwessies nie. Deur middel van onderhoude met die leiers van ons maatskappy is ook bevind dat die omgewing en die gemeenskaps kwessies slegs aandag geniet aangesien dit vir die nakoming van vereistes en reputasiedoeleindes verys word en nie as gevolg van 'n werklike oortuiging dat dit gedoen moet word nie.

Om hierdie begrip aan te spreek word 'n beroep gemaak tot leierskap deur middel van hierdie voorgestelde volhoubare ontwikkeling leierskap raamwerk wat die bevindings van die gevallestudie in ag neem. Die tesis eindig deur voor te stel dat hierdie voorgestelde raamwerk verder getoets moet word in ons maatskappy.

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List of Abbreviations

AMD	Acid Mine Drainage
CP	Cleaner Production
CSR	Corporate Social Responsibility
CSMI	Centre for Sustainability in Mining and Industry
DEAT	Department of Environmental Affairs and Tourism
DMR	Department of Mineral Resources
EE	Eco-Efficiency
FWRDWA	Far West Rand Dolomitic Water Association
GDE	Graduate Diploma in Engineering
GDP	Gross Domestic Product
HDSA	Historically Disadvantaged South Africans
Hg	Mercury
IDC	Inter-Departmental Committee
ICMM	International Council on Mining and Metals
IRP	International Resource Panel
MEA	Millenium Ecosystem Assessment
MPRDA	Mineral Petroleum Resources Development Act
NFSD	South African National Framework for Sustainable Development
SCTC	State Coordinating Technical Committee
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organisation
WBCSD	The World Business Council for Sustainable Development
WITS	University of Witwatersrand
UNCED	United Nations Conference on Environment and Development

1. Chapter 1: Introduction

*“... the strongest argument of the detractors is that the fields are devastated by mining operations ... Also they argue that the woods and groves are cut down, for there is need of an endless amount of wood for timbers, machines, and the smelting of metals. And when the woods and groves are felled, then are exterminated the beasts and birds, very many of which furnish a pleasant and agreeable food for man. Further, when the ores are washed, the water which has been used poisons the brooks and streams, and either destroys the fish or drives them away. Therefore the inhabitants of these regions, on account of the devastation of their fields, woods, groves, brooks and rivers, find great difficulty in procuring the necessaries of life ... **Thus it is said, it is clear to all that there is greater detriment from mining than the value of the metals which the mining produces.**” (German scholar Georgius Agricola in 1556 (Hoover & Hoover, 1950) cited in Mudd, 2004.*

One wonders if the pioneers of diamond and gold mining in South Africa (Cecil John Rhodes and Charles Rudd) were exposed to the scholarly work of Georgius Agricola. Looking at the impact mining, specifically gold mining, has had in South Africa and around the world, the sentiments expressed in the quote above seems to have been completely ignored. This thesis explores the various impacts of gold mining and makes a leadership call for action towards more sustainable futures.

This chapter begins by briefly giving a background and motivation to the study which is based in a gold mining company in South Africa and outlining the motivation for conducting such a study. The background and motivation is followed by a discussion on how the case study was developed and the reasons behind conducting the case study at our gold mine premised on systems approach to sustainability, where the embeddedness of social-political, ecosystem services, economic and governance systems are emphasised. The objectives of the study are then outlined, which is to develop a suggested sustainable development framework that can be tested at our company. The chapter concludes with a highlight of the significance of the study and then giving an outline of the thesis.

1.1 Background and Motivation

I am a senior manager in one of South Africa’s major gold mining companies (herein referred to as Gold Au), responsible for environmental management, community development and total employee health. Gold Au has in excess of 18 000 employees and

has a footprint of more than 10 000ha. In February 2008, South Africa was plunged into darkness because of Eskom’s electricity shortages. Our mining company was not spared. When the electricity cuts were implemented by Eskom, the mine was required to reduce the electricity consumption by 10% of the 2007 average consumption. This instruction led to several shafts and some working areas being temporarily shut down. The management at the mine immediately set up an electricity committee that was mandated to do an overhaul of electricity consumption at the mine. Some of the measures implemented by the electricity committee included:

- Disconnecting all the geysers in bathrooms
- Installing energy efficient lights and solar lights (where possible)
- Switching corridor lights off and installing motion sensors in all offices and boardrooms
- Examining all compressed air pipes for leakages and fixing them
- Issuing daily power updates per working area

Figure 1 below illustrates the weekly updates that were released to all employees regarding the state of electricity consumption with incentives such as an ox braai for the best performing area.

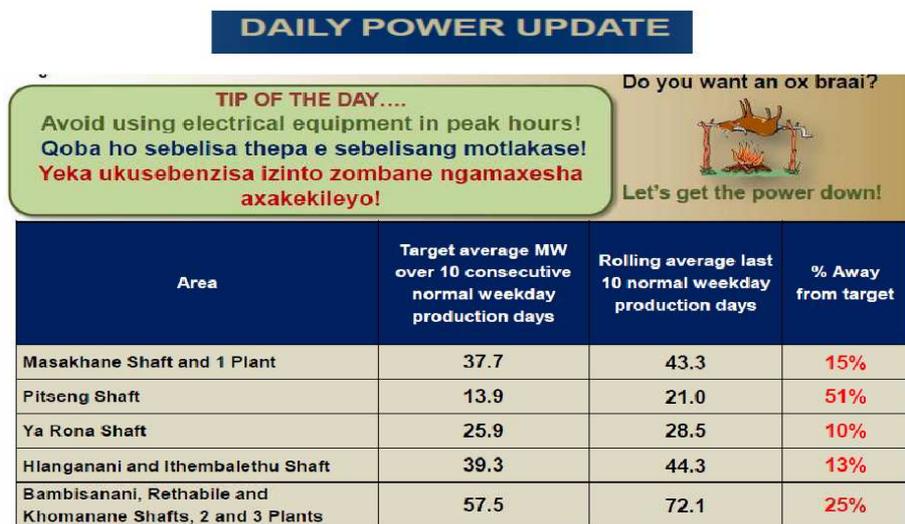


Figure 1: An example of Gold Au daily power updates to all employees

Source: Internal Company notices

Of importance was the focus management put in ensuring that production continues within the prescribed electricity consumption range. In a period of six months all working areas were reopened and the mine was in full production within the prescribed range. In all the

discussions regarding electricity, a constant thread was that we need production to be up because the mine is losing millions of rands through lost production.

One can argue that the electricity crisis, if not managed, could have led to collapse of Gold Au, however this was averted by leadership putting extra focus on managing the consequences of electricity shortage. In a sustainability context, the electricity crisis impacted directly on the economic sphere of sustainability. During this period of managing the electricity crisis, the question in my mind was, what or when will be the tipping point for the environment and social aspects, for collapse is not only going to be triggered by the economic aspects but also by the social and environmental aspects of mining.

Of even greater importance to me was how the rest of the employees at Gold Au rallied behind the call for conserving electricity. From the cleaners cleaning our offices, who had to work in dark corridors, they understood and did everything in their power to contribute towards energy saving. The general employees stood by the call for energy saving because they had a clear understanding that if the energy crisis continues it threatens their job security. I remember vividly a day when I received a call from the most junior member in our department asking me who does he need to talk to regarding stadium lights that were left on, so that those lights could be switched off. Everybody exhibited leadership in the areas where they worked when it came to saving energy.

During this period mine leadership displayed focused attention and commitment to solve the electricity crisis and most importantly, management ensured that everybody within the mine understood and commits to energy saving. This display of leadership was admirable and I was thinking that if it could be channelled towards addressing all other sustainability challenges then our gold mine could be a significant contributor towards sustainable futures.

The role that I play within the executive management team of Gold Au, is in ensuring that our impact on the environment and communities is minimised and provide advice and guidance to the mine on how best to manage the environment and community issues. The second role is to ensure that strategies and programmes are in place that will assure sustainability beyond mine closure.

In my interaction with the leadership team, it is clear that their focus, when it comes to environment and communities is compliance, and avoidance of any penalties. There is no commitment to doing the right thing beyond compliance. The electricity crisis opened up a window that I was not aware existed, a window where leadership displayed commitment and focused attention and successfully solving a challenge with the support and commitment by the rest of the mine employees. Are we going to wait for a crisis to start committing to addressing social and environmental challenges? This observation motivated me to explore leadership as the critical factor for sustainable futures in mining.

1.2 Framing the case study

“Sustainable development means the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.”(Department of Environmental Affairs and Tourism, 2006). This definition of sustainable development is best illustrated in figure 2.

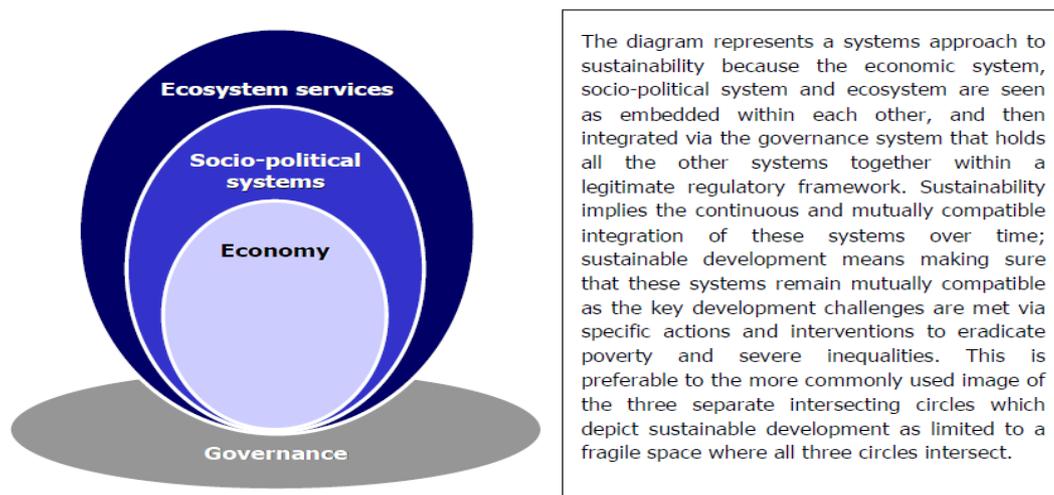


Figure 2: Illustration of a systems approach to sustainability

Source: South Africa's Department of Environmental Affairs and Tourism, 2006

In the context of our gold mining company and the background given in 1.1 above, the focus of the mine is biased towards the economic system without the acknowledgement of the embedded nature of all the systems of sustainability. For sustainable futures these systems need integration over time and to remain mutually compatible.

Challenges that are facing our company include, declining ore grades, which implies that, in order to mine these grades, substantially more water, energy and chemicals will be used, with a resultant increase in waste produced with all the associated impacts to the environment and communities. This challenge requires an understanding of the systems approach to sustainability. The 2008 crisis was an energy crisis, however a possibility exists where the crisis may be triggered by water, dust, health of employees and/or the communities.

Other than the potential challenge presented by the declining ore grades, mining in general is fraught with difficulties and complexities. Air pollution, water contamination, waste rock and tailings, abandoned mine shafts, pits and prospects, all have created physical dangers to people and wildlife. Outright disasters are too numerous, including tailings dam failure at Merriespruit Welkom, South Africa (Fourie, Blight, Papageorgiou, 2001) discussed in Chapter 2 below, emerging acid water drainage in the old gold mines of the west rand in South Africa also discussed in chapter 2, countless cases of ground subsidence, natural surface water-body and aquifer poisoning with widespread effect; and community and economic collapses due to sudden mine closures for various reasons, leaving disrupted or displaced indigenous populations (Weber, 2008). The almost complete loss of forests, native vegetation and soil productivity in some areas has so reduced productivity of lands that they remain essentially vacant or subject to intense economic depression (Weber, 2008).

The challenges described above have a potential to lead to collapse of our gold mine too because of the interrelated nature of sustainable development systems. The question is what the most appropriate response for our company is in order to avoid these consequences.

In this thesis I will argue that the effort to address the sustainability challenges for our gold mine need committed leadership, which has full understanding of the interrelated nature of sustainable development challenges. The argument is premised on the knowledge that through committed and focused leadership all challenges can be overcome as was displayed during the electricity crisis. This argument is presented in a form of a case study located in one of the oldest gold mines in South Africa (herein referred to as Gold Au), which still has

more than 30 years of mining left. It is also clear that the understanding and commitment is not going to emerge by itself, but through concerted engagement and awareness process with leadership within Gold Au.

1.3 Research Objectives

The overall research objective for this thesis is to develop a suggested Sustainable Development Framework that is premised on a call for action by leadership in our gold mine in addressing sustainable development challenges. It is envisaged that this suggested framework could be tested at the mine at a later stage.

The development of the framework will be supported by a rationale informed by four other objectives which are:

- an understanding of the gold mining industry in South Africa from an historical perspective,
- the perception of workers in our company on the impact of our gold mining activities on themselves, communities at large and the environment,
- understanding the role of leadership as related to sustainable development challenges; and
- examination of sustainable development programmes/projects within our gold mine

1.4 Significance of the Study

This study brings in a perspective that is still developing within the Sustainable Development discourse, the emphasis on leadership action. Of significance is the fact that this is an empirical study at the 'coal face' of the gold mining industry, an industry known for its negative environmental impacts. The findings of this study may play a useful role in supplementing other initiatives and the understanding of actions that need to be implemented by the mining industry in order to contribute to sustainable development.

1.5 Overview of the research design and methodology

A case study research design was adopted for this thesis in order to meet the objectives as outlined in 1.3 above. The study drew both non-empirical research (comprehensive literature review) and empirical research (primary data collection through observations, interviews and focus group discussions). Chapter 3 provides a detailed description of how the study was conducted, and the process is summarised below.

A comprehensive literature review (Chapter 2) was conducted, highlighting first and foremost general sustainable development challenges and also the impact gold mining has had on the environment and communities. Leadership literature review takes the form of understanding the kind of leadership traits that are genuine in managing environmental issues. The first objective is also addressed through a literature search (Chapter 4- first part) looking at gold mining from a historical perspective, specifically the relationship between gold mines and government. The outcomes of the literature review informed to a large extent the observations, interviews and focus group discussions described in chapter 3.

The empirical part of the study, included visit to various working areas mostly in the underground environment in order to do the observations and engage with conversations with various workers in the company. This was followed by focus group discussions and semi-structured interviews with union leadership and mine management. This process was adopted in order to address three of the four objectives that are supporting the development of the sustainable development framework.

1.6 Thesis outline

Figure 3 provides an outline of the thesis and this outline is briefly described below. Chapter One provides an introduction, background and motivation for the study, this is followed by the study objectives and significance of the study.

Chapter Two provides a comprehensive literature review that begins with a provision of sustainable development in general and relating the sustainable development challenges to

challenges faced by gold mining industry. This is followed by a discussion on the impacts of gold mining on the health and general wellbeing of people. The impact of mining to the environment is also discussed. The role of leadership is reviewed not from the perspective of the leadership style or positional leadership, but from developing an understanding of leadership traits or qualities that make a leader genuine in addressing environmental issues.

Chapter Three outlines in detail the research design and methodology, including motivation for the theoretical framework and justifications for the practical measures taken to meet the research objectives.

Chapter Four presents the case study, this chapter is divided into two parts. The first part addresses the historical perspectives of gold mining from a relationship between government and the gold mining industry perspective. This relationship and its consequences is linked to some of the activities, impacts or observations that are currently taking place at Gold Au. The second part of chapter 4 presents the findings from the empirical research. This second part gives details of observations, conversations, focus groups and interviews. Two project are also discussed one an environmental project and the other a community project that are being implemented at Gold Au.

Chapter 5 provides discussion, conclusions of the main findings of the study and provides the suggested sustainable development framework with recommendations for further scholarship.

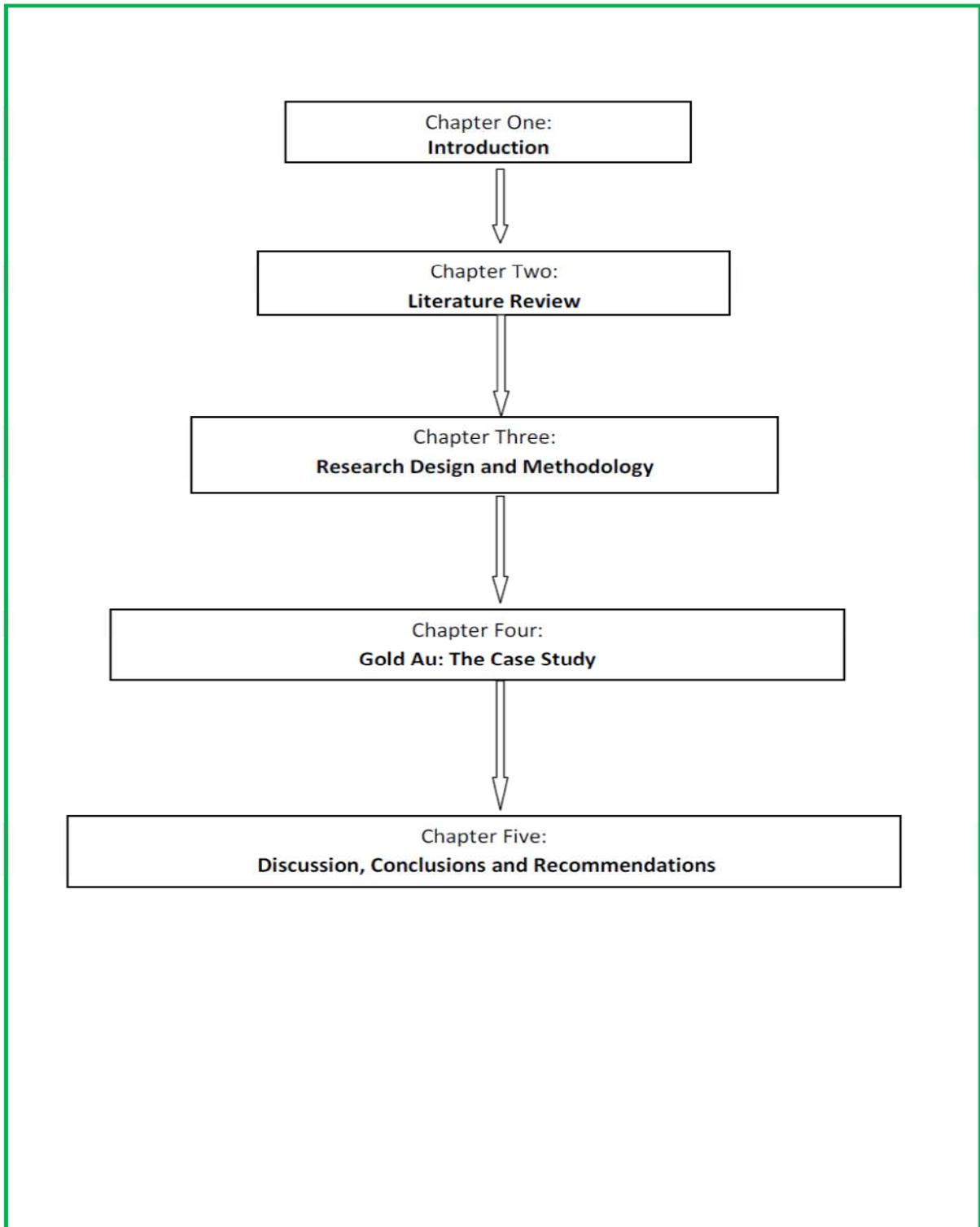


Figure 3: Outline of the Thesis

2 Chapter 2: Literature Review

2.1 Introduction

My core argument in this thesis is that the understanding of the impact of our mining activities on the environment and communities at large, coupled with a leadership approach that is genuine in addressing the impact of our mining activities from both the resource use and resource impact side, is the necessary condition for our mine to build more sustainable futures.

As mentioned in Chapter One, the overall objective of this thesis is to develop a suggested sustainable development framework that can be tested in the gold mine where I work. The framework will be supported by a rationale informed by four other objectives which are:

- an understanding of the gold mining industry in South Africa from an historical perspective,
- the perception of workers in our company on the impact of our gold mining activities on themselves, community at large and the environment,
- understanding the role of leadership as related to sustainable development challenges; and
- examination of sustainable development programmes within our gold mine

In building a case for my suggested sustainable development framework at Gold Au, this literature review begins with providing a broad contextual description related to sustainable development and its challenges. The first section gives a summary description of documents that are reshaping global socio-economic and ecological relationships going into the future. This description is intended to position this study within the global challenges and initiatives, and that the mining company I work for should not lose sight that the sustainable development actions that take place at the mine contribute to addressing global challenges.

The description is followed by highlighting resource intensity requirements of gold mining due to declining ore grades and mining at deeper and deeper levels. The resource intensity is taking place at a time when there are constraints posed by natural resources. A discussion highlighting decoupling resource use from economic growth as a possible approach in

addressing the resource intensity challenges is also described, though a document from the International Resource Panel (IRP). Eco-Efficiency and Cleaner Production are described as possible mechanism that should be reviewed and where possible be implemented in the possible decoupling programme.

The next section discusses the impact of mining in general, followed by specific impacts with examples from around the world. These sections highlight an important part of gold mining which is the fact that mining should not just continue without careful assessment of its impact on the environment and communities, highlighting the interrelatedness of the social, economic and environmental systems. These sections are included in this review in order to highlight the need for leadership that understands these impacts are able to support programmes and initiatives that are meant to avoid such impacts.

The last section describes the role of leadership in addressing sustainability challenges. The leadership role is discussed from a perspective of the leader's belief system rather than from a leadership style or approach. The approach adopted in this section attempts to highlight that sustainability leadership requires a different kind of leadership not just traditional leadership which is mostly based on the style or position of the leader. The understanding of the different belief systems that leaders have and the associated responses to environmental management issues provides for a much more informed approach when making a leadership call for sustainable futures.

2.2 Understanding Sustainable Development and its challenges

Swilling, M. & Annecke, E² (forthcoming) list seven documents (*Box 1 below gives a summary of these documents*) that in their view represent the most significant mega-trends that are reshaping global socio-economic and ecological relationships. They argue that these documents would be seen by future generations as the documents that marked a decisive

² Professor Mark Swilling is Programme Coordinator: Sustainable Development in the School of Public Leadership, University of Stellenbosch and Academic Director of the Sustainability Institute and Ms. Eve Annecke is the director of the Sustainability Institute from their forthcoming book "*Just Transitions: Explorations of Sustainability in an Unfair World*". Cape Town: Juta, forthcoming and Tokyo: United Nations University Press, forthcoming".

turning point in the way our generation started to comprehend and therefore, act in the world.

1. **Ecosystem Degradation:** the United Nations Millenium Eco-System Assessment compiled by 1360 scientists from 95 countries and released in 2005 (with virtually no impact beyond the environmental sciences) has confirmed for the first time that 60% of the ecosystems that human systems depend on for survival are degraded (United Nations 2005.)
2. **Global Warming:** the broadly accepted reports of the Intergovernmental Panel on Climate Change (IPCC) confirm that the global warming is taking place due to release into the atmosphere of greenhouse gases caused by amongst other things the burning of fossil fuels, and that if average temperatures increase by 2 degree centigrade or more this is going to lead to major ecological and socio-economic changes, most of them for the worst and the world's poor will experience the most destructive consequences (Intergovernmental Panel on Climate Change 2007).
3. **Oil peak:** the 2008 World Energy Outlook published by the International Energy Agency declared the “end of cheap oil” (International Energy Agency 2008). Although there is still some dispute over whether we have hit peak oil production or not, the fact remains that mainstream perspectives now broadly agree with the once vilified ‘peak oil’ perspective (see www.peakoil.net).
4. **Inequality:** According to the United Nations Human Development Report for 1998, 20% of the global population who live in the richest countries account for 86% of total private consumption expenditure, whereas the poorest 20% account for 1.3% (United Nations Development Programme 1998) – only the most callous still ignore the significance of the inequality as a driver of many threats to the conditions of social cohesion and a decent quality of life for all.
5. **Urban Majority:** according to generally accepted UN reports, the majority (i.e. just over 50%) of the world's population was officially living in urban areas by 2007 (United Nations 2006) – whatever our future is, for most it will be an urban one. According to the UN Habitat Report entitled The Challenge of Slums, one billion of the six billion people who live on the planet live in slums, or put differently one third of the world's total urban population (rising to over 75% in the least developed countries) live in slums (united Nations Centre for Human Settlements 2003).
6. **Food Insecurity:** the International Assessment of Agricultural Science and Technology for Development (IAASTD) (Watson, et al 2008) is the most thorough global assessment of the state of agriculture science and practice that has ever been conducted. According to this report modern industrial chemical –intensive agriculture has caused significant ecological degradation which, in turn, will cause food insecurity in a world where access to food is already highly unequal and where demand is fast outstripping supply. Significantly this report confirmed that “23% of all used lad is degraded to some degree (Watson, et al, 2008, Ch 1, p73).
7. **Material Flows:** according to the 2011 report by the International Resource Panel, (<http://www.unep.org/resourcepanel>), by 2005 the global economy depended on 60 billion tons of primary resources (biomass, fossil fuels, metals and industrial minerals, and construction minerals) and 500 ExaJoules of energy, an increase of 36% since 1980 (Fischer-Kowalski & Swilling 2011).

Box 1: Seven globally significant mainstream Sustainable Development documents

Source: Swilling, M. & Annecke, E. (forthcoming)

The Millennium Ecosystem Assessment Report (MEA) (2005) states that: “Everyone in the world depends completely on Earth’s ecosystems and the services they provide, such as food, water, disease management, climate regulation, spiritual fulfilment, and aesthetic enjoyment. Over the past 50 years, humans have changed these ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, freshwater, timber, fibre, and fuel” (MEA, 2005). The report further states that “some 60 percent of ecosystem services— climate regulation, the provision of fresh water, waste treatment, food from fisheries, and many other services— were being degraded or used unsustainably” (MEA, 2005). The main findings of the MEA are as illustrated in Box 2 below:

Four Main Findings

Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber and fuel.

The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people. These problems, unless addressed will substantially diminish the benefits that future generations obtain from ecosystems.

The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.

The challenges of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered, but these involve some significant changes in policies, institutions and practices that are not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services.

Box 2: The Main findings of the MEA

Source: Millennium Ecosystem Assessment (2005)

The findings of the MEA are further complemented by the Ecological Footprint Indicator, which compares humanity's ecological impact with the amount of productive land and sea area available to supply key ecosystem services, which shows that humanity now uses the resources and services of 1.3 Earths. (See Figure 4 below) (WWI, 2010).

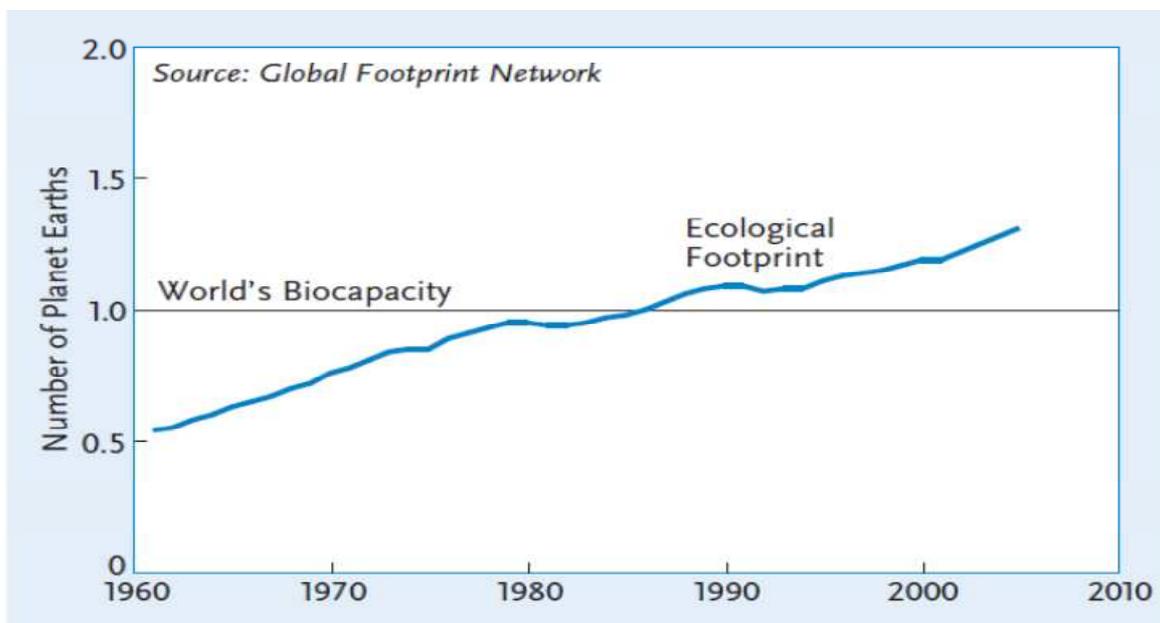


Figure 4: Humanity's Ecological Footprint, 1961 – 2005

Source: Worldwatch Institute Report (2010)

The 2010 State of the World report by Worldwatch Institute state that - *“Global consumption has risen, more fossil fuels, minerals, and metals have been mined from the earth, more trees have been cut down, and more land has been ploughed to grow food (often to feed livestock as people at higher income levels started to eat more meat). Between 1950 and 2005, for example, metals production grew sixfold, oil consumption eightfold, and natural gas consumption 14- fold. In total, 60 billion tons of resources are now extracted annually—about 50 percent more than just 30 years ago. Today, the average European uses 43 kilograms of resources daily, and the average American uses 88 kilograms. All in all, the world extracts the equivalent of 112 Empire State Buildings from the earth every single day”* (WWI, 2010).

As mentioned in the second finding of the MEA (see Box 3 above), the unsustainable use of natural resources have improved human wellbeing on one hand, and on the other hand, poverty in many parts of the world has substantially increased. Linked to the degradation of

ecosystems and persistent poverty and inequality is global climate change and the global economic crisis. With all these challenges, it is critical that humanity review its activities on earth to more sustainable patterns. This review of activities poses a challenge to the established industrial sectors like the gold mining industry.

The gold mine where I work (Gold Au) has been in operation for more than 50 years and has more than 30 years of life still left. The challenge to our gold mine is how can it position itself for the next 30 years and beyond, in the context of the global sustainable development challenges. Which actions could Gold Au take to reduce use of natural resources in the process of producing gold? What actions can our gold mine take to reduce the impact of our activities on the environment and communities?

I would like to argue that it is through committed leadership for sustainability that our gold mine can genuinely contribute to the global effort towards addressing the sustainable development challenges. Leadership in this context is viewed not from the leadership style of a leader, but from a point of view of the belief system of the leader when it comes to environmental management. This approach is based on an argument that I would like to put forth, that “the way a leader thinks, feels and relates to the environment is a possible determinant on how genuine the leader would put efforts and resources towards environmental management”.

Following the near-continual global mining boom since about 1960, there has been a wide-ranging debate about the sustainability of modern mining (Mudd, 2007). To understand the nature of these debates requires an understanding of the nature of mineral resources. Certain considerations have to be taken into account when a decision to mine any resource is taken. These considerations include issues such as ore grades, waste that will be produced, geological and mining constraints, environmental issues such as water, chemicals, land, energy requirements, pollutant emissions and lastly considerations of socio-economic constraints. These issues are known as resource intensity (Mudd, 2007). It is important to recognise the links between gold production trends and resource intensity, as this is critical for understanding future sustainability challenges (Mudd, 2007). The resource intensity of gold production, based on a comprehensive data set of global gold mining is set to increase due to the decline in ore grades (Mudd, 2007).

The Sustainable Development challenge faced by the gold mining industry as described by Mudd (2007) above is that of resource intensity which simply implies that, to mine the declining ore grades, substantially more water, energy and chemicals will be used, with a resultant increase in waste produced with all the associated impacts to the environment and communities. This resource intensity is particularly pertinent for our gold mine recognising that the gold extraction process currently takes place at 3.5km below surface. The resource intensity also happens at a time when South Africa is the largest contributor of greenhouse gas emissions in the form of CO₂ in Africa, see table 1 below, (Fischer-Kowalski & Swilling 2011). Gold extraction at these depths requires increased energy use by the mine. Understanding of these energy requirements by all employees of the mine and the implications to the environment is critical in order to develop mechanisms to save and develop alternative energy sources.

	Population (million)	GDP per capita US\$	Carbon footprint (CO ₂ emissions per capita (tons))	Carbon intensity (CO ₂ emissions per unit of GDP)
South Africa	46.6	10,715	9.8	0.99
Sub-Saharan Africa	781.3	1,945	1.0	0.57
USA	293.6	40,971	20.6	0.57
OECD	1160.5	28,642	11.5	0.45
World	6389.3	9,348	4.5	0.55

Table 1: Comparative carbon emissions 2004

Source: UNDP, 2007 in Fischer-Kowalski & Swilling, 2011

Water is another resource that is used intensively during the extraction process at our gold mine. In South Africa the “inter-basin water transfers have degraded the ecological integrity of aquatic systems and radionuclides, heavy metals and sulphates from mining activities have polluted valuable water resources” (Fischer-Kowalski & Swilling 2011). “In short the combination of low average rainfall, overexploitation and re-engineered spatial flows have led South Africa to an imminent water crisis in quantity as well as quality” (Fischer-Kowalski & Swilling 2011). It is therefore equally critical for Gold Au to understand the crisis facing South Africa when it comes to water resources and use water judiciously during mining activities.

As of 2005, the solid waste system in South Africa managed the disposal of 20 Mt of municipal solid waste and 450 Mt of mining related wastes (Fischer-Kowalski & Swilling 2011). The deeper the mining extraction process the more is the quantity of waste produced with a resultant increase in the environmental impact. The implication of the ore grade decline as illustrated in figure 5 below is that “about three times as much material needs to be moved for the same ore extraction as a century ago, with concomitant increases in land disruption, groundwater implications and energy use” (Fischer-Kowalski & Swilling 2011).

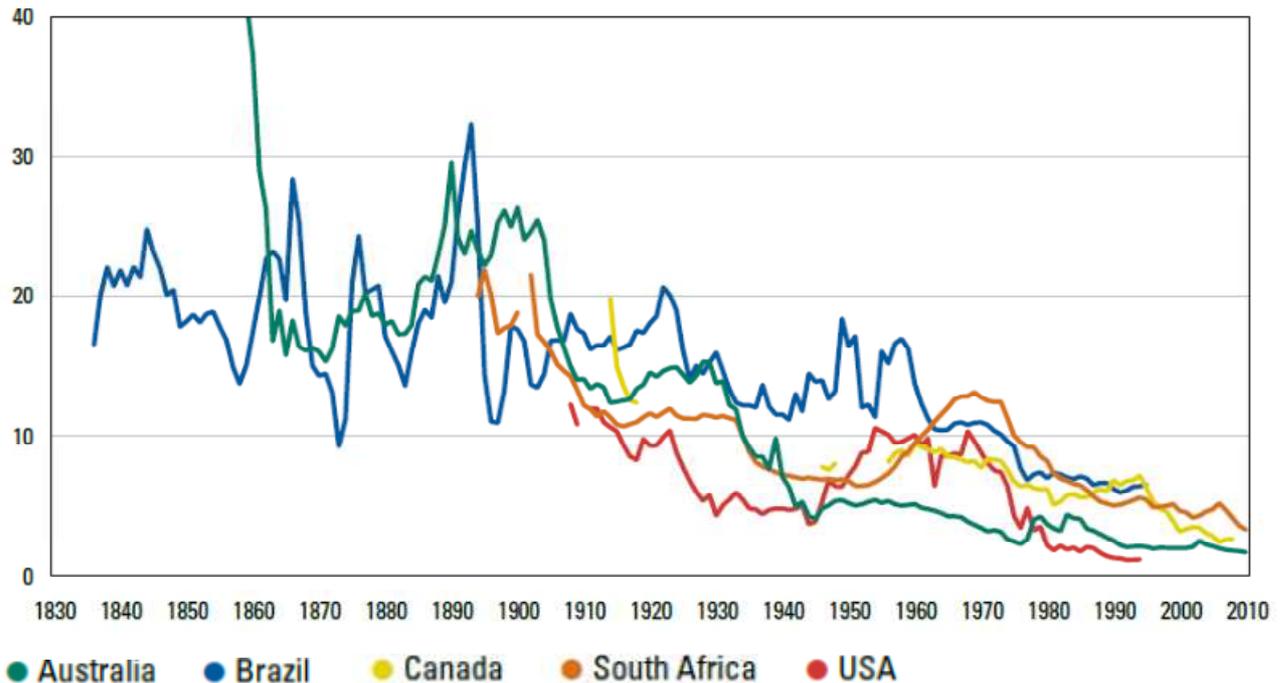


Figure 5: Ore grades of Gold mines, 1830 - 2010

Source: Giurco, et al, 2010 in Fischer-Kowalski & Swilling 2011.

In 2011 United Nations Education Programme (UNEP) released a report by the International Resource Panel (IRP) entitled “*Decoupling Natural Resources use and Environmental Impacts from Economic Growth*”. The core argument of the IRP is that “*There is no sustainable resource management without “decoupling”. Decoupling means two things, decoupling economic activity from resource consumption (“resource decoupling”) and from environmental impacts (“impact decoupling”)*” (Fischer-Kowalski & Swilling 2011). The IRP describes Resource and Impact decoupling as follows. “Resource decoupling means reducing the rate of use of primary resources per unit of economic activity. This ‘dematerialisation’ is based on using less material, energy, water and land resources for the same economic output and Impact decoupling on the other hand requires increasing economic output while

reducing negative environmental impacts. Such impacts arise from the extraction of required resources (such as groundwater pollution due to mining or agriculture).

The challenge therefore for gold mining industry lies on resource and impact decoupling (defined above), resource decoupling and impact decoupling are illustrated in figure 6 below.

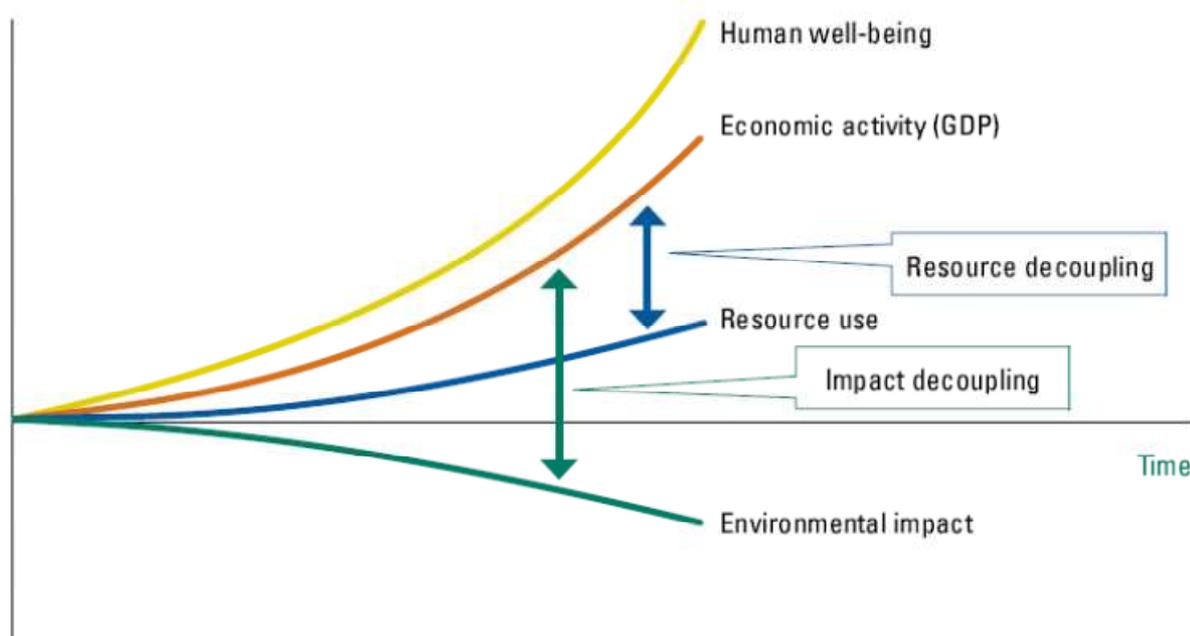


Figure 6: Representation of Resource decoupling and Impact decoupling

Source: Fischer-Kowalski & Swilling, 2011.

Perhaps for the gold mining industry to contribute to Sustainable Development an understanding of decoupling the resources used and environmental impacts from gold production output is required. It is my argument that a much more aware leadership coupled with intensive sustainable development awareness efforts may result in implementation of measures or strategies that lead to a reduction in resources used to produce gold while also achieving decreased negative environmental impacts.

The engineering department at our gold mining company is the one tasked with managing water and energy use on the resource use side and the environmental department is responsible for the resource impact side. For these two departments of our gold mining company to develop appropriate strategies and approaches an understanding of the decoupling concept as described above will be important. This understanding can be developed through educational programmes that not only are for the environmental and

engineering departments but also embedding the decoupling concepts throughout all the mine activities. It is through genuine leadership that such initiatives in our mine can be implemented.

There are various approaches to curb these impacts such as industrial ecology, eco-efficiency, cleaner productions, etc. I will take a look at two of these processes i.e. Eco-Efficiency and Cleaner Productions as applied in the gold mining industry.

The World Business Council for Sustainable Development (WBCSD) defines Eco-Efficiency (EE) as - “the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle, to a level at least in line with the earth’s estimated carrying capacity” (WBCSD, 2000). EE in minerals processing and metals production can have a positive impact on the composition, leachability and stability of processing residues, and is therefore relevant from the perspective of mine closure, site remediation and rehabilitation (Berkel, 2006). However to achieve satisfactory closure with minimal ongoing management requirements, EE in the processing stage needs to be complemented with planned approaches to mine closure, storage of large volume wastes and reduction of acid mine drainage. EE on its own is not sufficient, as it concentrates more on the strategic side of business (value creation) (Berkel, 2006), it needs to be complemented by a process that will also have an impact on the operational side of the business. The process that focuses on the operational side of the business is Cleaner Production (CP) which is defined by the United Nations Environmental Programme (UNEP) as – “the continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment” (UNEP, 1994).

Figure 7 below illustrates how EE and CP complement each other in mineral processing.

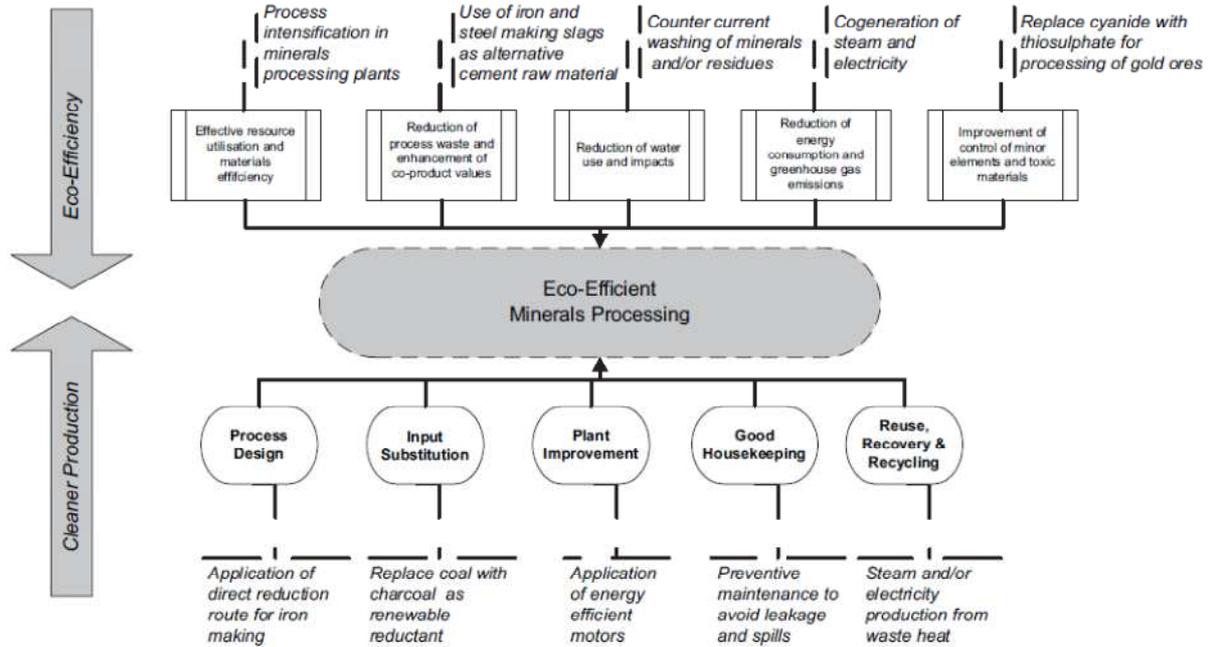


Figure 7: Inter-relatedness of EE and CP in the mineral processing industry
 Source: R. van Berkel / *Journal of Cleaner Production* 15 (2007) 772 – 781

The EE and CP concepts illustrated above need to be embedded in the mine processes, but these processes will not just happen, a concerted effort of increased awareness on how to implement EE and CP is needed and driven by strong leadership.

The EE and CP nexus can be linked back to the decoupling argument where there is resource or impact decoupling. The IRP refers resource decoupling as decoupling the rate of consumption of (primary) resources from economic activity, which is equivalent to “dematerialization”. Resource decoupling implies using less material, energy, water and land resources for the same economic output (Fischer-Kowalski & Swilling 2011). If there is resource decoupling, there is an increase in resource productivity or, in other words, an increase in the efficiency with which resources are used. Resource decoupling talks to the eco-efficiency part of the illustration in figure 7 above. The cleaner production part is described through impact decoupling which refers to “the relation between economic output and (various) environmental impacts.

There are environmental impacts associated with the extraction of resources required (such as groundwater pollution due to mining or agriculture), environmental impacts from production (such as land degradation, wastes and emissions), environmental impacts

associated with the use phase of commodities (for example mobility resulting in CO₂ emissions), and there are end-of-pipe environmental impacts (again wastes and emissions). If environmental impacts become dissociated from added value in economic terms, there is impact decoupling (Fischer-Kowalski & Swilling 2011).

2.3 General Impacts of Gold mining

To mine gold implies that one has to find the gold bearing rock first, which may be located in an environmentally sensitive area, sacred land, areas where there are communities living with cultural and heritage importance. Once a decision is taken to mine, environmental and social disturbances are bound to happen. This section gives a general overview of the impacts of gold mining.

Mining uses large amounts of water and energy, use of these resources by mining is in competition with other users such as the communities, and the more intensive energy use, which is mostly generated from coal, contributes to global warming (Oelofse, 2002). Mining affects communities in many different ways including, loss of access to natural resources, water pollution with negative consequences to aquatic life, agricultural sector, etc.(Oelofse, 2002). The migrant labour system which is highly associated with gold mining in South Africa, leads to negative social consequences such as family breakdowns and high levels of pandemic diseases like HIV/AIDS as described by Munnik below.

Munnik (2005) lists thirteen general impacts of gold mining as:

- Water use and water pollution, often in water-scarce situations
- Energy-intensity, where coal is the main source, it has climate change knock-on effects
- Waste in huge volumes, some of it highly toxic
- Surface disturbance of vegetation and failure to meet rehabilitation requirements
- Geological disturbance like sinkholes and seismic movements
- The effects of acid mine drainage, including the liberating of heavy metals
- The use of chemicals like mercury and cyanide

- Uranium and radioactivity coming from uranium in tailings and scrap metal contaminated by uranium plants
- Dust leading to health problems like silicosis
- Explosions/blasting leading to cracking of walls in nearby houses and excessive noise levels.
- Environmental injustice where communities are the victims of mining through displacement, loss of land and livelihoods, political confrontations, contaminated ecosystems – especially with “indigenous communities” in remote areas.
- Uneven gender impact, where women shoulder the burden of externalised costs through loss of natural resources, and stress on the social system, while excluded from most of the benefits.
- The legacy of more than a century and a failure of those who profited from mining to take responsibility for the present day consequences that communities live with around abandoned and “ownerless” mines.

Water pollution is one of the most important impacts of mining because of the trans-boundary nature of water and also because of its importance in various ecosystems (Turton, A.R., C. Schultz, H. Buckle, M. Kgomongoe, T. Malungani and M. Drackner, 2006). Great quantities of water are used in gold mining, such as in ventilation and cooling deep underground, as dust suppressant during the actual drilling processes, pumping water out from underground to facilitate mining, washing gold with chemicals such as cyanide (Turton, et al, 2006).

An account from a book by Paul Johnson entitled, *“Consolidated Gold Fields: A Centenary Portrait”*, gives an insight into the scale of water pumping associated with deep level mining: “...from 1955 West Driefontein never pumped out less than seven million gallons a day. (Johnson, 1987). In 1962-64 it had to pump out over thirty million gallons a day, and it soon had more pumps than anywhere else in Africa, capable of handling up to sixty three million gallons daily (Johnson, 1987). At one time enough water was pumped out of West Driefontein each day to supply a quarter of the needs of six million people living in the Witwatersrand, Pretoria, Southern Transvaal and the Orange Free State (Johnson, 1987)”.

“...water pollution is an increasingly important socioeconomic issue in South Africa. Experience overseas (Europe and North America) has shown that the costs involved in the remediation of large-scale polluted areas are far too high, owing to too large quantities of contaminated material being treated. The uncontrolled release of acid mine drainage as a direct result of poor operational treatment is unequivocally the single most important impact of mining activities on the environment. Acid Mine Drainage (AMD) originates primarily from the oxidation of sulphide materials, which occur in significant quantities (30-50 kg of sulphide minerals per ton) in the primary ore. The acid drainage emanating from the gold residue material in South Africa contains, as a rule, large quantities of salts (sulphate and chloride), significant concentrations of toxic heavy metals and trace elements such as Cu, As and CN, as well as radionuclides... (Roesner, T, Reyneke, R, Aucamp P and Vermaak J, 2001)”

The other important negative impact of gold mining is in the area of climate change. As the grades fall and mining has to take place deeper and deeper, more and more tons of earth have to be removed, energy to pump water has to increase, energy for cooling and ventilation underground also increases. The source of energy is mostly from coal and therefore the more energy used by the mining company the higher the impact on climate change (Mudd, 2007).

“Mining has a long history in South Africa, which has resulted in large quantities of mine waste. In 1996 a total of 377 million tons of mine waste was produced, accounting for 81 per cent of the total waste stream in South Africa (Godfrey, L., Oelofse, S., Phiri, A., Nahman, A., and Hall, J, 2007). The presence of these mine dumps resulted in large-scale pollution of the subsurface, affecting an area of approximately 180 km² (Godfrey, et al, 2007). This poses a potential threat to the scarce water resources (surface and groundwater) of South Africa and is cause for serious concern with respect to land development of sites, where tailings dams have been reclaimed. The majority of the tailings dams (more than 200) were deposited 30-50 years ago... (Roesner, T, Reyneke, R, Aucamp P and Vermaak J, 2001)”

These mine dumps sterilise the land on which they are located and are a source of several other disturbances such as dust which may be a health hazard to surrounding communities

such silicosis. The Legal Resources Centre state that –“Apartheid era planning practices placed poor, black communities towards the south of the city (Johannesburg), downwind of the tailings dams, and reserved the sheltered areas for white, middle class people. These traditionally black townships are densely populated and, in many cases, town planners have failed to allow for buffer zones between tailings dams and human settlement. Some people literally live at the foot of a mine dump. These areas experience heavy dust falls in the windy, dry months of the year. Furniture, gardens and even food tend to be covered with a thin layer of dust. This may introduce chemical irritants in the deep lung region, causing conditions such as chronic asthma and bronchitis” (Environmental Justice Project, LRC, 2002).

2.4 The Impact of Mining on People wellbeing

Geita is one of the administrative districts in Mwanza region of Tanzania and is one of the five (Geita, Musoma, Tarime, Chunya and Mpanda) major goldfields of Tanzania (Kikula & Kiangi, 2002) in Kitula (2004). In a case study conducted in the Geita district on *“the environmental and socio-economic impacts of gold mining on local livelihoods in Tanzania”* by Kitula (2004) positive and negative impacts of were found. On the positive aspects the study found out that approximately 93% and 80% of respondents in mining and non-mining communities, respectively, benefit differently from the existence of mining activities (Kitula, 2004). These benefits ranged from being directly employed by the mine to improved road networks, water, school constructions and indirectly through food crop sales and other subsistence petty businesses.

A study in Ghana also found that the mining sector, largely gold mining, is said to be a significant contributor to formal and informal employment in that country (Akabzaa & Darimani, 2001). Up to 1995, the sector accounted for an estimated 20% of formal sector employment, with large-scale mining companies employing about 20,000 people, and the small- scale and artisanal mining sectors accounted for more than twice that number. In addition, mining sector support companies such as assay laboratories, equipment leasing and sales agencies, security and catering agencies also contribute to formal sector employment (Akabzaa & Darimani, 2001).

In Indonesia mining has often been regarded as a catalyst for accelerating development of infrastructure and increasing community well-being in many areas. This is particularly true for many districts (*kabupaten*) where local governments generally lack the capacity to provide public services (Resosudarmo, Resosudarmo, Sarosa & Subiman; 2009). Resosudarmo, *et al*, further state that *“The companies created wealth and jobs, delivered public services, and generally improved the welfare of the people”*. Contribution of the minerals sector to Indonesian Gross Domestic Product (GDP) has been significant, in 2000 mineral mining contributed 3% and by 2007 the contribution grew to 8% of Indonesia’s GDP. The export of ores and minerals increased from US\$3.2 billion in 2000 to US\$7.2 billion in 2005 (PricewaterhouseCoopers, *mineIndonesia 2007*) cited in Resosudarmo, *et al*, (2009).

The results of studies in Chile, Bolivia and Peru on the costs and benefits of mining operations conducted by McMahon and Remy in 2001 found that *“there were substantial benefits and few economic costs to the communities near the mining operations”* (McMahon & Remy, 2001). These benefits came mostly in the form of employment in sub-contracted firms or suppliers of mine-related goods and services which were often equal to or much higher than mine employment, fourteen times as high in the case of one of the mines. In turn, estimated non-mine related employment generated through multiplier effects was often much higher than direct or indirect mine employment —about 2.5 times as high in some cases. McMahon and Remy also found out that salaries for miners and contractors were much higher than general local levels in the cases where data exists. Other benefits came in the form of infrastructure development.

In one case a development of a paved road to the coast created a potential for further development of the agricultural sector and tourism. *“In most cases, the most important expenditures on infrastructure were for construction of or upgrading local roads, schools, and hospitals. An interesting exception occurred in the case of Puquio Norte in Bolivia, where the company and local community combined funds to build a gas pipeline to the mine that was larger than necessary to meet the company's needs. The extra capacity was used to provide electricity to the local rural population”* (McMahon & Remy, 2001). Training and education of mine employees and the community were also found to be significant.

However, Scott Pegg³ offers a different argument, and he argues that mining is more likely to lead to poverty exacerbation than it is to poverty reduction (Pegg, 2005). *“A World Bank study distinguished three different types of mining countries – countries where mining is “dominant” (mining products contribute more than 50% of all exports), where mining is “critical” (contributing between 15 and 50% of all exports) and where mining is “relevant” (6 - 15% of exports). Strikingly, it found that per capita gross domestic product (GDP) growth was negative for all three categories of mining countries from 1990 to 1999. Beyond this, growth rates were inversely associated with the level of dependence on mineral exports - countries with lower shares of mineral resource dependency had their economies shrink by less than countries with higher shares did. Specifically, the 18 countries where mining is “relevant” (6 - 15% of exports) had an annual GDP per capita growth rate of -0.7%. The 22 countries where mining is “critical” (15 - 50% of exports) had an annual GDP per capita growth rate of -1.1%, while the eight countries where mining is “dominant” had an annual GDP per capita growth rate of -2.3%” (Pegg, 2005).*

From the above discussion one can easily conclude that the impact of mining on people wellbeing is largely economical in nature. The above demonstrates few benefits or effects of mining beyond the economic realm, in areas such as community values, cultures, health, etc. Our mining company employs people from various backgrounds who come from different regions of South and Southern Africa, their understanding and perception of the impact the work they do to society is important. Their understanding and perceptions would inform the company on what measures need to be taken for the mine as a whole to ensure that the mine contributed to sustainable development. These measures may include the kind of education and awareness programmes that need to be implemented. The following sections will look at the other impacts of gold mining beyond the economic impacts.

2.5 The Impact of mining on social norms

The South African gold mines employ more than 200 000 male workers, 95% of whom are migrants, some from rural areas within South Africa and others from surrounding countries such as Lesotho, Botswana and Mocambique (South African Chamber of Mines, 2009). The

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vast majority of these workers are housed in single sex hostels close to their workplaces (Campbell, 1997). In a cross-sectional community based study of migrant men working in the gold mines in Carletonville and non-migrant workers and their partners, Lurie et al (2002) found that 25.9% of migrant men and 12.7% of non-migrant men were infected with HIV and they concluded that migration is a significant risk factor for HIV infection in men. In Campbell's study of migrant workers still in the Carletonville Gold mines, factors such as the general working and living conditions on the mines , the ever-present danger of accidents, and mine workers' perceived lack of control over their health and well-being repeatedly emerged as important features of the world in which mine worker identities were fashioned (Campbell, 1997).

“The correlation between social support and risk-taking behaviour provides an interesting framework within which to consider the high levels of unsafe sexual behaviour practised amongst mine workers. Informants spoke at length about the loneliness of being away from their families. They spoke of anxieties that their distant rural wives or girlfriends might be unfaithful; of worries about their children growing up without a father's guidance; of their own guilt about money they might have wasted on alcohol and commercial sex which they should have sent to their families” (Campbell, 1997)⁴.

Perhaps there is no single industry that has precipitated more disputes over land use than mining. As Castro and Nielsen (2001) cited in Hilson (2002) explain, natural resource conflicts are typically “severe and debilitating, resulting in violence, resource degradation, the undermining of livelihoods and the uprooting of communities”, and if not addressed, “can threaten to unravel the entire fabric of society” (Hilson, 2002). In Indonesia, much of the conflict is triggered by the allocation of mining permits or contracts to companies on community or indigenous lands (Resosudarmo, et al, 2009). These allocations are mostly done without the consent, consultation and even proper compensation to the communities.

In most cases these permits are allocated on lands where traditional and indigenous communities have dwelled, earned their livelihood, and practiced their cultural heritage for

⁴ Though the study was conducted in 1997, the current situation at the mines has slightly changed with improved living conditions and more flexible working conditions and effort to recruit most workers from local communities, however the remnants of the migrant labour system are still felt and are present within the mines.

generations. As a result, conflicts abound when these mining operations trespass or excavate communities' villages, hunting areas, gardens, farms, or burial and sacred grounds (Resosudarmo, et al, 2009).

In the Tarkwa region of Ghana mining operations specifically gold mining, have had a serious impact on social organization and cultural values of people. *"Concerns have been expressed about inadequate housing, youth unemployment, family disorganisation, school dropout rates, prostitution and drug abuse. If these problems are not new to the Tarkwa area, they have risen to a level that the population perceives to be threatening and the main cause has been the concentration of mining activities in the area. According to the Wassa West District Planning Officer, the concentration of mining activities has triggered massive migration of all kinds of people to the area"* (Akabzaa & Darimani, 2001).

Akabzaa and Darimani further stated that "One of the major social issues that have emerged from the concentration of mining activities in Tarkwa is prostitution. Over 70% of the communities contacted complained of the increase in prostitution and cited it as one of the factors responsible for the erosion of social values in the area". In Tarkwa there has also been an increase in the use of addictive drug abuse especially among clusters of galamsey operators and prostitutes. These drugs are consumed in the belief that they stimulate the miners to work very hard.

The same findings were observed in Tanzania in Geita District, mining has had socio-cultural impacts which include displacement and unemployment, child labour, accidents, and theft, high influxes of migrants in search of jobs. This, in turn, has resulted in prostitution, increased incidences of banditry, changes to indigenous lifestyle, and increased competition among local residents for natural resources (Kitula, 2005).

In the province of Benguet in Philippines mining has not only caused serious environmental destruction and suffering for the affected communities, but have also violated the collective rights of the indigenous peoples. As proven by the experience of the Benguet indigenous peoples, large-scale corporate mining and dams destroy, pollute, disrupt agricultural economies, and displace indigenous peoples (Cordillera people's alliance, 2007).

In a worst-case scenario, mines have even fueled conflict in some developing countries by providing revenue for warring factions to purchase weapons. A 2005 report by the Human Rights Watch titled “The Curse of Gold- Democratic Republic of Congo” states that *“AngloGold Ashanti, one of the largest gold producers in the world, started exploration activities in the Mongbwalu gold mining area AngloGold Ashanti representatives established relations with the FNI, an armed group responsible for serious human rights abuses including war crimes and crimes against humanity, and who controlled the Mongbwalu area. In return for FNI assurances of security for its operations and staff, AngloGold Ashanti provided logistical and financial support – that in turn resulted in political benefits – to the armed group and its leaders. The company knew, or should have known, that the FNI armed group had committed grave human rights abuses against civilians and was not a party to the transitional government”* (Human Rights Watch, 2005).

In the same report it is stated that *“In 2003, an estimated \$60 million worth of Congolese gold was exported from Uganda, much of it destined for Switzerland. One of the companies buying gold from Uganda is Metalor Technologies, a leading Swiss refinery. Metalor knew, or should have known, that gold bought from its suppliers in Uganda came from a conflict zone in north eastern DRC where human rights were abused on a systematic basis. The company should have considered whether its own role in buying gold resources from its suppliers in Uganda was compatible with provisions on human rights and it should have actively checked its supply chain to verify that acceptable ethical standards were maintained. Through purchases of gold made from Uganda, Metalor Technologies may have contributed indirectly to providing a revenue stream for armed groups that carry out widespread human rights abuses”* (Human Rights Watch, 2005).

In general, the social and cultural repercussions of mining can be grave especially with local rural and or indigenous people. Because mining has a potential to employ people, immigration of people from various parts of the country or even from other countries is not uncommon. Of great concern is a situation where the culture and values of the local/indigenous community and the migrants are different, local communities could feel that their own culture would be ‘diluted’ and even overwhelmed by the arrival of a large number of workers with possible disastrous consequences for the society at large.

The social norms are not easily observable especially to those people who are not locals or who visit a mining area for work or to those people who have been attracted to the area in search of employment. However there are other clearly observable impacts of mining even to the 'new' or to the 'visitors'. These impacts are mostly those associated with health and environment.

2.6 The impact of mining on Health and Environment

2.6.1 Health Impacts

"The World Health Organization (WHO) and other organizations report that the prevalence of human diseases during the past decade is rapidly increasing. Population growth and the pollution of water, air, and soil are contributing to the increasing number of human diseases worldwide. Currently an estimated 40% of world deaths are due to environmental degradation" (Pimentel, S., Cooperstein, H., Randell, D., Filiberto, Sorrentino, S., Kaye, B., Nicklin, C., Yagi, J., Brian, J., O'Hern, J., Habas, A., & Weinstein. C., 2007). This begs the question – what is or has been the contribution of the mining industry to this environmental degradation and human diseases?

In a case study by Kitula in the Geita district of Tanzania it was discovered that metallic mercury (Hg) used to trap fine gold from ore pulp is often discharged into the environment (air, water). When this uncontrolled discharge happens metallic mercury can be transformed into methylmercury which is readily available and may be found at elevated concentrations in higher levels of the food chain, particularly in aquatic systems (Kitula, 2004). People reliant on fish are particularly susceptible to methylmercury and when they are exposed can suffer from muscular dystrophy, seizures, mental disturbance. Methylmercury is easily transferred from women to the fetus, with effects ranging from sterility, spontaneous abortion, and from mild-to-severe neurological symptoms (Kitula, 2004).

In the Philippines, Drasch & Bose-O'Reilly conducted a study of 102 workers (occupationally Hg burdened ball-millers and amalgam- smelters), 63 other inhabitants (exposed from the environment), 100 persons, living downstream of the mine, and 42 inhabitants of another

site (serving as controls) was undertaken. Bio-monitors and medical scores for both workers and the surrounding communities were taken. The authors report that “By this method, 0% of the controls, 38% downstream, 27% from Mt. Diwata, nonoccupational exposed and 71.6% of the workers were classified as Hg intoxicated” (Drasch, Bose-O'Reilly et al, 2001).

In Ghana at the village of Dumasi a study by United Nations Industrial Development Organisation (UNIDO) showed a diffuse mercury contamination of all the environmental media in the village. Fish caught locally had a mercury content above the U.S-FDA action level, meaning that they should not be consumed. The study on human health revealed that the entire community of Dumasi, whether directly involved in gold mining or not, was over-exposed to mercury (UNIDO, 2001).

Respiratory diseases are one of the most common impacts of mining to human health ranging from exposure to asbestos, silica dust and coal dust. Asbestos has been mined for centuries and known to be hazardous since the beginning of the 20th century (Stephens & Ahern, 2001). In a study by Armstrong and de Klerk in Western Australia of 6505 men and 411 women who were employed in the mining and milling of crocidolite at Wittenoom in the Pilbara region of Western Australia between 1943 and 1966. Statistically significant excess death rates were observed in men for neoplasms, particularly malignant mesothelioma (*a type of malignant lung cancer specifically linked to asbestos*) (32 deaths), neoplasms of the trachea, bronchus, and lung, and neoplasms of the stomach; respiratory diseases, particularly pneumoconiosis; etc. (Armstrong, de Klerk, Musk & Hobbs, 1988).

In a study by Aakabzaa, Seyire and Afriyie (2007) state that heavy metals such as Mercury (Hg), Lead (Pb), Nickel (Ni), Copper (Cu), Arsenic (As), Cadmium (Cd), Manganese (Mn) and Zinc (Zn) can have serious consequences to human health when they enter the food chain. Table 2 below illustrates some impacts that are caused by these heavy metals to human health. All these metals are can be used in various stages in the gold mining process, be it during extraction, processing or waste disposal stage.

Cadmium: Respiratory tract infection, lung toxicity, bronchitis, kidney damage, gastrointestinal irritation, nausea, vomiting and pain. A possible carcinogen.

Copper: Irritation of eyes, mouth and nose; nausea, diarrhoea and abdominal pain, headache, dizziness, liver and kidney effects.

Lead: Impaired growth, induces weakness in the fingers, wrists and ankles, increased blood pressure; anaemia, damage to kidneys; abortion in women and damage to male reproduction system leading to sterility

Manganese: Chronic exposure affects the nervous system and the effects are termed manganism characterised by feeling of weakness and lethargy and progress with other symptoms such as speech disturbance, a mask-like face, tremors, psychological disturbances, and respiratory effects such as incidence of cough and bronchitis and also increased susceptibility to infectious lung diseases. It may also cause reproductive/developmental effects such as impotence and loss of libido.

Mercury: Kidney damage, irritation, nausea, vomiting, pain, ulceration and diarrhoea; and toxicity to the brain and nervous system.

Nickel: Respiratory tract infections such as chronic bronchitis, asthma and emphysema

Zinc: Gastrointestinal effects, impaired lung functioning and respiratory irritations

Table 2: Human Health Effects of some heavy metals used in the mining industry

Source: (Da Rosa and Lyon, 1999, Guo and Valberg, 1997; Ogola et al., 2002, Ross, 1999, Smith and Huyck, 1999)

In various district communities in Ghana, Aakabzaa, et al, (2007) conducted various health impact surveys within communities exposed to various gold mining activities. The Kwabrafoso community is situated along the Kwabrafoso Stream which takes effluents from a number of old gold mining tailing dumps and from the Pompora Treatment Plant (PTP). The plant roasts sulphide ore for efficient processing but also sends noxious gases of both sulphide and arsenic into the air. The five most prevalent diseases in the area were acute respiratory infections, eye infections, skin diseases and diarrhea. All of these diseases have possible causal links to a variety of heavy metal oxides associated with roaster fumes. A similar pattern of the diseases were also found in Sansu community. Sansu has a concentration of surface mining pits, ore crushing and milling facilities in addition to Sulphide Treatment Plant (STP). These activities give rise to considerable dust pollution and pollution of streams through the mobilisation of heavy metals in waste emanating from these facilities.

In two other communities in Ghana (Dokyiwa and Binsere), it was observed that acute respiratory infections, eye infections, skin diseases, malaria and diarrhoea, were the most prevalent diseases. The Dokyiwa Stream receives mine effluent from waste gold dumps upstream. In addition, there is a huge spent cyanide containment pond close to these communities.

Bridge (2004) points to HIV/AIDS as a leading mining hazard, particularly in South Africa where the combination of widespread poverty and the system of migrant mine labor that developed under apartheid established social conditions conducive to the rapid transmission of sexually-transmitted diseases. The World Bank estimates 20% of coal miners and 30% of gold miners in South Africa are HIV positive (prevalence rates 17% higher than in the base population), and productivity losses from the disease are estimated around 20% (Bridge, 2004).

The system of migrant labour and single sex hostels which is prevalent in gold mining industry in South Africa perpetuates the high levels of HIV/AIDS within the industry. In a study by Gebrekristos and Lurie in 2003 of the prevalence of HIV/AIDS amongst men who live with their partners and those that are separated they found that "HIV prevalence was found to be lowest among men who spent the most time with their partners. As for the women, HIV prevalence was highest for those who received the most visits from their men who were migrant workers. The implication is that migrants contracted HIV from casual sexual encounters and brought it back to their long-term partners (Gebrekristos and Lurie 2003). In the same study, couples who stayed together all year had the lowest rate of infection. Because of the migrant labour system, the high levels of HIV/AIDS and TB within the gold mining industry gets transmitted to far flung areas of the country too. The gold mine workers have very high levels of TB, Silicosis and HIV. Churchyard, Ehrlich, Naude Pemba , Dekker, Vermeijs, White and Myers (2004) state that the prevalence of silicosis in a recent cross sectional study of 520 gold miners (with mean length of service of 21.8 years) was found to be 18.3–19.9%, according to two X-ray readers (Churchyard et al., 2004). The high level of migrancy has also played a role in escalating disease rates. Migrancy has reduced the ascertainment of compensable disease, externalized the costs of attending to

occupational disease to remote labour-sending areas (Rees, Murray, Nelson and Sonnenberg, 2009).

The gold mines in South Africa have among the highest TB incidence rates in the world. TB prevalence has increased steadily, from 806/100,000 in 1991, to 1914/100,000 in 1998, to 3,821/100,000 in 2004 (Glynn, Murray, Bester, Nelson, Shearer and Sonnenberg, 2008). TB acquired in the mines has the potential to fuel TB transmission in home regions through the process of oscillating migration (*process of going to work in a faraway place for periods of time, go back home and then return to work*). Once TB was introduced onto the gold mines it spread rapidly to communities throughout the migrant labour system because “black mineworkers who developed TB had their contracts terminated and were repatriated to the neighboring countries and rural areas from whence they came, thus transmitting TB to the rural areas of southern Africa (Collins, 1982 in Rees, et al, 2009).

Two studies, in Botswana (Steen et al, 1997 in Rees et al., 2009) and the Eastern Cape province of South Africa (Trapido et al, 1998a in Rees et al., 2009), demonstrate the high rates of silicosis in former gold miners living in remote labour-sending areas. Trapido et al. (1998a in Rees, et al, 2009) summarized this by saying “A combination of natural disease latency and social, political and economic factors associated with labour migrancy have resulted in an externalizing of occupational disease costs away from the gold mining industry.”

A greater understanding of these health impacts by our employees is important because it will shape their attitudes towards their own health and safety and also efforts by mine leadership towards minimizing these impacts. The objective of exploring this understanding by our employees is important because it may assist with the development of programmes that can enhance the understanding and possibly re-engineer the working environment for the benefit of the employee and community health. It is through this understanding that a relevant framework for sustainable development can be developed that cater for the contribution of our gold mine to sustainable development challenges. In developing the sustainable development framework, it would be crucial to bear in mind that health impacts do not only affect the workers but have a general negative impact on poverty, as the people

who are impacted negatively by our mining activities can lose their jobs and thus increased unemployment and poverty.

2.6.2 Environmental Impacts



Figure 8: Tailings spillages into the environment and a typical acid mine drainage water in Carletonville, South Africa (2009)

SOURCE: Personal archives

Acid Mine Drainage (AMD) is responsible for the most costly environmental and socio-economic impacts in South Africa (Oelofse, Hobbs, Rascher & Cobbing, 2007). During 1997, South Africa produced an estimated 468 million tons of mineral waste per annum. Gold mining waste was estimated to account for 221 million tons or 47% of all mineral waste produced in South Africa, making it the largest single source of waste and pollution. There are more than 270 tailings dams in the Witwatersrand Basin, covering approximately 400 km². These dams are mostly unlined and unvegetated, providing a source of dust, as well as soil and water pollution (Oelofse et al., 2007).

Mine effluent currently decants between 18 and 36 megalitres per day from an old Black Reef Shaft on the Old West Rand Consolidated Mine property (Harmony Gold Mine Limited), and an unquantified volume is still escaping downstream or into the groundwater (Hobbs and Cobbing, 2007). The water quality of the river systems, wetlands, and groundwater in Gauteng and the North West Province has been deteriorating rapidly over the past five years due to mine effluent issuing from old abandoned gold mines.

The high acidity of acid mine drainage and the high amounts of dissolved heavy metals (such as copper and zinc) generally make acid mine drainage extremely toxic to most organisms

(Pentreath, 1994), especially aquatic animals. Other than the visible reddish color of acid water, the impact of AMD is far worse and mostly hidden from day to day activities of human beings. Soil micro-organisms play a vital role in energy flows and geochemical recycling of nutrients through decomposition of plant and animal tissues that return nutrients to the soils (Pentreath, 1994). These nutrients are further taken up by plants and later, by consumer animals through the food chain. AMD destroys this cycle and with the consequential impact on the entire food chain (Pentreath, 1994).

The impacts of acid mine drainage (AMD) are not confined to the water in a river. The riparian zones along the riverbanks are unique habitats for plants and animals. Acidic water seriously affects such habitats in terms of heavy metals deposition especially in areas with clay particles. The resulting contamination of soil with metal-rich acidic water would not only kill soil fauna and microorganisms but would have a detrimental effect on fruit bearing plants cultivated by the people (Pentreath, 1994).

According to Van Eeden, Liefferink and Durand (2009), in the West Rand region of Gauteng; South Africa - "Acidic mine water is currently decanting from a number of old abandoned gold mining shafts into the Tweelopiespruit Catchment immediately to the north of the Wonderfonteinspruit and flows into the local dolomitic aquifer; the water level is still rising in this area and may decant into the Wonderfonteinspruit, *with all the associated consequences*" (Van Eeden, Liefferink and Durand., 2009). They further state that – "The pollution of the Tweelopiespruit and the Wonderfonteinspruit by AMD not only impacted negatively on the biodiversity of the region, but also on the health of the surviving organisms that are dependent on the water from the river or groundwater in the vicinity of the mines in that region (Van Eeden, Liefferink and Durand., 2009).

AMD-contaminated groundwater is used for irrigation in the vicinity of the mines. Metals and other pollutants are accumulated in organisms as they pass through the food chain (Van Eeden, et al 2009). During the process of bioaccumulation, some toxins can become more concentrated as they travel up the food chain and have a detrimental effect on higher trophic levels (Kang et al., 1997 in Van Eeden et al 2009).

Quantification of the effects that mining activities have on ecosystems is a major issue in sustainable development and resources management. In 2005 Latifovic, Fytas, Chen and Paraszczak assessed land cover change resulting from large surface mining development in Athabasca, Alta Canada. The analysis showed a decrease of natural vegetation in the study area (715,094 ha) for 2001 of approximately 8.64% relative to 1992, KRI trend analysis of the area also indicated a slightly decreasing trend in vegetation greenness in close proximity to the mining development (Latifovic., et al., 2005).

Table 3 below shows the various impacts of mining on biodiversity.

Environment	Mining Impact
<i>Forests</i>	The key direct impact of mining on forest ecosystems is the removal of vegetation and canopy cover. Indirect impacts include road building and pipeline development, which may result in habitat fragmentation and increased access to remote areas. While larger intact forest ecosystems may withstand the impacts of mining and oil development, smaller fragments are likely to be particularly sensitive to clearing.
<i>Wetlands and Mangroves</i>	Wetlands (including estuaries, mangroves, and floodplains) act as natural pollution filters, as well as provide unique habitat for aquatic species. Mangroves act as an important interface between terrestrial and marine ecosystems, often providing food and refugia for marine organisms. Wetlands may be destroyed through direct habitat elimination or by pollution from heavy metals and oil spills upstream. Mining and oil development can also contribute to the destruction of mangroves and wetlands through altering upstream watersheds and increased sedimentation.
<i>Arid Environments</i>	Water scarcity is the primary constraint in arid environments. Vegetation is limited, but biodiversity is high among insects, rodents, and other invertebrates, especially in semiarid regions. The main impact of mining and oil development on these ecosystems is the alteration of the water regime, especially lowering of the water table and depletion of groundwater. These impacts may result in increased salinization of the soil and erosion, which eventually lead to a decline in vegetation and wildlife species. In densely populated areas, the competition for scarce water resources makes these ecosystems especially fragile.

<p><i>Coral Reefs</i></p>	<p>Coral reefs harbor the most biodiversity of any marine ecosystem. Located primarily in the Indo-Western Pacific and Caribbean regions, coral reefs are important links in maintaining healthy fisheries. Mining directly impacts coral reefs through increased sedimentation especially in cases where wastes are dumped directly in rivers and oceans, as well as through increased pollution of heavy metals.</p>
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Table 3: Impact of mining on biodiversity

Source: H.A. Mooney et al., "Biodiversity and Ecosystem Functioning: Ecosystem Analyses," In V.H. Heywood and R.T. Watson *Global Biodiversity Assessment* (London: Cambridge University Press/ UNEP, 1995); J.A. McNeely et al., "Human influences on Biodiversity," in V.H. Heywood and R.T. Watson, *Global Biodiversity Assessment*; World Resources Institute, *World Resources Report 2000-2001* (Washington, DC: World Resources Institute, 2001).

The impacts discussed above are not exhaustive, but they give a good indication of what the mines can do and are doing to people's health and environment

There are however, occasions where mining can have a disaster that instantly affects large numbers of people and the environment. One such disaster is the bursting or failure of a gold mine tailings dam in Merriespruit, Virginia South Africa in February 1994 resulting in the deaths of 17 people and widespread damage to the village and surrounding environment. The first row of houses in Merriespruit was only some 300 m from the breach location, the wave of tailings was about 2.5 m high when it reached these houses. Many houses were swept off their foundations and others had walls demolished. Figure 9 below shows a pictorial view of the disaster (Fourie, Blight, Papageorgiou, 2001).



Figure 9: 1994 Merriespruit Tailings dam failure in Virginia, South Africa

Source: Google images

On the 9th of March 2005 the largest ever South African mining-related earthquake (magnitude 5.3) hit the town of Stilfontein. The seismic event killed two miners at Hartebeestfontein gold mine and caused structural damage to two commercial properties, three blocks of flats, the civic centre and 25 houses (Goldbach, 2010). The damage to buildings was estimated at R20 million – R 30 million. The insurance damage was estimated at R 500 million. Around 3200 miners were evacuated under difficult circumstances. DRD Gold Mine liquidated its Stilfontein mines after the earthquake (Goldbach, 2010). About 6500 workers were left without jobs, affecting the livelihood of some 100 000 South Africans who depended on the income of these miners. Approximately 2300 families were left destitute after the closure of the mine (Goldbach, 2010). A similar event occurred in Welkom (South Africa) in 1976 resulting in severe damages (collapse) to a block of flats, fortunately in this event no lives were lost.



Figure 10: Damage to buildings as a result of mining related earthquakes in Stilfontein and Welkom South Africa
Source: Goldbach, 2010.

The two events illustrated above are unpredictable and can happen anytime. Of greater concern is the lack of sufficient knowledge on the relationship between mine water and

seismicity because fluid-induced seismicity may occur as mines approach the end of their lives, cease operations and allow the underground workings to be flooded with groundwater (Goldbach, 2010). The consequences of allowing a mine to flood could be an earthquake that is large enough to cause damage to a big city or metropole, such as Johannesburg. The increase in seismicity may be associated with gradual flooding of the Central Rand Basin. The Central Rand Gold mining company has recently restarted gold mining activities beneath Johannesburg. No-one knows whether Johannesburg will experience an earthquake the size of the Stilfontein event once Central Rand Gold has closed and the mine floods. But, if it does, the consequences could be severe (Goldbach, 2010).

In sections 2.3 – 2.6 above the impact of mining to society and the environment at large has been discussed. The understanding of these impacts of mining serves as important indicators that could contribute towards a development of a sustainable development framework that our gold mine can test. These impacts also emphasize the importance of decoupling economic outputs from natural resource. For our gold mine the challenge is how do we produce gold using less natural resources and having reduced impact on the environment?

2.7 The role of leadership in addressing sustainability challenges

It is now 2011, 39 years after the 1972 Limits to Growth report by The club of Rome, in 1987 there was the World Commission on Environment and Development conference, in 1992 there was the Earth Summit in Rio, in 1997 the Kyoto Protocol, in 2002 the Earth Summit in Johannesburg, in 2009 the Copenhagen accord, for 2012 the world is preparing for Earth Summit in Rio which is known as Rio+20. All these conferences and summits have been discussing sustainable development issues and how to respond. This begs the question, what kind of leadership is required to address the sustainability challenge?

According to Ferdig⁵ (2007) the sustainability challenge requires a shift in consciousness where:

- *Anyone can choose to become a leader and take responsibility for fostering sustainable conditions in the workplaces, communities and even on a global scale;*
- *The role of a leader includes capabilities beyond those we currently attribute to leaders, primarily learning what it means to be a leader with others instead of a leader 'of' or 'over' others;*
- *A leader cannot effectively operate outside the holistic interconnections that exist among and between people and natural systems (Ferdig, 2007).*

It is the sustainability leadership (as described above) that needs to be embedded within our gold mine in order to address our mining activities impact on the environment and communities with the same vigour and enthusiasm displayed during the 2008 electricity crisis.

In a study by Herremans, Herschovis and Bertels (2008) of the petroleum industry in Canada studying the sources of resistance to change among firms in the Canadian petroleum industry in response to a shift in societal level logics related to corporate environmental performance (Herremans,et al, 2008) found out that there were various competing institutional logics that determined the response of the industry. "Firms within the industry were driven by different institutional logics with one population guided by a logic aligned with increasing societal pressures for improved corporate environmental performance and reporting (labeled "leaders,") and the other guided by a logic shaped by local, cultural, political, and economic ideals less receptive to environmental performance and reporting (labeled "laggards")" (Herremans,et al, 2008).

Delmas and Toffel (2003) state the adoption of environmental management practices by firms is based on two theories, the economic approach and the institutional theory. The economic approach describes firms' adoption behavior as driven by performance outcomes

⁵ Dr Mary Ferdig is the President and CEO of Sustainability Leadership Institute a non-profit research and development organization that supports sustainability leaders based in Omaha (US).

and the institutional theory states that firms respond to institutional pressures (Delmas and Toffel 2003). Delmas and Toffel support the argument by Herremans, et al, emphasizing the role external forces (regulators, society, suppliers, customers, competitors, etc) play in firm's adoption of environmental management practices.

Delmas and Toffel further argue that one of the reasons why organizations in the same sector react differently from the same institutional forces is because the institutional forces are transformed as they permeate organizational boundaries because they are filtered and interpreted by managers according to firms' organizational unique history and culture. This interpretation by managers is also confirmed by Khanna and Speir (2007) when they state that: "Several case studies of firms suggest that managers' attitudes and commitment play an important role in filtering, interpreting and prioritizing the signals they receive from the external environment and in facilitating or impeding proactive environmental management" (Khanna & Speir, 2007).

The role of leadership, has also been further emphasized by Cordano and Frieze (2000) when they suggest that- "attitudes towards a behavior arise from a person's beliefs about the consequences resulting from its performance and that person's affective response to those consequences." As a person's attitudes towards a behavior become more favorable, their intention and effort exerted to perform the behavior is likely to increase. These attitudes might be affected by beliefs about the benefits and costs of voluntary environmental management. They found that managerial attitudes influenced preferences for source reduction activities. Nakamura, Takahashi and Vertinsky (2001) also found that perceptions of managers' recognition of personal responsibility to protect the environment had a strong influence on the extent to which environmental policies were integrated into corporate policies and practice.

Berry and Gordon as cited in Egri and Herman (2000) defined environmental leadership as "the ability of an individual or a group to guide positive change toward a vision of an environmentally better future" They contended that the unique characteristics of environmental problems (long term, complex, multidisciplinary and emotion-charged) require that environmental leadership be different from traditional leadership (Ergi &

Herman, 2000). This difference is described by Shrivastava as that leadership that is guided by personal belief system that deeply values and identifies with nature (Shrivastava, 1994).

David Rooke and William R. Torbert (2005) state that “Most developmental psychologists agree that what differentiates leaders is not so much their philosophy of leadership, their personality, or their style of management. Rather, it’s their internal “action logic”—how they interpret their surroundings and react when their power or safety is challenged” (Rooke & Torbet, 2005). After extensive research in America and in Europe over a period of more than 25 years Rooke & Torbet describes seven transformations of leadership or what they term seven action logics as described in Table 4 below.

Action Logic	Characteristics	Strengths
Opportunist	<i>Wins any way possible. Self-oriented; manipulative; “might makes right.”</i>	Good in emergencies and in sales opportunities.
Diplomat	<i>Avoids overt conflict. Wants to belong; obeys group norms; rarely rocks the boat.</i>	Good as supportive glue within an office; helps bring people together.
Expert	<i>Rules by logic and expertise. Seeks rational efficiency.</i>	Good as an individual contributor.
Achiever	<i>Meets strategic goals. Effectively achieves goals through teams; juggles managerial duties and market demands.</i>	Well suited to managerial roles; action and goal oriented.
Individualist	<i>Interweaves competing personal and company action logics. Creates unique structures to resolve gaps between strategy and performance.</i>	Effective in venture and consulting roles.
Strategist	<i>Generates organizational and personal transformations. Exercises the power of mutual inquiry, vigilance, and vulnerability for both the short and long term.</i>	Effective as a transformational leader.
Alchemist	<i>Generates social transformations. Integrates material, spiritual, and societal transformation.</i>	Good at leading society-wide transformations.

Table 4: Seven Transformations of Leadership
 Source: Rooke & Torbet (2005) Harvard Business Review

Boiral, Cayer and Baron (2009) examined how the action logics developed by Rooke and Torbet can influence the meaning which these leaders give to corporate greening and their capacity to consider specific complexities values and demands of environmental issues (Boiral, Cayer & Baron, 2009).

Their findings were a progressive increased environmental awareness by managers from the Opportunist to the Alchemist.

- **Opportunists:** have little sensitivity to environmental issues except when they present a threat or an opportunity for the manager;
- **Diplomats:** support environmental questions due to concerns for appearance or to follow a trend in established social connections;
- **Expert:** considers environment from a technical, specialized perspective and prefers proven technical approaches;
- **Achiever:** integrates environmental issues with organizational objectives and procedures, responds to market concerns with respect to ecological issues, concern for improving performance;
- **Individualist:** inclined to develop original and creative solutions and questions pre-conceived ideas, develops participative approach with greater employee involvement;
- **Strategist:** Inclined to propose a pro-environmental vision and culture for the organization, develops a more pro-active approach conducive to anticipating long term trends with marked interest for global environmental issues;
- **Alchemist:** re-centering of the organisation's mission and culture with regard to social and environmental responsibilities, involved in various organizations and events promoting harmonious societal development.

This section has highlighted that environmental leadership is not just driven by policies, regulations and standards but by people (leaders) who have certain kinds of belief systems that influence the approach or attitude of a leader towards environmental management.

In the context of the sustainable development challenges as described above an understanding of the action logics embedded within leadership at Gold Au, would possibly assist in the development of sustainable development programmes and initiatives that could be embraced and fully supported by the leadership.

2.8 Chapter Summary

This chapter started by highlighting the global sustainable development challenges and the initiatives that are in place attempting to address them. The initiatives include a summary of seven documents that are highlighted as documents that have a potential to shape the future sustainable development.

This is followed by a discussion on the challenges faced by the gold mining industry, specifically those related to resource intensity specifically the need within gold mining industry to use more energy, water and increased waste production, all occurring because of the declining ore grades and the fact that gold mining is happening at deeper and deeper levels. The resource intensity is happening at a time when South Africa has energy, water and waste crisis. The resource intensity need is discussed within a context of decoupling, whereby for mining to continue, leadership is required to understand the decoupling concept, specifically resource and impact decoupling. Example of processes such as Eco-Efficiencies and Cleaner Productions are discussed as some processes that have a potential to offer the necessary decoupling.

The emphasis in the resource intensity and decoupling are geared towards the economic system of the mining process, discussions on the environmental and social systems are highlighted in sections that follow. They are highlighted as discussions from around the world on the impact of gold mining to the environmental and social systems (health, people wellbeing, culture and values). The examples discussed in these sections again are meant to raise the awareness to leadership within Gold Au in ensuring that such impacts are avoided by all means at our mine. The chapter ends with discussion on the kind of leadership required to address sustainable development, which is mentioned as leadership that is based on the belief system of the leader rather than a leadership style or position.

3 Chapter 3: Research design and methodology

3.1 Introduction

Chapter 3 outlines the approach and process followed in conducting this study in order to address the objectives as outlined in Chapter One and on how the findings presented in Chapter Four below were arrived at. Given the complexity of this case study and the objectives that need to be addressed, a qualitative study design using various methodological approaches was used to achieve these objectives.

The study objectives as outlined in Chapter One are as follows:

- an understanding of the gold mining industry in South Africa from an historical perspective,
- the perception of workers in our company on the impact of our gold mining activities on themselves, community at large and the environment,
- understanding the role of leadership as related to sustainable development challenges
- examination of sustainable development programmes within our gold mine

The above objectives are used to support the development of the suggested sustainable development framework that can be tested in the gold mine where I work.

Quantitative design would not be able to adequately provide an answer to these study objectives, because it would require the use of a deductive approach. A deductive approach requires drawing on existing theoretical and substantive prior knowledge, to conceptualise specific situations and predict what will happen to particular people or groups and why (Frankel & Devers, 2000). On the other hand qualitative research design is a form of systemic empirical inquiry into meaning, which implies that researchers try to understand how others make sense of their experience (Shank, 2002 in Ospina, 2004).

Conger, 1998; Bryman et al, 1988; Alvesson, 1996 in Ospina (2004) argue that the advantages of doing qualitative research include:

- flexibility to follow unexpected ideas during research and explore processes effectively;
- sensitivity to contextual factors;
- ability to study symbolic dimensions and social meaning;
- increased opportunities
 - to develop empirically supported new ideas and theories;
 - for in-depth and longitudinal explorations of leadership phenomena; and
 - for more relevance and interest for practitioners.

3.2 Research Design

A research design is a plan or blueprint of how one intends conducting the research (Mouton, 2001). The design focuses on the end product, asking “what kind of study is being planned and what kind of result is aimed at?” (Mouton, 2001).

At the beginning of this study a literature review was conducted, as a foundation to derive an understanding of the impact of gold mining in society and the environment from studies and findings around the world. The understanding derived from this part of the review served as a basis or reference point in the discussions to explore the second objective of the study which is “*to explore the perceptions of workers within our gold mine on the impact of mining to themselves as workers, community and the environment at large*”, whereby the understanding from the literature reviews is weaved into the discussions, conversations and interviews conducted with the employees.

In this thesis leadership is explored from a perspective of a leader’s belief system (“*the way a leader thinks, feels and relates to the environment*”) towards environmental management or sustainable development. It is not looked at from a leadership style or approach of the leader. Leadership is also looked at not only as embedded in a position but also as initiatives/attitudes/actions of people towards sustainable development related issues.

In the literature review leadership literature was reviewed from findings across the world, in examples that were not necessarily in gold mining industry. The literature highlighted reasons why some leaders and/or companies will consider environmental management very highly while others will not consider it at all. The reasons ranged from the historical values and culture of organisations to social and institutional logics. This review of leadership framed the approach to addressing the objective of understating *“the role of leadership towards environmental management”*.

Secondary data analysis was utilised to address the first research objective which is *“to gain a better understanding of the South African gold mining industry from a historical perspective in terms of the relationship between government and the gold mining industry”*. This understanding is presented in Chapter 4 below. The approach adopted in the secondary data analysis was reviewing various reports and published papers and personal communications with people who have been working within the gold mining industry for many years and some who are already retired. This analysis served as a foundation for understanding some of the challenges that our gold mine and others, are facing today, and also to understand why the state of gold mining is what it is today and finally the historical importance of gold mining to the South African government and the South African economy at large. This understanding informs the decisions and the approaches that could be used or developed going forward by our gold mine.

In conducting this study an approach that was adopted is that of a case study, using the gold mine I work at as a manager for Sustainable Development. I am a member of the executive team of the mine and the responsibilities managed by my department include total environmental management of the mine, employee health and community development. For the purposes of this study the company is called Gold Au. The reason for calling it as such is because when the permission to conduct the study was granted, mine management preferred that I use a pseudo name wherever the name of the company is to be mentioned (for reasons that were not disclosed to me).

A qualitative case study is an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources. This ensures that the issue is

not explored through one lens, but rather a variety of lenses which allows for multiple facets of the phenomenon to be revealed and understood (Baxter and Jack, 2008).

According to Yin (2003) a case study design should be considered when: (a) the focus of the study is to answer “how” and “why” questions; (b) you cannot manipulate the behaviour of those involved in the study; (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. Based on this description, a case study design was preferred over other designs as the issues that are explored in this study are embedded in the context of the employees and the communities around our mine.

Stake (1995) and Yin (2003) base their approach to case study on a constructivist paradigm. Constructivists claim that truth is relative and that it is dependent on one’s perspective. This paradigm “recognizes the importance of the subjective human creation of meaning, but doesn’t reject outright some notion of objectivity. Pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object” (Miller & Crabtree, 1999). Constructivism is built upon the premise of a social construction of reality (Searle, 1995). One of the advantages of this approach is the close collaboration between the researcher and the participant, while enabling participants to tell their stories (Miller & Crabtree, 1999). Through these stories the participants are able to describe their views of reality and this enables the researcher to better understand the participants’ actions (Lather, 1992; Robottom & Hart, 1993). The case study relies on multiple sources of evidence and multiple data collection techniques. Yin (2003) lists six major sources of evidence: documents, archival records, interviews, direct observation, participant observation and physical artefacts. In this study all six of these methods were applied to various degrees.

The impact of our gold mine on its own workers, the community and the environment at large cannot be understood outside the way the employees behave or the actual interpretation by the workers and the communities who are directly affected by the mine activities. It is this phenomenon described as constructivist paradigm that informed choosing a case study design approach over others. It is this constructivist paradigm understanding that in order to suggest a sustainable development framework for our mine,

the framework has to be informed by the experiences and interpretations from those affected by our mining activities.

As mentioned, the study is based at the mine itself which comprises more than 18000 employees. I spent time with employees of the mine at various levels (from the underground workers to senior management), observing their behaviour at work and conducting various interviews on their understanding of Sustainable Development and their opinion on Gold Au's approach to Sustainable Development. The impact of their working conditions on themselves, the communities and the environment was also explored.

The examination of sustainable development programmes looked at the curriculum of various courses presented at the training centre of the mine specifically looking for sustainability trend. This examination was further expanded beyond the confines of Gold Au to the University of Witwatersrand's Centre for Sustainability in Mining and Industry (CSMI) and the school of mining engineering which are education partners to Gold Au. Two other sustainable development projects were examined, an environmental and community project. These two projects are meant to address the fourth objective of examining Gold Au sustainable development initiatives.

The study is informed by an inductive logic. Saunders, Lewis and Thornhill, (2003) describes inductive approach as the principle of developing theory after the data have been collected. In this study the inductive approach means that I would be describing and getting to understand employees of Gold Au's and the surrounding communities' particular situations, experiences and meanings as related to sustainable development before attempting to make sense and interpret and develop a suggested sustainable development framework that could be tested at Gold Au. The purpose for looking at these projects is to demonstrate the role of Gold Au leadership in the context of addressing the social-political and ecosystem services systems of sustainable development.

3.3 Research Methodology

This section describes how the study was conducted. It describes in detail how the research was undertaken in order to meet the research objectives, identifying the data sources that were used to generate the study findings.

3.3.1 Organisational Structure of Gold Au

Gold Au is structured into three operating units with a total of six operating shafts. These shafts have approximately 15 000 workers, the rest of the Gold Au employees work in gold plants, assay laboratories and various other support services, such as transport services, housing services, human resources, finance, etc.

Within the six operating shafts, there are shaft task teams, these teams were established by the mine to observe the working processes and recommend areas for improvement to the mine leadership (mine management and union leadership). The task teams consist of an average of eight members representing (management, labour unions, occupational health, safety, production employee from various production areas and support services).

These members were nominated by the shaft employees themselves. The task team members are themselves employees who work at various areas within the mine. Once a week the task teams meet and visit various working stations to conduct their own observations and hold conversations with workers in the visited work stations to understand the working conditions and constraints. On a monthly basis the task teams give hold feedback sessions with the mine leadership to share the findings from visits conducted that month and whatever recommendations the task teams might have.

3.3.2 Exploring Gold Au worker perceptions

In exploring the perceptions of the workers on the impact of Gold Au on themselves, the community and the environment, I spent four months with the task teams described above going to various working stations on a weekly basis. The methodology adopted for this

objective is that of participant observation. This method involves the researcher "getting to know" the people they're studying by entering their world and participating - either openly or secretly - in that world. "This means you put yourself "in the shoes" of the people you're studying in an attempt to experience events in the way they experience them" (<http://www.sociology.org.uk/mpoprint.pdf>). The point, therefore, is to observe and experience the underground environment as it is experienced by the worker. Therefore I participated in the working environment, while retaining an observer's eye for understanding, analysis and explanation. Whenever we visited any new work team or area, I would be introduced as part of the task team rather than being seen as doing research. The objectives of these task teams are known. During the period spent with at the working areas, I had conversations with various workers. These conversations were exploring how the general workers perceive the impact of Gold Au to themselves as workers.

One of the limitations of the participant observation methodology is that of access within the social setting being studied. In the case of this study this limitation was not a challenge because of the use of existing structures within the mine (shaft task teams) and also because the scope of my daily work requires a thorough understanding of where people work and the challenges they face. Iacon, Brown and Holtham (2009) state that participant observation method lacks breadth as the focus is typically on one particular situation or phenomenon, hence one common criticism is the lack of generalisability. This case study focuses on understanding the workers in their natural setting and particular attention is paid to the contextual conditions and how they interpret their conditions generalisability therefore is not a requirement for this study.

Another concern regarding participant observation is that, data collection can be time consuming and tedious, and can result in the accumulation of large amounts of data (Iacon, et al, 2009). In this study participant observation is used as part of various other data collection methods, therefore the tedious and protracted nature of participant observation data collection did not have much effect in the study.

The next step in data collection was conducting focus group discussions with each of the task teams focusing specifically on the impact of mining on people, communities and the

environment. During the four months period, six focus group discussions were conducted, 11 visits to various working areas (development sections, stoping sections, tramping sections and underground engineering sections) across the mine, holding conversations with more than 300 people individually and in groups.

Focus groups are group discussions organised to explore a specific set of issues, they are distinguished from the broader category of group interviews by the explicit use of group interaction as research data (Kitzinger, 1994). Morgan (1996) describes three essential components of focus group discussions, firstly they are a research method devoted to data collection, second it locates the interaction in a group discussion as the source of the data and thirdly, it acknowledges the researcher's active role in creating the group discussion for data collection purposes (Morgan, 1996). Morgan further emphasises that focus group discussions must be distinguished from procedures that utilise multiple participants but do not allow interactive discussion, such as nominal groups and Delphi groups and should also be distinguished from methods that collect data from naturally occurring group discussion where no one acts as an interviewer (Morgan, 1996).

One of the criticisms of the focus group discussions is the convenience sampling strategy commonly used in focus groups that may introduce bias into the research process. To counteract this criticism the group used for focus group is as representative as possible of the total study group relevant to this objective.

3.3.3 Understanding the role of leadership

Following the focus group discussions, I also conducted various semi-structured interviews with members of mine management and labour unions again focusing on the understanding of the meaning of sustainable development as related to the impact of mining on people, communities and the environment. The interviews also focused on Gold Au's approach to sustainable development based on the United Nations Global Compact Gearing Up model. The model uses an analogy of vehicle gears to illustrate a company's approach to sustainable development from gear one which is compliance to gear five which is business processes re-engineering. The interviews also sort to understand the mental models or mind

maps of mine leadership pertaining to sustainable development and relate that to the dominant approach of Gold Au to sustainable development.

There are various levels of leadership at Gold Au as follows:

- Gold Au Executive Management: a total of nine people were interviewed
- Gold Au Operational Excellence team: a total of 32 people interviewed
- Mine Shaft leadership teams i.e. each shaft with its own management team (six shafts in total): a total of 12 people were interviewed
- Within a shaft there are various sections with own leadership teams (these were part of the shaft task team people) – six individuals were interviewed from the task teams
- Organised labour leadership: a total of six people (the office bearers) were interviewed

In choosing the interviewees the non-probability sampling methodology where quota sampling of the various leadership groups was applied. In total 65 semi-structured interviews were conducted with the people from the various leadership groups, as stated above.

3.3.4 Examination of sustainable development programmes

This part of the thesis looks at examining sustainable development programmes at Gold Au. The focus of this examination is on three areas, only one example on each of the areas would be examined:

- Education Programmes
- Environmental programmes
- Community programmes

The purpose of examining these programmes is to elicit the aim of the programme and the role mine leadership plays in them.

Education programme:

Gold Au has a business and leadership academy which offers various training courses that support the mining industry in general. The examination of the sustainable development programmes of the study was conducted by reviewing the course contents of Gold Au's academy specifically looking for any sustainability trends embedded within the courses or specific sustainable development course and semi-structured interviews with management of the academy. At this point of the study I expanded beyond Gold Au to the University of Witwatersrand where I conducted semi-structured interviews with the director of the Centre for Sustainability in Mining and Industry and also the Head of the School of Mining engineering, these two institutions were chosen because they have a close relationship with Gold Au's academy.

Environmental Programme:

In 2008 Gold Au initiated an environmental programme for conversion of waste to energy as a result of the February 2008 electricity crisis, this programme was linked to an alien invader trees eradication programme. The examination of this programme took the form reviewing all the project documents and conducting interviews with people involved in the project.

Community Programme:

In 2009 Gold Au started a project to clean up all the rock dumps that were not going to be reprocessed for gold. The project was conceptualised to train and utilise communities in the clean up process. As with the environmental programme, the process followed included reviewing all the project documents and conducting interviews with people involved in the project.

One criticism of semi-structured interviews is the lack of standardisation which leads to concerns of reliability. Reliability based on whether a different researcher would come to the same conclusion or reveal similar information. Reliability issues are overcome by the fact that this kind of study is not meant to be repeatable, because of the complex and dynamic nature of the topic studied. The value in using this methodology is based on the flexibility to explore these complexities, repeatability therefore is not imperative.

However, triangulation methodology was applied to a limited extent to increase the validity of the findings. Bryman (2006) defines triangulation as the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings. According to Denzin (1970) in Bryman (2006) there are four forms of triangulation:

- *Data triangulation*, which entails gathering data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered.
- *Investigator triangulation*, which refers to the use of more than one researcher in the field to gather and interpret data.
- *Theoretical triangulation*, which refers to the use of more than one theoretical position in interpreting data.
- *Methodological triangulation*, which refers to the use of more than one method for gathering data.

The combination of various data collection methodology was applied in this study as described above, such as, participant observation and informal conversations with the workers, followed by semi-structured interviews and focus group discussions. In interpreting the data gathered especially from focus group discussions, there were three people collecting the data, they were myself as the facilitator of the discussion, an assistant to me who was able to speak a several languages in order to ensure that people in the focus group could express themselves in whatever language they were comfortable with and the last person was the scribe. After the discussions we would sit together to ensure that we all had the same understanding of the content of the discussion.

3.4 Data Analysis

Seidel (1998) describes qualitative data analysis as:

- *Iterative and Progressive*: The process is iterative and progressive because it is a cycle that keeps repeating. For example, when you are thinking about things you also start noticing new things in the data. You then collect and think about these new things. In principle the process is an infinite spiral.

- **Recursive:** The process is recursive because one part can call you back to a previous part. For example, while you are busy collecting things you might simultaneously start noticing new things to collect.
- **Holographic:** The process is holographic in that each step in the process contains the entire process. For example, when you first notice things you are already mentally collecting and thinking about those things.

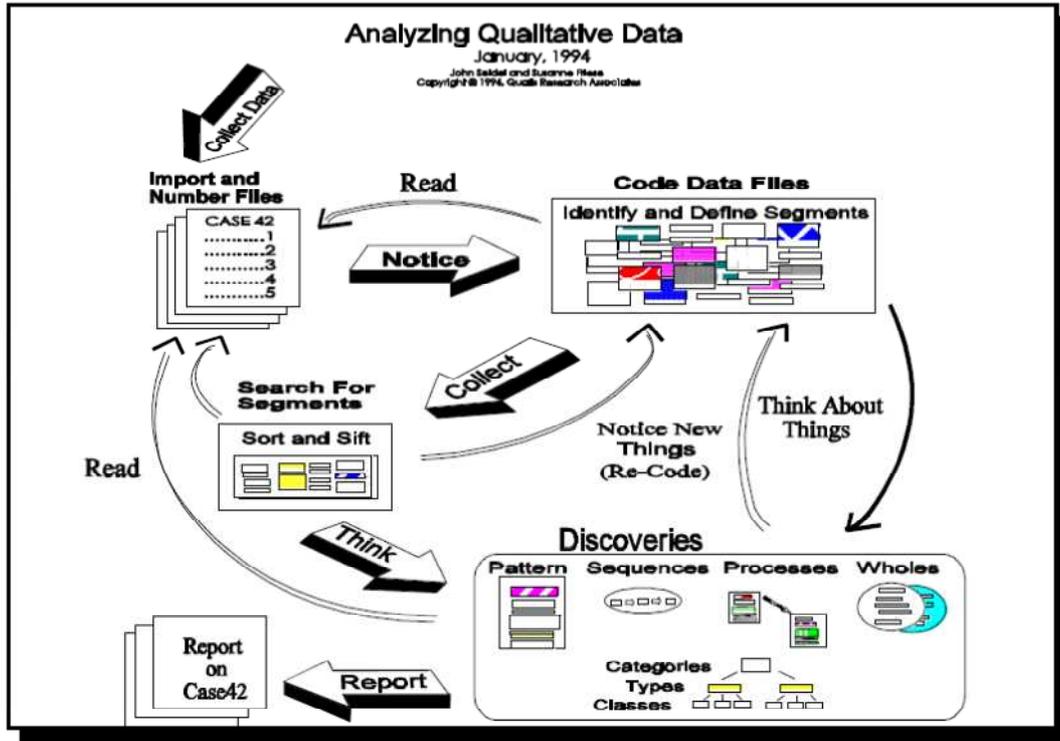


Figure 11: A model of qualitative data analysis

Source: Seidal, 1998: *Qualitative data analysis*

Data analysis for this study typically followed the process described and illustrated by Seidal above, whereby conversations, discussions and interviews conducted earlier inform the following discussions and interviews and also triggers further data collections. The process of data collection and analysis was continuous and simultaneous.

3.5 Chapter Summary

This chapter has given details of how the whole research process was undertaken. It begins with highlighting the objectives of the study and continues to describe how each objective was addressed in the thesis. The research design section describes that the research was largely qualitative and various reasons for why qualitative approach was the most suitable

for this study have been highlighted. The case study design is also highlighted and its limitations are also mentioned. The approach to literature review and the objectives of the types of literature that was reviewed is also highlighted linking the review to the objectives of the thesis. Each objective is highlighted and described in detail on how it was achieved together with limitations associated with the methodology adopted. The iterative data analysis process is also a highlighted.

4 Chapter 4: Gold Au: The Case Study

4.1 Introduction

Gold Au is a large established, shallow to ultra deep level gold mine operating under a mining right covering a total area of 10000 hectares. It has six operating shafts with the lowest level being approximately 3 500 metres below surface. The mine has more than 30 years of life left. The mine is located in the Gauteng province of South Africa in Merafong municipality in Carletonville.

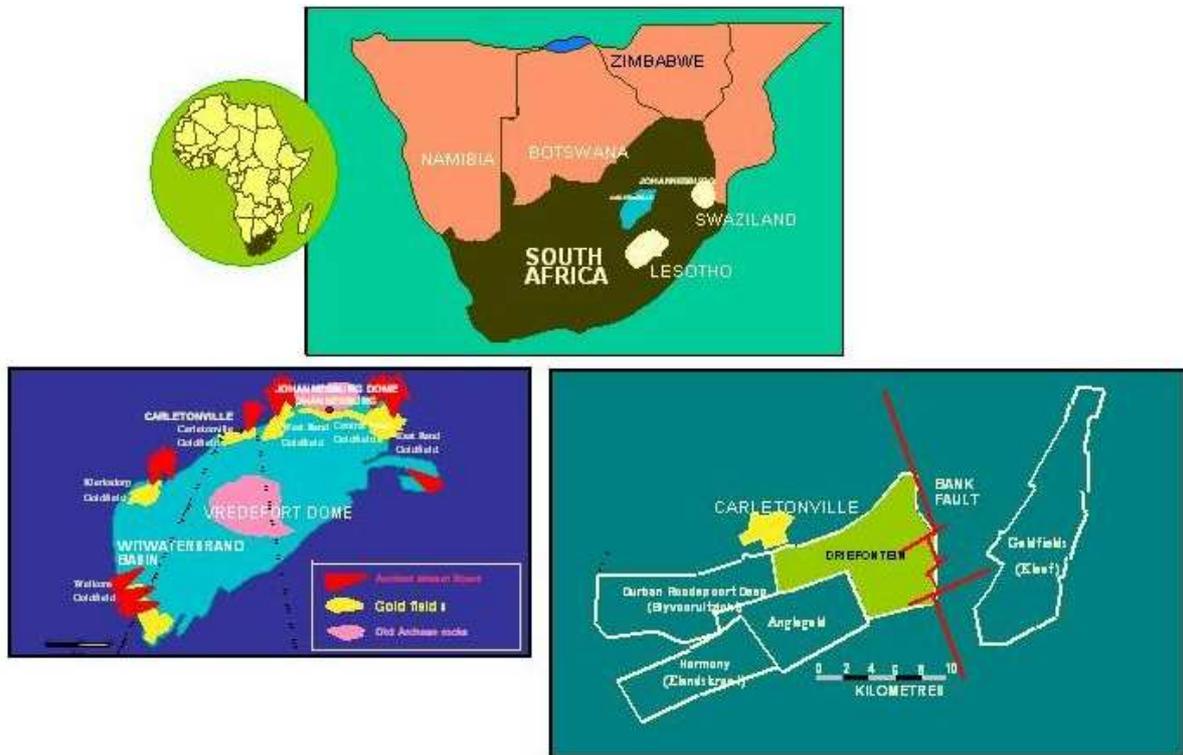


Figure 12: Geographical location of Gold Au

Source: Gold Au archives

The mine was granted its first mining right in 1945 and production started in 1952. The mine prides itself as the only mine in the world that has produced in excess of 100 million ounces of Gold. The mine employs in excess of 18000 people from different parts of southern Africa (South Africa, Mozambique, Lesotho, Swaziland and Botswana). Approximately 65% of these

employees have been working for the mine for more than 20 years and live in single sex hostels⁶ that are fully operated by the mine.

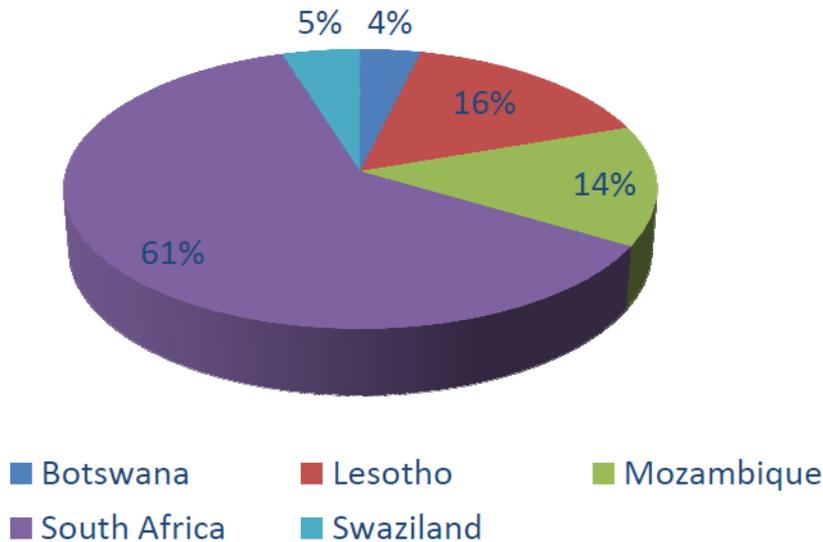


Figure 13: Distribution of employees by country of origin at Gold Au

Source: Gold Au archives

This first part of this chapter gives a brief highlight of gold mining in South Africa. This is followed by examination of the evolution of gold mining in South Africa from the discovery of gold in 1887 until today. In this chapter the examination is looked at from an angle of a relationship between the gold mining industry and government. The relationship is divided into three different distinct phases from 1887 to post 1994. The phases are the colonial phase, the apartheid phase and the democratic phase. The exploration of this relationship serves as a basis for understanding some of the current gold mining legacies that South Africa and specifically Gold Au is currently experiencing and also an understanding of the future role of gold mining within the Sustainable Development discourse, based on the changes in this relationship. The relationship highlights the roots of the relationship between gold mining, the environment and the communities.

The second part of the chapter presents the research findings, based on the observations, conversations, focus group discussions, semi-structured interviews and two project reviews. All these findings were conducted in various working areas at Gold Au.

⁶ Previously there used to be more that 12 people sharing a room and bathrooms, currently the conditions are being improved with a target of one person per room to be achieved by 2014

4.2 Gold Mining in South Africa in general

South Africa is richly endowed with minerals, and possesses the principal world reserves of gold, manganese, platinum group metals, chromium, vanadium and alumino-silicates (Boocock, 2002). In addition there are large reserves of other minerals including iron ore, coal, diamonds, uranium, titanium and nickel (Boocock, 2002).

Mining accounts for a mere 2.3% of employment and 3% of GDP, down from around 14% in the 1980s, having been the world's biggest gold producer for more than a century, South Africa has fallen behind China, Australia and America (<http://www.economist.com/node/16248641>). The decline in gold production from being number one producer to being number four has been due to lower grades and greater depth of reserves (Boocock, 2002). Some of South African gold mines are nearing the end of their productive lives, but gold continues to be an important contributor to the economy, earning 49 billion rand in foreign exchange in 2009. That makes it the country's second-biggest export after platinum, where South Africa is the global leader (<http://www.economist.com/node/16248641>).

The fact, as described above, that South Africa is richly endowed with minerals implies that, mining is still going to continue in the country, it is no wonder that the section 24 of Chapter 2 of the Constitution of the Republic of South Africa states that (Republic of South Africa, 2006):-

“Everyone has the right”

- a. to an environment that is not harmful to their health or wellbeing; and*
- b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-*
 - (i) prevent pollution and ecological degradation;*
 - (ii) promote conservation; and*
 - (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development”.*

The current South African constitution is only 15 years old and it incorporates sustainable development imperatives and a trend towards environmentally conscious policies that have relevance to the mining industry. The challenge is, what is it that the gold mining industry can do differently to contribute to sustainable development now and into the future, taking into consideration the more than a century of activities that did not consider sustainability issues.

The environmental legacies of gold mining began almost immediately with the discovery of gold, as in December 1887 the government of South Africa permitted James Siverwright to transfer water from Doornfontein to the young township of Johannesburg, allowing for the rapid growth of the mining industry in the area (Turton, et al, 2006). This heralded the beginning of Gold mining in the central and western basins of Witwatersrand. It is now more than a century since the historic discovery of gold in the Witwatersrand.

The mining of gold on the Witwatersrand began as a simple extractive process during British colonial occupation, whereby all profits were claimed by the European superpower (Adler, et al, 2007). The consequent demise of colonial rule as a result of the 1948 Afrikaner National Party victory signalled an obvious change in policy. This change took the form of the mining industry and its profits being treated as national assets for the benefit of South Africa (Turton, 2006). In essence, this meant the merging of entrepreneurial and profit interests of the large mining houses [*Gold Au included*] and the state (Adler, et al, 2007). It is thus unsurprising that not only did the government allow the industry a privileged position of power, but its activities were not based on any notions of environmental concern. Instead, “the early gold-economy was simply an extractive industry with little consideration given to possibly adverse long-term effects” (Adler, et al, 2007). This pattern characterises the relationship between the environment and the mining industry in South Africa between the time gold was initially discovered right up until the late days of apartheid rule.

4.2.1 Relationship between gold mines and government

For a clearer understanding of the role gold mining can play in Sustainable Development going forward, one needs to gain a brief understanding of the historical perspective of

mining that has led to all the current so called mining legacies. Section 24 of the constitution as stated above, can only be effective within the mining industry when one has a thorough understanding of the development of the relationship between government, the mining industry and scientific community. Adler R., Funke N., Kieran F., and Turton A., in 2007 produced a report for the CSIR entitled *“An assessment of the relationship between the government, the mining industry and the role of science in the Far West Rand of South Africa”* In this report, the relationship is divided into three distinct phases i) the Colonial Phase before 1956; ii) the Apartheid Phase, between 1956 and 1994, and iii) the Democratic phase, after the establishment of the democratic government in 1994 (Adler et al, 2007).

When one looks at these phases from a sustainable development perspective, one can begin to understand the roots of the relationship between mining and the environment and also to gain a better understanding of what needs to be done by the mining industry to contribute to Sustainable Development.

The Colonial Phase:

According to Adler, et al (2007) the Colonial Phase was characterised by having very little scientific involvement in the formation of mine regulation. The government served as a facilitator that privileged the mining industry at the expense of the public and the environment to maximise profits. In addition, to maintaining profitability, the mining industry required cheap labour and consequently looked outside its borders to recruit workers. The legacy of recruitment of labour from areas far from the mine is still visible at Gold Au. 39% of employees at Gold Au are from the neighbouring countries, however of the 61% from South Africa only about 23% of the employees are from Gauteng province, the rest are from provinces such as the Eastern Cape, Kwa-Zulu Natal, Limpopo (internal company documents).

As part of the requirements of the current government to improve the living conditions of employees, Gold Au conducted a study in a neighbouring informal settlement in 2009. The aim of the study was to determine the needs of this community pertaining to health and housing. The findings of the study were that 67% of the people in the settlement originated from countries other than South Africa (26% from Lesotho, 3% from Malawi, 36% from

Mozambique, 20% from Zimbabwe and the rest of the 15% was distributed between Swaziland, Botswana, Nigeria, Pakistan and Somalia). There were various reasons mentioned on why they settled in this settlement, some came looking for jobs at the mine, others are former employees of the mine who got retrenched or went on pension but never returned home. Of significance these people do not qualify for the South African government scheme by virtue of them not being South Africans.

White labour, imported for their mining skills and experience shortly after gold was discovered in 1886, saw this massive recruitment of blacks as a threat to their relatively high wages (Schoofs, 1999). To combat this threat, the white unions, amongst other things, forced the industry and then government to adopt the 'colour bar', banning blacks from skilled jobs and preventing black families and black workers from settling permanently in mining towns (Schoofs, 1999). These mining policies were the forerunners of the apartheid system (Cronje and Chenga, 2005). The impact of these policies on the social and economic conditions in mining communities has been identified as the major risk factors associated with poor developmental issues in these communities (Cronje and Chenga, 2005).

As a consequence of the above-mentioned background, mining communities in South Africa are characterised by poor social conditions such as poverty, unemployment, poor housing (and overcrowded single-sex male hostels) and infrastructure, prostitution, poor health as well as the high influx of unaccompanied documented and non-documented migrants (Cronje and Chenga, 2005).

The informal settlement discussed above neighbouring Gold Au is a prime example of the policies that were developed by the colonial phase of this relationship. The Gold Au study revealed that there were close to 8500 informal housing structures in this settlement with an estimated population of 18000, table 5 illustrates the key findings from the study.

Key Findings	Informal Settlement
Employment	27%
Access to health facilities	12%
Access to water	16%
Access to electricity	7%
Access to rubbish disposal facilities	8%
Use of Pit Latrines	82%
Schooling facilities	0

Table 5: Key findings from a study in an informal settlement bordering Gold Au

Source: Gold Au archives

The Apartheid Phase:

The Apartheid phase was characterised by collusion between the government and the mining industry. During this phase the relationship between government and the mining industry was that of partnership. This partnership was based on the fact that government profited heavily from this intimate relationship with mining and there was little incentive for government to learn and understand the impacts of mining on individuals living in close proximity to the mines and other unwanted consequences that might have occurred as a result of industrial activities.

According to Adler et al (2007) the estimated working revenue of gold mining in 1957 was about £1,514,000,000 and £504,000,000 of that was the estimated state's share of the profits and the estimated dividends to shareholders was £180,000,000. With such huge amounts of money from the gold mining industry to government, it made sense that the government would turn a blind eye to some or all the externalities of mining. In my opinion this is the root cause of the bad legacies of gold mining that are currently plaguing South Africa.

Fine and Rustomjee (1996) argue that the central axis of South African economy in the period 1948 – 1989 was based on a mineral-energy complex. The heart of the mining sector

is gold, which according to Fine and Rustomjee (1996) generated, directly and indirectly, as much as 40% of South Africa's GDP. During the period 1948 – 1989 unlike in manufacturing, the wage share in mining fell. The centrality of gold mining in the South African economy is illustrated by the fact that, suppressed wages in mining during the period 1948 -1989 led to wage suppression in the whole economy. This illustrates the importance of gold mining for the South African government during the apartheid phase.

During this period, the mining industry used the scientific studies to shield themselves from liabilities. Although there were a number of policy recommendations that were scientifically based, no significant legislative measures were taken during this period because government was generating substantial revenues from the gold mining industry. The government and the industry shielded themselves through establishing various committees such as the Interdepartmental committee (IDC), the State Coordinating Technical Committee (SCTC) and the Far West Rand Dolomitic Water Association (FWRDWA).

The IDC was established as advisory committee to make recommendations to the government about how to proceed with mining related issues, while the SCTC's role was to investigate technical issues related to mine dewatering and the movement of water and the FWRDWA was established to ensure all policy decisions related to dewatering were enforced, to settle all claims, to establish alternative supplies of water for those who were affected by mine dewatering and to raise finance to compensate individuals for damages (Adler et al, 2007). The SCTC was however viewed by the mining industry as a vehicle to empower them to provide technical information that would allow them to avoid liability and legal responsibility for the damages associated with mine water dewatering.

The FWRDWA on the other hand was used by the mining industry to receive, consider and settle or otherwise dispose of all the claims made by local authorities, companies and individuals against the Association with respect to damages caused by dewatering by the mines. The majority of claims were disposed in order to limit the mining industry's liability and thus externalising their costs (Adler, et al, 2007).

The consequences of the dewatering policies were felt by Gold Au in 1962, when a sinkhole that had developed overnight swallowed a seven storey building and claimed 29 lives. By 2010 there were more than eight sinkholes around the 10000ha property of Gold Au.



Figure 14: A sinkhole that developed at Gold Au property in 1962

Source: *Gold Au archives*

Sinkholes are not the only consequences of dewatering, there is a potential of water pollution when the abstracted water is discharged onto a river system. Over the past decade, debates have been raging in the far west rand regarding Uranium contamination of the Wonderfontein spruit (Gold Au operations are in this region). A report by the Water Research Commission in 2004 stated that “samples collected [at Wonderfontein spruit] show highly elevated levels of uranium (and other metals) in sediments. Sequential extractions performed on these sediments indicate that much of the uranium is bound in a potentially mobile form, with a number of environmentally plausible processes being able to liberate this uranium from the sediment into the water posing a threat to downstream water users” (Coetzee, 2004).

The major impacts of mining that the country is currently facing such as problems associated with dewatering (sink holes), tailings management, atmospheric emissions, acid mine drainage especially due to the legacy of past mining coming from abandoned gold mines and social disintegration mostly have their roots in the apartheid phase as a result of the partnership that the mining industry had with government.

The Apartheid phase led to several negative social and environmental impacts in mining that are challenging to address even in today's South Africa. The next section takes a look at one of the social legacies of the apartheid phase in the gold mining industry – that of mine accommodation.

4.2.2 Mine Accommodation

The gold mining sector has dominated the economy in South Africa for more than a century. In the 1980s the gold mining industry had a total workforce of more than 500 000 people who were mostly migrant labourers from various parts of South Africa and Southern Africa (Laburn-Pearl, 1995). These workers have traditionally been accommodated in single –sex hostels that are company owned and located close to the mine shafts on mine property. This kind of accommodation was due to the notion that all these workers were temporary residents of the urban industrial areas who will sooner or later have to go back to their rural homes.

Historically the mine hostel accommodation had been fraught with violent clashes between the various ethnic groups. In most cases these clashes would be a spillover of violent clashes from the surrounding townships especially in the 1980s (Minaar, 1995). The other prevailing factor in mine conflict, and one which has traditionally been cited by mine owners as the "sole" cause of conflict on certain mines, is ethnicity. However, a closer examination of such "ethnic" incidents of violence often reveals a political origin (Minaar, 1995).

The ethnicity issues are still visible within Gold Au hostels. Gold Au has three hostels accommodating between 1500 and 5000 employees. A careful observation of where the various ethnic groups are accommodated reveals that each block is dominated by one ethnic group. On enquiring this observation from hostel management, they say that where the people get accommodated is determined by the employees themselves, and the argument that is put across is that, some employees prefer to be closer to those they are familiar with in terms of culture (trying to have home away from home). In February 2010 violent clashes rocked Gold Au and the information that was supplied to mine security and to police was that the clashes were revenge attacks by Xhosas who were attacking Sothos

because a certain Sotho speaking person injured and killed a Xhosa person. These allegations were never proven, however the police managed to control the situation with 72 hours all was back to “normal”.

⁷The living conditions at the mine accommodation are usually very poor. Payze (1995) describes the rooms in one hostel in a gold mine as follows, “the room housed 16 people on double concrete structures which were used as beds. Each room had electricity, lights and a small cupboard. The ablution facilities were of a very low standard. Toilets had a central flushing system, and all showers shared one water inlet. There were no partitions, doors or taps in the showers and the toilets had a pervasive foul smell. Some urinals were provided, but there were no basins” (Payze, 1995).

The single sex accommodation system of the gold mines has led to various negative impacts on the communities. The major concern for the workers in the hostels is separation from their families for long periods of time. This separation had various negative impacts on the families and the communities surrounding the mines. The majority of mine workers living in the hostels are troubled by the fact that they cannot participate properly in raising their children (Payze, 1995). This absence in many instances leads to ill-behaved children who become a menace to society. Other than the absence, the migrant system combined with single sex hostel dwellings leads to the majority of men in these hostels taking mistresses from the surrounding community. This has led to family difficulties and often divorce, resulting in them even losing their homes and being forced to sometimes remain in the mining area in informal settlements. This leads to high prevalence of HIV/AIDS within the surrounding mine communities that becomes a huge burden to society and the government. Other than the single sex hostel mine accommodation, the mines also provide houses for married people with families what is generally known as mine village or “*skomplas*”. These are two, three or even four bedroom houses provided by the mine to supervisors and managers who work for the mine. The occupancy of these houses is dependent on continued employment by the mine. Once a person is no longer employed by the mine,

⁷ The conditions at the hostels are now improving with the democratic government putting up measures to ensure that they are improved (see discussion below).

through retrenchment, retirement or resignation, he/she is given not more than 90 days to vacate the house.

The impact of this housing system has not spared Gold Au. In 2007 Gold Au conducted an HIV/AIDS prevalence survey as part of the employee wellbeing programme. The survey revealed that 33% of the employees at Gold Au were HIV infected and 62% of those infected lived at the mine hostels and 29% lived at the informal settlement neighbouring the mine.

The democratic phase:

The democratic phase is characterised by the revision of most laws and policies related to the industry and to break from the approach of the previous government and to play the role of being a regulator. However the democratic government faced several challenges the first being inheritance of existing structures such as the IDC, SCTC and the FWRDWA, without proper historical context and inability to access information about and the rationale behind some of the activities of these committees. This challenge is mostly due to minutes of meeting and/or records of these committees being held in private individual's hands, private companies and/or scattered throughout various governmental buildings without in most cases being archived (Adler et al, 2007).

I represent Gold Au at the FWRDWA, the challenge faced by this association at present is that there is no government participation. When the FWRDWA was established government was represented by the Department of Water Affairs and by the Council for Geo-Sciences. The dominant discussions at FWRDWA at present relate to managing sinkholes that are developing or have developed in the areas where several gold mining companies in the region are operating. The argument presented by these government departments are that, the present legislation do not make any provisions for their participation in such association and therefore they cannot participate until a clear policy or guideline is given. Of concern and of higher risk is that the participants at this association all represent various gold mining companies who are not prepared to accept individual liability for any sinkholes or water pollution issues. The situation lends itself to circumstances where communities and the environment could be negatively affected with no compensation or genuine remediation programme.

The change in policies and regulations by the new government also presented a new challenge that of enforcement, where it became unclear which agencies are primarily responsible for defining standards with regard to the environment and water quality specifically for the mining industry. The mining industry is regulated through the departments of mineral resources and the department of water and environmental affairs. The policies from each of the governmental departments do not necessarily conflict with each other, rather, multiple policies outline various standards that can be applied to the environment and water management as it applies to mining regulation and a debate remains as to what policy should be used to guide mine water, other environmental impacts and mine closure (Adler, et al, 2007).

The enactment of Minerals and Petroleum Resources Development Act (MPRDA) as the principal Act governing the mining industry heralded a change in the way government deals with the mining industry. The Act aims at making provision for equitable access and Sustainable Development of the nation's mineral and petroleum resources in line with section 24 of the constitution.

The democratic phase is slowly bringing in new changes to the mine accommodation. In September 2010 the department of mineral resources (DMR) released a document known as the Broad-Based Socio-Economic Empowerment Charter for the South African Mining and Minerals Industry better known as the Mining charter. The objectives of the mining charter are stated as follows (Department of Mineral Resources, 2010):

- To promote equitable access to the nation's mineral resources to all the people of South Africa;
- To substantially and meaningfully expand opportunities for Historically Disadvantaged South Africans (HDSA) to enter the mining and minerals industry and to benefit from the exploitation of the nation's mineral resources;
- To utilise and expand the existing skills base for the empowerment of HDSA and to serve the community;
- To promote employment and advance the social and economic welfare of mine communities and major labour sending areas;

- To promote beneficiation of South Africa's mineral commodities; and
- Promote sustainable development and growth of the mining industry.

In an attempt to address the mine accommodation legacies described above, the mining charter states that all hostels must be upgraded to accommodate one person a room by 2014 and the mines must provide family units for those employees who wish to bring and live with their families (Depart of Mineral Resources, 2010). The mines also provide a living out allowance for those employees who want to live on their own outside of mine property. There is also a discussion currently taking place regarding collaborative efforts between government and the mine companies on mechanisms to provide full home ownership schemes for those employees who want to own their own homes.

By December 2010 Gold Au had 72% of all its hostels upgraded to accommodating a maximum of two people per room. The hostel upgrade programme is scheduled to be complete by the end of 2013.

4.2.3 Other elements of the mining charter

The mining charter has other elements that are meant to transform the South African mining industry. The other elements include the following, ownership, procurement and enterprise development, beneficiation, employment equity, human resources development, mine community development, sustainable development and growth of the mining industry and the last element is reporting.

It is beyond the scope of this thesis to discuss all the elements of the mining charter, however two of the elements will be highlighted below, which are: - Mine Community Development and Sustainable Development and Growth of the mining industry.

4.2.4 Mine Community Development

The mining charter states that “Mine communities form an integral part of mining development, there has to be meaningful contribution towards community development, both in terms of size and impact, in keeping with the principles of the social license to operate. The mining charter further states that “Mining companies must conduct an assessment to determine the developmental needs in collaboration with mining communities and identify projects within the needs analysis for their contribution to community development in line with Integrated Development Plans (IDPs), the cost of which should be proportionate to the size of investment” (Department of Mineral Resources, 2010).

Gold Au has a full programme of community development. This programme is driven by several stakeholders including local government and the unions. Development of community projects takes place via a community consultation process that is largely driven by the municipality. The chosen projects are then included in the municipality’s Integrated Development Plans.

At Gold Au I am the responsible person driving the community related initiatives. I am the person liaising between the mine management and communities. The full community development programme has several elements. The first being community projects that are sustainable and independent of the mine (i.e. projects not dependent on supplying a service or product to the mine for survival). The second element is community skills development programmes – these programmes have dual role the first is training community members on portable skills that can be used by the trained person to look for work within and outside of the mining industry or for a person to be equipped and certified to start their own business. The third element is in up-skilling community small and medium enterprises and open opportunities for them to be able to comply with procurement standards of Gold Au so as to be able to be considered when there are products or services that need to be supplied to the mine.

The success of these programmes at Gold Au is varied. Projects that are independent of the mine are the most successful, however it is a struggle to get management to approve funding for these projects, the focus is always on whether the mine will get credited by the Department of mineral resources or not. In essence these projects are conducted for the sole purpose of compliance. The second element (that of skills development) also is a further struggle firstly approval of funding for training and the battle to get the trained people onto the mine for learnerhips. Procurement from the small and medium enterprises for capital goods is negligible, they are seen mostly by the mine as suppliers of consumables and certain non-core services.

4.2.5 Sustainable Development and Growth of the mining industry

The mining charter states that “Mineral resources are non-renewable in nature, forthwith exploitation of such resources must emphasise the importance of balancing concomitant economic benefits with social and environmental needs without compromising future generations, in line with Constitutional provisions for ecological, sustainable development and use of natural resources. The mining charter compels the mining industry to manage the environment by:

- Implementing environmental management systems that focus on continuous improvement to review, prevent, mitigate adverse environmental impact;
- Undertake continuous rehabilitation on land disturbed or occupied by mining operations in accordance with appropriate regulatory commitments;
- Provide for the safe storage and disposal of residual waste and process residues;
- Design and plan all operations so that adequate resources are available to meet the closure requirements of all operations.

The charter also compels the mining industry to improve the industry’s health and safety performance by:

- Implementing a management systems focused on continuous improvement of all aspects of operations that have a significant impact on the health and safety of employees, contractors and communities where mining takes place;

- Providing all employees with health and safety training and require employees of contractors to have undergone such training;
- Implement regular health surveillance and risk-based monitoring of employees.

Gold Au has fully fledged environmental management system and health and safety programmes, however all the elements that are conducted are done for the purpose of compliance and avoidance of liabilities.

4.2.6 Section Summary

Section 4.2 has highlighted the evolution of the South African gold mining industry and its relationship to government over the period 1887 to post 1994. In essence the relationship between government and the gold mining industry before 1994 was that of partnership, based on the government benefiting from increased revenue from the gold mines and the mines benefiting by exploiting the natural resources and externalising the impacts with no government interference and generating profits for their shareholders.

The current state of gold mining industry is heavily influenced by these historical facts, moving from the migrant labour system, to the mine accommodation in single sex hostels and all the unintended consequences of breaks in the families, increased levels of health impacts such as HIV/AIDS and the informal settlements. The environmental impacts are also huge with water pollution, ecosystems degradation, acid mine drainage are but few of the impacts.

The democratic government (post 1994), changed the partnership relationship and acted as a regulator of the industry, however this change in the relationship is complex because of lack of understanding by the current government of various committees that were formed by the previous government together with the gold mining industry. Through enactment of the MPRDA and the mining charter, the democratic government clearly highlights its role as a regulator of the industry rather than a partner to the industry. The mining charter states very clearly the importance of Sustainable Development within the industry through conditions imposed to the industry to address issues such as community development, environment, employee and community health and mine accommodation.

The impact of this historical perspective is visible within Gold Au albeit with an effort to try and change the situation. However the effort for change is driven more by the need to comply rather than by the understanding and commitment to go beyond compliance.

This section has addressed the first objective of this thesis, that of gaining an understanding of the South African gold mining industry from a historical perspective in terms of the relationship between the industry and government. The section forms the basis for exploring the rest of the other objectives.

4.3 Findings from observations, discussions and interviews⁸

4.3.1 Introduction

Section 5 provides research findings based on the various interactions that took place during the course of conducting the study, as outlined in Chapter 3. These findings will be divided into three distinct areas, based on the research objectives. The first will be findings from the visits from the observations and conversations that were conducted in visiting various working areas, this will be followed by the focus group discussion findings from the shaft task teams, then the leadership semi-structured interviews and finally the exploration of sustainable development programmes and/or initiatives at Gold Au and its partners.

To give context to the mining process figure 15 below illustrates a typical Gold mine flow model, which basically illustrates what happens underground from preparing the rock face till when the bar of gold is produced. The flow model consists of six steps.

⁸ All interview questions are appended as Appendix 1 and the full transcripts of the interviews can be made available on request

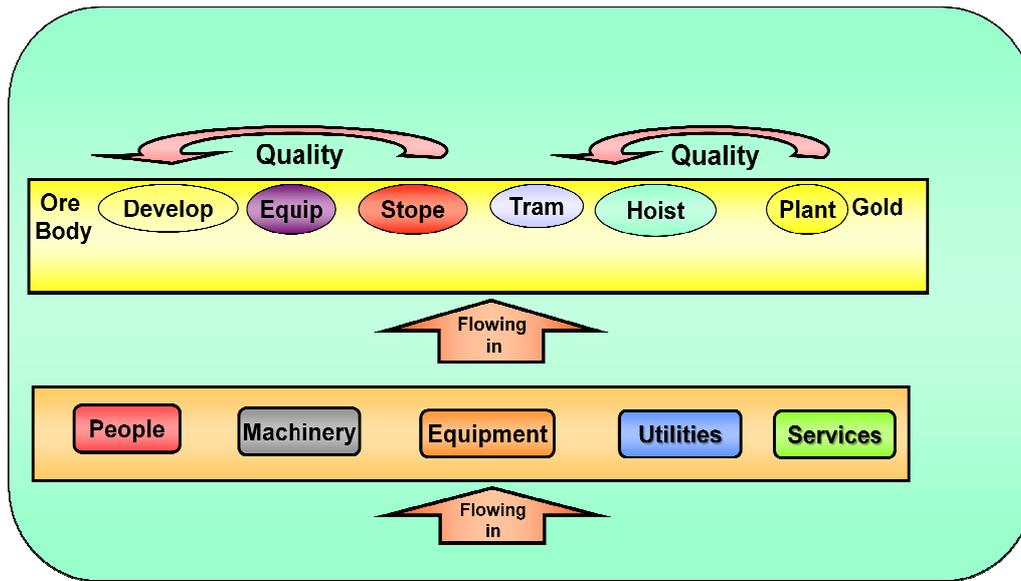


Figure 15: Flow model for underground Gold Mining

Source: Gold Au Archives

4.3.2 Step 1: Development

Development is the excavation process that enables the workers to access the ore body. It is composed of excavating almost entirely the non-valuable rock (waste rock) in order to access the gold bearing rock (ore body). This process removes hundreds of tons of rock that get “stored” on the environment above ground. Some of these rock piles are the unnatural “mountains” that are typical of any mining town. The steps involved in development include drilling the rock faces, load them with explosives and blasting, this is followed by removing the blasted rock, making the area safe by supporting the roof and the sidewalls to protect the workers and equipment from damage. The excavations from development can cover tens of kilometres underground. The working area where development takes place is called the development end.

4.3.3 Step 2: Equipping

Once the development is done the next step is equipping which consists of providing all the materials that are necessary to remove the gold bearing material. Equipping includes providing rail strips, provide further drilling equipment, material cars or locomotives, all the equipment required for providing safety support, etc. The most important equipment that is also provided is what is called utilities (air pipes, water pipes, electricity lines, etc).

4.3.4 Step 3: Stopping

Once all the equipment is provided the next step is called stopping, which basically means the removal of the wanted ore, using the same techniques of drilling and blasting. The working area where stopping takes place is called a stopping end.

4.3.5 Step 4: Tramming

Tramming is the process of removing the blasted gold bearing rocks from the stopping end and removal of waste rock from the development end. Tramming from stopping end is done separately from the one from development end, because their destinations are different. Waste rock (from development end) goes to surface storage and gold bearing ore goes to the processing plants where gold extraction takes place. Tramming is mostly done by locomotives.

4.3.6 Step 5: Hoisting

The trammed rocks are then loaded onto conveyances that transport the rocks to their destinations. The conveyances could be belts that take the ore directly from underground to the processing plants or the rocks get loaded onto cages that get hoisted to the surface where the rock get tipped onto trucks/trains transporting them to their destination.

4.3.7 Step 6: Processing

This is the final step that leads to the production of a bar of gold. When the ore gets to the processing plants, large crushers, mills, reactors and other equipment consolidate the mineral rich material and extract the gold. Waste that gets produced in this process is what is termed tailings. Tailings are stores in Tailings Storage Facilities (TSFs) or tailings dams, similar to the one illustrated in figure 5 above.

The most important and integral part of the flow model is that it cannot happen without people. The whole process occurs anywhere between one and four kilometres under the earth's surface.



Figure 16a: A typical underground walkway



Figure 16b: A typical Stopping area

Source: Personal Archives

4.4 Exploring Gold Au worker perceptions

4.4.1 Observations and conversations in the working areas

In section 2.6, I discussed the impact of mining on health and environment. The purpose of spending time at the working areas was to understand the environment where people work and also to understand the mental models of the workers themselves regarding the working environment. More specifically I wanted to understand the perceptions of the workers related to the working environment's impact on their own health, and their view of the impact of mining to society and environment in general.

The date is Monday the 15th of February 2010 and the time is approximately 06:45 am, I am leisurely driving to work when suddenly my phone rings, and it's a lady from work requesting me to urgently go to the boardroom for a meeting with some important visitors. I explain to her that I am about 30 minutes from work. She then proceeds to ask me my shoe size and trousers size and proceeds to instruct me to go straight to the boardroom when I arrive. I calmly request for an explanation for this instruction and my clothes sizes. She promptly tells me that there are important visitors to the mine and I will form part of the managers who are going to accompany them underground.

Indeed when I arrive at work there were very important visitors from government. After the boardroom protocols a delegation proceeded to change and put on underground clothes.

The boots that I was allocated were maybe a size bigger and the overall about two sizes bigger, I looked like I was a small potato in a big bag, but I did not complain.

When the delegation arrived at the shaft, before going onto the cage that will transport us into the belly of the earth, Kobus, a safety officer gave us a quick safety talk about what we would need to do in case of an emergency. Kobus is a tall stout man, who has been working for the mine for more than 30 years, he has such a deep voice that I was tempted to put on ear plugs when he talks to protect my ear drums from bursting. After the safety talk we proceeded to put on a battery (~3kg) that powers the light on the safety hat, the battery is inserted on the waist belt on one side and another side of the waist is a gadget called a self contained self rescuer. The self contained self rescuer would be used in case there is disturbance underground with air, or a power failure or anything related to ventilation failure, it is basically a modified oxygen mask. We proceeded to the cage that took us to about two kilometres underground.

Once we reached the level we were visiting, Kobus again gave us a quick safety brief before proceeding to the stoping area. After travelling on a locomotive for a further two kilometres we reached the working area. To reach the working area we climbed on very loose rocky area onto small passages and suddenly we were on a very confined space about 1.5m height and width of about 2m.

The temperature in the area was about 29 degrees Celsius with very high humidity. My oversized boots and overall were at the moment dripping wet and felt even bigger, in the working area there was a group of 12 men all looking happy and continuing with their work. In conversation with some of them they shared with me that this is where they spend more than eight hours a day. In this environment, one cannot stand up because the place is very confined, the only way of moving around is through crawling (see figure 16b above).

The drilling machine itself has a water spray for dust suppression. The workers were complaining though that the water sprays do not always work and they are regularly exposed to dust from the drilling. They also mostly complained about back problems and the water they drink. They informed me that they use the same water for dust suppression

and for drinking and they believe that the water is not meant for drinking. They seem to have accepted their working conditions. The team leader of this group name was Sibongiseni who said *".....because of our poor education we have no choice but to work in these conditions, where we do not even know whether we would come out alive or not"*. He further emphasised a point and said *".....even if we come out alive working in these conditions for more than five years significantly shortens our lives because of the dust and water we are exposed to here"*. In trying to decipher whether the members of the team understand the full value chain of gold production, the answer was a very simple one that said, *"we remove the gold bearing rock and we should ensure that we advance not less than 12 metres a day, it is the responsibility of others to separate gold from the rock not us"*. All the team members agreed that mining was providing a good service to the communities around and therefore the communities should not complain because the mine has provided jobs for them and directly and indirectly put food on their tables. There was no sense on how the mine impacts on the environment on this team at all.

Most of the workers in this stoping area were happy to have the important visitors visiting their working area. However there were a few of them who did not show any interest at all. Tsietsi said *"there is no point in visiting us, you are just delaying the targets that you as management has put for us to achieve on a daily basis and you will again penalise us for not reaching that target"* When I explored further what he meant he said *"at Gold Au workers are just machines who can talk, there is no consideration on the way we feel about the working areas, nobody cares about our health, we use old equipment which is dangerous to our own safety, but as long as we produce gold, they do not care"*. Tsietsi has been working for Gold Au for 13years and is 42 years of age. He is from Lesotho and has five children. He currently works as a machine operator. He is more concerned about his health and safety in the area where he works and says he will do anything to get out of this working environment preferably to leave the underground work environment altogether. He worries everyday about his children and the anxiety of maybe one day he may not come back alive from underground.

Ricardo from Mozambique said *"if only management would put the same emphasis on ensuring we are safe in this stope as they are when they want production our lives and those*

of our families will be better” He further stated that at the moment it is a struggle to get any equipment that is seen to better the working conditions because “.....*we are told there is no money, if we put all the equipment you are looking for we may have to retrench some of you to save money for the equipment”*. “*We just keep quiet because no one wants to be retrenched”* he said.

When the production supervisor was still describing the work done in this place to our important visitors, there was suddenly a huge noise from one of the machines. I believe that my heart jumped out of my chest into my mouth and my lower legs turned into jelly, because in my mind a disaster was about to happen or has happened, only to observe that almost all the workers were killing themselves laughing. Apparently it is an old trick that they use when there are non-mining people visiting where the workers would suddenly and unexpectedly switch on the drilling machines for their own amusement of the reactions of the visitors.

When we left the area I was more appreciative of the workers that I always see in their dirty overalls, boots and hard hats at the same time feeling a bit emotional regarding their working conditions and the conversations I had with them pertaining to their own fears and helplessness. I had several other stoping area visits with similar conditions and related conversations. The other areas visited were development end visits.



Figure 17: Typical underground working environment.

Source: Personal Archives

Figure 17 above illustrates some of the areas that I visited in the various underground visits that I undertook.

The date is Thursday the 18th of March 2010, I am in my oversized underground working clothes, the time is 06h15 a.m. and it is chilly outside. I am welcomed at the shaft by the shaft manager Mr. Smith who introduces me to JP, the person I am going to be with the whole day. JP is a mine captain responsible for all the development ends at the shaft and is part of the shaft task team at this particular shaft. JP is a short man his upper lip is completely covered by a rusty and bushy moustache. The rustiness is clearly from years and years of smoking as observed by the three cigarettes he has smoked the few minutes I have been with him. His is a middle aged man of about 50 years of age, he has a very clumsy walk, when he walks it seems like both feet want to be in front at the same time. I had to continuously restrain myself from trying to hold him, because he walks as if he could fall anytime.

The cage took us down at 07h15 to 50 level which is 3.5km underground and I was informed that this is the deepest level of any shaft at Gold Au. The cage had about 40 people crammed in like sardines, and the conversations were about a burst water pipe that supplies water to the various working areas underground. When we alighted from the cage it became very apparent to me that this was not an ordinary day. The temperature was about 33 degrees Celsius and I was soaking wet already from the crammed cage and the poor cooling underground because of the burst water pipe.

JP informed me that water and electricity is the lifeline of mining, because as the mines get deeper and deeper more and more water and electricity get used. He informed me that over the past few years tight controls have been put by the mine on water and electricity usage because of the exorbitant costs of electricity. Naively, I asked why the need to tightly control water usage, I can understand the tight control on electricity. His simple answer was that *"it is easy to bring water underground, however a lot of electricity is used to pump the water out, therefore less water in, equates to less water having to be pumped out"*. He quickly continues to give me some relative figures, he says *"10 years ago we were using about 4.5kl of water per ton of gold produced but now we are averaging 7.5kl of water per ton produced"* This increase has been due to two factors, *"stricter regulation regarding dust suppression and also because we are mining deeper and deeper"*. He also mentioned that electricity is also following the same trend.

We proceeded with JP and his team to the development end. The observation was that the working area is much higher than the stoping ends that I visited previously, more than 4m in height and wider. The drilling machine used is also a bigger machine that gets operated by several people working together. JP left me with one of his teams under the leadership of Mona, the team leader. Mona has been the team leader for more than 10 years leading a team of 15 people. He was howling instructions to his team like a commander in an army. I struggled to hear him properly not only because of my poor understanding of Sotho and Fanakalo, but also because Mona speaks as if he has a hot potato that he does not want to spit out or swallow in his mouth.

The major complaint for this team of the working conditions revolved around three issues. The first one is the unbearable dust, the second one is what they termed “kidney problem” and the third noise levels. In trying to understand what do they mean by kidney problem, Mona showed me the way the big machine vibrates when it drills and he says the vibrating movement leads to back pain because the kidneys get shaken out of their positions (*I opted not to offer any medical opinion from this kidney theory*). They also informed me that the water shortage problem is a regular occurrence and this leads to insufficient ability to suppress dust from drilling and thus almost all the team members suffer at one point or another from chest related problems. When I asked about the masks for protecting dust inhalation, they politely asked me, “...you have a noisy machine, by law you have to put ear plugs to protect your hearing, you also have to put a dust mask that covers your mouth, tell me how are you going to issue instructions and communicate with each other?... the solution lies in the fact that there must always be water at this end so that dust does not affect us”. The conclusion they came up with was “...we are just treated as if we are these machines...the management does not care about us, when you are sick you just get replaced like they would replace this drill (pointing to a drill bit on the machine)”.

By this time, I have been underground for almost two and half hours, the heat was unbearable, and in my mind I was wondering how do these workers continue to work in such conditions, especially today without any water? I retreated from the working area to the waiting area about 20m from the development end. At the waiting area I found two young men sitting (almost sleeping). Both of them were well spoken and aged 21 and 22

(they looked 16 to me). They informed me that they passed their grade 12 two and three years ago respectively and their job at this working area is to fill the holes that are being drilled by Mona's team with explosives for blasting at the end of the day.

The 21 year old's name was Tebogo he had a squeaky voice and was very opinionated and the 22 year old's name was Fana who was much more reserved and seemed to be disinterested in my presence. While I was busy trying to get a bit of a rapport with them, loud cheers with clapping of hands and whistling noises erupted from the different working areas. My heart started racing and I could swear that may be a certain popular celebrity has arrived. I jumped up to look around as to what is going on. Tebogo and Fana seemed not to be moved at all. I realised that this was because water has been restored and was flowing again. The cheering and excitement brought by the presence of water made me even to realise more, how important water is in these working areas.

Back to Tebogo and Fana, Tebogo explained to me how he hates going down the cage daily to these working areas because of the fear of injury and the impact of these working areas to his health. He has been working in the area for the past 11 months and he has seen several people getting injured and the health of some of them deteriorating due to the poor working environment. He says there is no way that he will continue working here, however he likes working for Gold Au because he has a study grant to study environmental management through UNISA, he will most likely join the environmental department (I opted not to inform him that I am the head of the environmental department).

Tebogo had a thorough understanding of the impact of dust on the workers health and the impacts of mining on the environment and communities. His view is that – *“we should not stop mining, but management has to make sure that all the necessary precautions are taken to ensure that the impact to the environment and people is minimised”*. He continued to say that he has heard several of his colleagues saying, injuries, deteriorating health, and the negative environmental impacts comes with the territory of mining, there is not much that can be done to prevent this. His opinion is that it all comes down to how genuine and serious management is in preventing these impacts and he believes that one day he will be in a position where he can influence the way mining is conducted.

At this time Fana was deep in his sleep, Tebogo and I quietly left him alone and we went back to Mona's team, who were jubilant of the restoration of water. At this time I had several general discussions regarding the impact of mining outside the working areas. It became clear that this team had an understanding that the waste rock that gets removed from the development end affects the environment in a bad way. One of the team members related a story of sickness of people who live around the mines because of the dust that the rock dumps produce. However no solution was offered as to how this can be prevented.

Ma-Shorts, one of the team members was more concerned about the impact of mining on vegetation and water, he says he used to own cattle on the land owned by the mine, but *"...one by one my cattle died and I was informed that the death was due mostly to contaminated water from the mine"*.

The temperature in the area was still unbearable to me, JP came back and took me to the waiting station, and he had 2.5 litres of iced water that he shared with me. I was surprised when he told me that he is 39 years of age and has been working in the mines for all his life from the age of 18. His concerns were not very different from that of his team, the sense of helplessness on the working conditions was evident. He boldly said to me *"...doc you must be grateful that you went to school and do not have to face this rubbish we have to go through every day.....let me tell you mining is not for sissies"* I think he was indirectly telling me that I am too soft to be in mining and indeed I think I was about to collapse due to heat exhaustion. We proceeded back up to the surface at about 14h00 in the afternoon, the cage was not only as crowded but the stench from sweaty men almost made the 5minutes trip back on surface unbearable. Two other visits to the other development ends also produced similar concerns as JP and Mona's team concerns and conditions.

The next visit to a working area was to spend a full shift with the engineers. On this day I prepared myself well in that I only put my oversized overall and had my own 1.5 litres of water to take with underground. When I arrived at the shaft at about 08h00 in the morning, the chief engineer, Louis, introduced me to the team that we were going to spend time with that day. He informed me that, *"today we are going to visit the shaft examination team and don't worry about the water you will not need it"*. I was a little bit uncomfortable leaving my

water, because the previous visits taught me that water is everything in these working areas, however I trusted that Louis knows exactly what is needed.

Shaft examination is a process of examining the integrity of the shaft infrastructure. The examination includes checking all the water, air and electricity pipes from surface to underground, checking the ropes that hoist the people, rock and material carrying cages. Shaft examination is a regulatory requirement primarily for safety reasons, and also to ensure that all the utilities are managed correctly with no infrastructural defaults that may lead to wastage of water, air or energy.

After a lengthy safety talk by the chief engineer, we were all given harnesses that we had to put on and climbed onto different cages. One of the junior engineers, Mthandeni came to me and said *“it seems like you are underdressed, its winter inside these cages”* he advised me to go onto the man carrying cage because it is not as cold.

We proceeded onto the cages and the harnesses clipped on the cage structure. The cages used are different from the ones used to go underground in that they are open. I likened this to going down a huge chimney that is approximately 4m in diameter, the inside walls of the chimney are lined with several pipes. It is these pipes that are examined for any structural defects. The defects found are either fixed immediately or are recorded for repairs at a later stage. I realised that there is not much talking in this team everyone is concentrating on the pipes and what needs to be done. I soon realised what Mthandeni was talking about (*when he said its winter down there*), it was extremely cold, I think my heart, and my intestines and all my internal organs were slowly getting frozen.

In a conversation with Louis after the shaft examination, he patiently explained to me the importance of this examination. Beyond it being a regulatory requirement, maintaining the shaft infrastructure is the life blood of mining. He says *“any slip up can easily lead to death of people”*. He shared with me several examples of situations that affect people’s health, such as the water pipe burst that deprived sufficient water for cooling, and dust suppression. The impression he gave was that the impact of such cannot be measured because the consequences would last beyond the working career of most of the workers. He

demonstrated a genuine concern and care for the integrity of the shaft infrastructure. He also shared with me an incident that happened in a certain other mining company where the ropes that are used to hoist people from underground snapped, resulting in instant death of eight people with scores of others injured. The whole engineering team that I spent time with demonstrated deep understanding of their work and its implications.

The next series of areas that I visited were the tramming sections. On this occasion I was visiting one of the older shafts in the mine. Roy was the person who was to be my guardian on the day. Roy is a tall thin bald man, whatever hair left on his head he tied it into a ponytail. He is wearing spectacles, but I could see through the spectacles that he actually has one eye, the left "eye" is a prosthetic. He shared with me that he used to work in a stoping area until the accident that led him to lose his eye. He has been working at this mine now for 22 years.

Roy was stressed because an investigation was being conducted on his section because of an accident that happened the previous two weeks where a person through an accident had fractured his left arm. The initial findings were lack of leadership in his section. A striking difference that I observed with Roy as compared to other sections I had previously visited was the cordial and respectful relationship he has with his team. I could not help wondering whether the findings of the accident investigation led to this cordial relationship or is it a case of not "*washing your dirty linen in public*".

However throughout the day in all areas visited the comradie and respect was evident. Roy informed me that what irks him is the fact that the accident investigating teams are people who themselves do not have enough experience and understanding of various working areas, and their different nuances and because they want to preserve their own jobs, they will do anything to find blame in people especially leadership, when they do these investigations, he concluded by saying "*I am so gatvol of that*".

Thabo one of the team members told me that tramming is the most important function within mining because other people can develop, drill and blast but the rocks have to be transported out of the underground environment, to enable further development and

stopping and most importantly for the rocks to be processed to produce gold. He further stated to me that there is no leadership in this mine. *“Leadership in this mine do not care about our own needs, those of our families and even the communities around”* When I probed further he pointed out the kind of equipment they use to load rocks onto the locomotives, he took me through the railway line that the locomotives have to travel on, pointing poor maintenance and said they have reported the conditions and placed orders for spares with only promises and no action. He points out that Roy is doing his best to ensure that work is done in a safe manner, but the managers above him are useless *“they are just happy receiving their fat salaries”*. He further pointed out that poor maintenance leads to poor safety and people can die and have died before.

The team pointed several other shortfalls of the tramming section, they all felt that the mining company can and should do better in supporting the communities around especially on issues like the provision of health care and education facilities. They did not seem to care much about the environment. Joel said *“...the environment does not bring food to the table, but education, health and safety will enable one to work and put food on the table”*.

These observations and conversations were covered in the period 15th February 2010 to 04th June 2010. I had interactions with close to three hundred people during the period. What was striking was the commitment that all the teams I interacted with had for the work they were doing. They mostly had a very clear understanding of where their role fits into the full mining flow model. However, there was a considerable lack of linkage of the work they do with the outside environment, except on very few occasions. The understanding of the role of other departments within the mine was also lacking. For example the role of employee wellbeing programmes were poorly understood and considered mostly as peripherals and of less importance.

Leadership was only understood in the context of positional leaders. No one was considered a leader unless he/she has a certain title. When leadership is discussed it is mostly in the context of mine management and the union representatives. In some cases things could only be done if there is a management instruction, otherwise they do not get done. Almost all the people I interacted with did not consider themselves as leaders, however on probing

further some of them were prominent respectable members of the communities where they come from. Some of them were pastors in their churches, others served in traditional councils of their communities. Some commanded considerable respect from the team members they work with though they were not accorded any formal leadership positions, but they all did not consider themselves leaders or were not considered leaders by their colleagues.

Almost 90% of people I interacted with came from communities very far from the mine. They were migrant workers mostly from the Eastern Cape and Kwa-Zulu Natal provinces of South Africa and also from Mozambique, Lesotho and Swaziland. The community and environmental issues were of less importance to most of them because they felt that they do not really affect their own communities. On asking them how would they feel if the mine could be relocated to their own communities in the rural areas where they come from, the majority felt that they would not like the mine to come to their communities because the mine destroys the grazing land, pollutes water and will interfere with their culture and traditions.

There were however very strong emotions related to the role leadership (*read management*) can play to improve the work and living conditions. Of importance the perceptions were that management did not care about the workers wellbeing and also the unions are sometimes in collaboration with management.

The role the mine could play improving the lives of communities around the mine, was viewed only as far as offering employment to the communities.

4.4.2 Focus Group discussions

As described in section 3.3 above six shaft task teams were established at the mine, it is these task teams that the focus group discussions were conducted with. I had one session with each of the task teams. The discussions revolved around five themes.

- Impact of mining on people (employees)
- Impact of mining on communities

- Impact of mining on the environment
- Role of leadership
- Role of education

The sessions were conducted mostly in English, however several of the participants expressed themselves in their mother tongue or the common mine language of Fanakalo. In all the sessions I was assisted by Kenny who has been with the mines for the past eleven years and is fluent in most of the South African languages including Fanakalo. Lorraine assisted as a scribe and all the sessions were also recorded. The discussions mostly took place in the afternoons lasting between two and three hours at an allocated meeting room at the shafts.

The Impact of mining on people (employees)

The discussion on the impact of mining on people, invariably within all the groups, started with safety related impacts. The biggest impact that people feel mining has on people is on their safety. People work in the mines with a clear knowledge that mining is extremely dangerous and therefore it is an expectation that people may not come back alive or may have permanent disability from injuries. If a person working at the mine does not get injured he will definitely have health related effects. They all felt that safety training provided by the mine is just provided to cover management in case of an accident. *“People get injured because the unwritten rule of this mine is that you first produce then deal with safety”* said one of the group members with nodding heads from others. *“We are never going to solve safety in this mine because we are driven for production, get paid less, need to work overtime or work extra, to get a bonus, we all live on bonuses here”* That was a concluding remark from the group. Injuries do not only affect the person injured but also his colleagues and the families. *“Once a person is injured he is of no value to this mine and management do not care of what happens to that person.....they only think of how to get rid of the person even without compensating him”*. They (management) do that with a clear knowledge that most people are illiterate and do not understand the intricacies of law and compensation. One of the participants asked (he was from the union)- *“did you know that 60% of the shareholders of this company are from America and Britain? Do you think management care*

about employee health? You must be joking!!! Your life is valueless to the Americans and the British”

All the groups complained that the biggest health impact on people working at the mine revolve around exposure to dust. Therefore everyone who works underground will at one point or another in their working career develop respiratory problems. *“...you cannot work at the mine and go back home with your health intact”*, this was a statement that was uttered by several of the members of the task teams. *“Almost all the workers working underground here have developed TB or will develop TB (read TB or Silicosis or Chronic Obstructive Airways Diseases) sometime in our working or post working lives”*.

Due to the dangerous condition in which the people work under, there are two impacts that are usually not very apparent and are not getting addressed adequately. The first is drug abuse, especially alcohol and cannabis. The abuse of these two drugs is endemic within the mines to a point where there are significant numbers of people who go underground to work in dangerous conditions under the influence of cannabis. Cannabis is commonly used because there is no readily available test that people can be subjected to before going underground. Alcohol testing gets conducted through the use of breathalysers.

The second common impact is mental disorders. *“...you just need to spend one night at the hostels, to hear how many people scream and cry because of nightmares that are brought on by all the deaths and debilitating injuries that people have been exposed to”* said one Sifiso in one of the discussions. There has been a good number of people who had to be taken back home because they never recovered from being exposed in near death situations or had witnessed some of their colleagues dying in front of them.

Despite all the negative sentiments expressed on the impact of mining on people, all the groups expressed the need for mining to continue albeit with better focus on improving the conditions where people work focusing on improving safety and reducing health impacts.

The Impact of mining on communities

The majority of the groups felt that the biggest community impact of mining surrounds HIV and TB. They felt that the system of hostels that accommodate “healthy” men who face death on a daily basis by going underground makes people less concerned about HIV. Their opinion was that the spread of HIV in mining communities is a direct result of the accommodation policies of mining. As a result of this system the HIV gets spread beyond the surrounding communities but to the families who live in remote rural areas where the majority of workers come from.

It was also apparent from the discussions that were it not for mining, the surrounding communities would also be poorer, and therefore mining has provided much needed jobs for the community. Of importance was the fact that mining provides not only direct jobs but also indirect jobs. The groups also clearly articulated that, according to the new mining legislation, mines are obliged to develop the communities around them according to what the communities themselves want. Although they have the understanding of what the law requires of the mine, they felt that the mine was doing the bare minimum just to appease government. In one of the groups Themba asked *“Is the government not abdicating its responsibility of community development to the mines? The mine is here to make money, and the government generates taxes from the mine, why the need for government to on top of the taxes also obligates the mine to develop communities?”* Themba’s point generated a heated debate with some members saying that mines are not taxed enough therefore they still need to put more money on developing communities, others were saying that community development programmes are a better solution than giving money to the government “gravy train”.

Bheki, one of the few people in the groups who come from the surrounding communities was for the mine to develop the communities. He related a story whereby he was informed by his grandparents that before the mines came in, everyone in the region was well and there was enough food for the community. The area was apparently a good farming area. With the arrival of mines, water got polluted, farming stopped and starvation started. He was staunchly advocating for more mine community development.

With all the groups there was no sense of the impact of the mine on the culture, values and traditions of the surrounding community. One of the members of the group said *“the surrounding communities are here only because of the mine, once the mine closes this community will disappear, the culture that exists within this community is that of the mine, you cannot expect any values or traditions in a mixture of people from vast backgrounds”*.

Some of the discussion members felt that one of the most important negative impacts of the mine on communities was the fact that they employ people from very far, this leads to children in the rural communities growing up without a father figure who should be able to instil discipline and respect. The absence of the father figure creates a gap and alienates the father from the total family. In some cases the incidents of divorce are said to be high because the husband and wife becomes strangers. Some of the people do not want to go back home because of mostly two reasons, first they either have another “wife” around the mine or they know the wife left at home has another “husband”. When the people get retrenched from the mine some of them end up in the informal settlements that are typical of many mining areas including the way next to us. These were some of the sentiments expressed by the focus groups.

The Impact of Mining on the Environment

The impact of mining on the environment proved to be the most obvious and well known impact across all the discussion groups. The groups all related several articles they had seen on the newspapers regarding water pollution by the mine. They all felt that the mine was not doing enough to control run-off of polluted water from the mine. They said *“water is everything, you wash with it, you drink it, you cook with it, and therefore the mine should do everything possible to prevent pollution of water”*. However the majority of the groups felt that there was not enough done by *“our management to prevent dirty water from damaging the environment.....most of the managers live far from the mine in Johannesburg and do not care about water that is causing sinkholes in many places within our communities”*.

Markos in one of the groups related of a story where several houses in the township where he comes from has large cracks and they have been informed that, it is due to instability of the ground and they are to be relocated". This he says *"is an environmental impact of mining that is affecting our families who have been living in these areas for centuries, now we have to leave our forefathers land to new areas because of mining"*.

The second most important environmental impact of the mine related to the vast amount of land that has been rendered unusable because it is covered with waste rock dumps and tailings storage facilities. Of concern to the groups was the fact that mining will one day stop because gold will be finished and when that stops the communities around the mine will also close because there will not be able to live off the land due to land pollution posed by these tailings and rock dumps.

However there were some members of the discussion group who felt that the mine did not have any significant negative effects on the environment. There was a complete lack of understanding of the impact of mining on biodiversity in general and no understanding of ecosystem services. There was also a lack of understanding of climate change and all issues related to the depletion of natural resources. Across the groups there was consensus that natural resources are still intact and available for further exploitation in order to create employment and reduce poverty. However they all agreed that in the process of exploitation all efforts need to be taken to prevent pollution.

There was no sense of trans-boundary environmental impacts of the mine, such as pollution of water where the mine is located may affect people who live kilometres away downstream. Most of the discussion members felt that by the time the water reaches communities about 100km away the river system has already cleaned itself, therefore people in those communities would not be affected. It is the immediate communities that are adversely affected by the pollution.

The role of leadership

The first discussion surrounded the understanding of what leadership is by the groups. Leadership was only seen in the context of positional leadership. All the people sitting at the group discussions did not consider themselves leaders because they did not have any leadership positions, though some of them were in leadership positions in the union and were supervisors of their sections and were respected leaders in the community. They however conceded that they may be providing leadership when they recommend certain actions that the mine needs to take in order to improve various areas in the working conditions at the mine, but the decisions need to be taken by the leaders (read senior management). They all felt that the leaders must be visible, they must give direction, and they must be compassionate to the needs of the workers.

The groups felt that the leadership of the mine had only one concern and that concern is production. *".....this mine does not care about the production machine which is people, they see workers in the same context as they see the drilling machines"*. They felt that leadership of the mine did not care about safety of people, about worker's health and the health of their families. They also felt that it is the responsibility of the government to protect the environment therefore mine leadership need to concentrate more on issues affecting workers, *"... mine leadership should just follow on what government wants"*. They felt that mine leadership should comply with the laws of the country because if they do not do that the license to operate the mine can be taken away. Going beyond what government wants is like taking resources away from the mine, resources that could be used to improve salaries of the workers and improve safety of the workers. This view seemed to contrast the discussion on the environmental and community impacts discussed. In exploring this further, it was explained that the primary function is to look at the workplace first before concentrating on the outside.

The overwhelming view of the groups on leadership was that *"leadership in this mine do not care about the workers, do not care about the environment and do not care about communities, they are here to run the mine, make money and afterwards disappear"*.

The role of education

The role of education in environmental management was poorly understood by all the groups. They felt that education is only important in the context of improving one's salary at work and also to be able to leave the mines to get employment in another industry with a better health and safety record.

The issues of using education as a tool to manage sustainable development related challenges generated no debate across all the groups. Education for environmental management should be left to people who study environmental management. They felt that there was no need for the engineers, mining people, metallurgists, etc to study and understand the environment as their work has no bearing on the environment. If there were environmental issues related to the work of engineers *".....environmental people must come and sort those issues not the engineers"*.

In all the focus groups, it was fascinating to observe the relationship between those members of the group in management positions and those in union leadership positions. The management representatives were less vocal about their views and were cautious when giving their opinions. However the union representatives were more scathing in the way leadership addresses issues and their roles. Those in management never openly challenged the views uttered by the union leadership.

4.4.3 Semi-Structured Interviews

In conducting the semi-structured interviews, I used two models to illicit the dominant approach that Gold Au leadership attach to issues of sustainable development. The first model is the UN Global Impact Gearing Up model. The Gearing Up model incorporates five stages, the fifth of which extends beyond that of other stages. These gears represent stages of activity within a company and the interplay between the company and the stakeholders. The interviews were complemented by sending out 32 questionnaires based on the gearing up model to the operational excellence team. All 30 of the 32 questionnaires were completed and returned (see Appendix 1 for the questionnaire).

The first stage is **compliance** – at this stage sustainability is only viewed as an add-on posed by society and/or regulators. The second stage is that of **voluntarily** managing sustainability challenges, however the actions are taken only to manage risk and reduce direct operational impacts. The third stage is that of **partnership** development, the focus is addressing sustainability challenges in partnership with other stakeholders, be it suppliers, customers, other industry players, etc. The focus of this stage is reputation building and pro-active risk management. The fourth stage pertains to increasingly **embedding sustainability in business processes** and sustainability is seen in a strategic light and viewed as a competitive advantage and value creation to society at large. The fifth stage involves **redesigning the business** based on sustainability principles. The stage includes business proactive lobbying of various stakeholders such as communities, regulators, investors, other industries, etc, to influence policy changes towards a more sustainable approach to company activities.

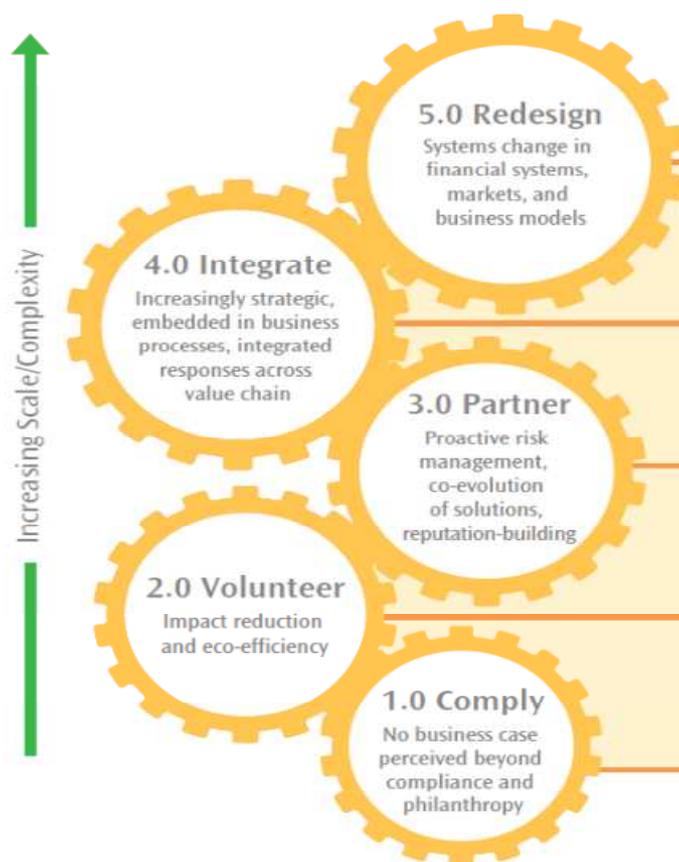


Figure 18: Illustration of UN Global compact Gearing up model

Source: adapted from Avastone Consulting

In conducting the interviews I did not lay out the Global compact model in front of the interviewee, but asked the questions based on the various stages. The first question that I

asked from most managers was “Why is our company a signatory to the UN Global compact and a member of the International Council on Mining and Metallurgy (ICMM)?” To those who were aware of what the UN Global compact was about, invariably replied by saying “*for reputation building, you know investors like companies that are signatories to these things*” More than 50% of the managers I interviewed did not know about the UN Global compact and ICMM let alone that our company as a signatory to both.

The majority of the interviewees said that all sustainable development activities are geared towards complying with government regulations, however to be a “good corporate citizen” you also need to have activities within the community because that buys you goodwill and your social licence to operate is protected.

A few of the interviews especially at senior management levels spoke at length about the importance of managing sustainability challenges together with other surrounding mining companies and civil society because “*the challenges are beyond any one company and the fact that these issues are not localised but spread beyond the artificial boundaries of the mine*”. The senior managers also emphasised the need to be seen by investors as a company that produces gold without trampling on the environment and people, “*hence our being signatories to ICMM, the Global compact, the Cyanide code and all our mines are ISO14001 certified*”.

The dominant view however was that of compliance to regulations and risk management to ensure that the licence to operate is protected at all times.

The second theme of the interviews was based on the David Rooke and William Torbet’s seven transformations of leadership as illustrated in Table 4 above. The formal assessment of the leadership approach was done for the top twelve leaders of the company. The rest of the assessment was through subjective interviews with the rest of the managers.

From the formal assessment 80% of the leaders fell within the Achiever action logic. According to Rooke and Torbet these leaders create a positive work environment and focus their efforts on deliverables, the downside is that their style often inhibits thinking outside

the box. 10% were Experts, 5% were strategists and the other 5% was composed of individualists.

The rest of the action logics of leadership were assessed through describing the different action logics and discussing with the manager their opinions and reasons for the dominant logic of Gold Au leadership approach. The responses were that the majority of leadership's action logics were Experts (75%). The reasons were that mining is an instruction business and the instructors must be experts in their fields or else people may die if the instructions are not given by experts, because those instructions might be inadequate. *"People respect you if they know you have been at the coalface and you have the qualifications"*

The rest of the interviewees felt that 25% of the leadership at Gold Au fell within the Achiever logic. The reasons for this was given as the fact that the mining environment is a production driven business, daily targets are set and measured but at the same time having to balance with the needs of the investors and society at large. *"There is no time in mining to philosophise or dream everything is practical"* said one of the interviewees. The interviewees felt that all the other action logics were present within Gold Au, but all at very insignificant levels.

4.5 Gold Au's Sustainable Development programmes

4.5.1 Education Programmes

Gold Au Business and Leadership Academy

Gold Au has a business and leadership academy that provides several courses and training to support the mine. The academy does not only provide training to Gold Au employees, but support several other mining houses too. I spent time at the academy going through the content of the courses presented, with the aim of assessing whether sustainable development is embedded within the contents of the various courses or looking for a standalone sustainable development course.

The academy offers 248 courses in the following categories, Mining, Rock Engineering and Strata control, Metallurgy, Engineering, Mineral Resource Management, Occupational

Environment and Hygiene, Security and Business management and Leadership. Going through the contents of the courses offered what comes out clear is that safety of employees is embedded within the contents of training in the majority of the courses. However, there is no reference to environmental protection and no reference to surrounding communities in any of the offered courses.

Occupational and Environmental hygiene courses mostly cover the monitoring, evaluation and instrumentation, indirectly these courses are geared towards improvement of control measures for occupationally related health effects such as dust, temperature control, etc. There is no sustainable development standalone course offered. The academy has collaborations with other institutions that assist with provision of certain courses that are not offered at the academy.

I had a discussion with the academy managers on their views regarding sustainable development. The views of the managers is that the academy as a living institution has over the years expanded their offerings, therefore sustainable development is currently an important aspect of mining and therefore the course is being developed with an assistance of a local university.

Gold Au offers bursaries to students to pursue various qualifications, it is the obligation of these students to work for Gold Au on qualifying. The majority of bursars pursue mining and engineering studies and are mostly based at the University of Witwatersrand (WITS) in Johannesburg, South Africa. I undertook to conduct an interview with the school of mining engineering at Witwatersrand University to understand whether sustainable development is included in the curriculum or not.

Wits School of Mining Engineering

“The School of Mining Engineering at the University of Witwatersrand is recognised as one of the top mining engineering schools/departments in the world. The School has one of the most successful growth rates of any of the engineering schools/departments, consistently having an increase of students to its courses. The School was one of the founding schools of

the University of the Witwatersrand, and can trace its origins back to the Kimberley School of Mines. Throughout its existence, the reputation of the Department has been based on the quality of our graduates, many of whom have risen to hold senior positions in the South African Mining Industry and have made significant contributions to its growth and technological development (<http://web.wits.ac.za/Academic/EBE/MiningEng>).

With a proud history of being one of the top mining engineering schools in the world, producing quality graduates that have risen to hold senior positions in the mining industry, I started the interview with the view of the school regarding sustainable development. The response from the head of the school was that – *“sustainable development is an important aspect of mining engineering training at WITS not only because of the requirements of the law, but also because the students themselves are exposed to various impacts of mining on the environment and some of them have been directly exposed to such impacts through their families and/or communities”* said the school head. However he was quick to point out that the older generation of mining engineers who are currently well into their mining careers, were trained at a time when sustainable development imperatives were not considered.

The environmental and social legislation have just been recently introduced that compels a sustainable approach to any mining operation. Previously, there was however talk about environmental issues but the sensitivity was lacking. When the impacts of mining on safety, environment and communities were realized, it is only then that all were taken into consideration. As such, the school embarked on establishing a centre for sustainability in mining to assist with the sustainable development needs. The centre is called Centre for Sustainability in Mining and Industry (CSMI).

The mining engineering curriculum is packed with all the technical requirements of the qualification. However the school provides an opportunity to the students to receive environmental and social courses specifically from the CSMI. The approach that the school has adopted is to instill within the students that they should all be aware that mining engineering is not only about the technical designs, but more about people and therefore, whenever they drive around the communities seeing the old rock dumps, the tailings facilities and other mining impacts they should ask themselves how would they design and operate mining differently.

The school also offers student-driven seminars where former students who are now in the industry come back to the university for a debate on mining and its impacts on Saturday mornings. These debates are mostly organized by students themselves. In so doing, the students receive a more realistic perspective from the people working within the industry already. The presenters at these seminars are not only former students but any other person within the industry. There are about ten such seminars organized a year. The most important topics that get discussed are the impacts of mining on society, the existing culture within the mining industry and how to cope as younger graduates entering an old industry that has its own embedded approaches to work.

Sustainable development has not been embedded in all the courses, but in the course of teaching, attempts are made to ensure that students are taught responsible mining. At a postgraduate level, there are however standalone courses that students need to complete before they qualify. These courses include aspects of environmental management, occupational health and safety and community development. At WITS these courses are provided for by the CSMI. It is again at the postgraduate level where there is collaboration between the school and social sciences faculty, these collaborations are however mostly driven by topics being researched rather than standing relationships. There are no formal collaborations with other mining engineering schools at other universities in the country or abroad. There is also no collaborations or partnerships (formal or non-formal) with any communities and/or civil society organizations.

The challenge that the school is facing is that, the lecturers themselves need to update their own knowledge with sustainable development. It is a huge a challenge because most of them are specialists in their own fields. The relationship between the school and the mining industry can be improved, the interaction only occurs for specific issues. Very few mining companies send their managers for updating their knowledge on non-technical areas, such as sustainable development.

The Centre for Sustainability in Mining and Industry (CSMI)

On the 21st of September 2010, I interviewed the director of the centre and she immediately listed what she termed the three most important challenges facing the mining industry. In her opinion the industry needs to take care of its impacts on water, land and community.

“South Africa is a water stressed country, therefore the mining industry, especially gold must do all it can to prevent water pollution, when the industry uses water, it must always make sure that it does not pollute and returns neutral or cleaner water. Mining industry occupies vast amounts of land and therefore the competing needs for land especially in South Africa requires that the little land available is protected and not degraded. With the impact of mining over decades on communities, it is extremely important for the mining industry to prioritise community development”. These were the opening words from the director of CSMI.

The CSMI’s approach to sustainable development is that of networks and collaborations, because in order to make a difference in sustainability discourse partnerships and collaborations across different stakeholders is important. The CSMI is not confined only to the school of mining engineering, but also collaborates with other faculties and departments within the university. It is the view and the approach of the CSMI that sustainable development must be embedded within existing courses of different degrees, however this approach may have its own challenges. The biggest of which is the fact that most lecturers would have to get sustainable development training themselves.

The CSMI provides various short courses especially to government regulators from the Department of Mineral Resources, and the environmental department. It is the view of the CSMI that empowering the regulators would also contribute to better legislation and monitoring of the activities of the industry. The mining industry mostly sends those people who need to complete certain qualifications like the Graduate Diploma in Engineering (GDE) to the CSMI because the qualification requires an understanding of sustainable development principles.

4.5.2 Environmental Programme⁹

The 2008 electricity crisis that Gold Au was plunged into, led to several departments within the company to look for projects that have a potential to alleviate the energy crisis in a long term. One such project was a collaborative project between the engineering department and the environmental department. The project was termed **“Gold Au Renewable Project”**

The project documents state the purpose of the project as follows: *“The proposed project will convert biomass to energy from a number of sources. The sources of fuel could include waste from surface and underground, as well as biomass from alien eradication and from the harvesting of sustainable energy plantations from areas undergoing phytoremediation”*

Figure 19 below depicts the total project overview

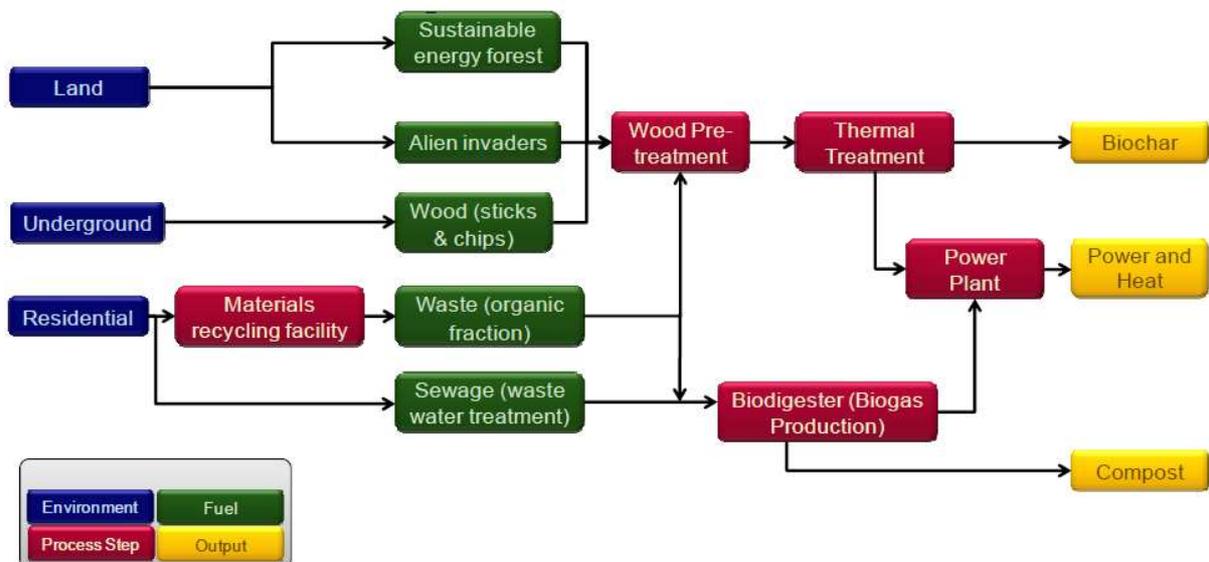


Figure 19: Gold Au waste to energy project overview

Source: Internal Gold Au document

The objectives of this project were stated as follows:

- **Energy Security:** The provision of Eskom independent power on the mine will contribute to the energy security of the mine. The energy security of the project has two components to it. The first is to provide a source of power that is not dependant

⁹ The information presented in this section is from confidential internal company documents, that I have access to but not accessible to the general public. I was part of the project team that conceptualised and conducted the pre-feasibility study.

on the Eskom grid. The second is to provide power that is shielded from the expected Eskom price increases.

- **Economic:** The project must yield an acceptable Internal Rate of Return (IRR) for the money invested
- **Sustainable Development:** The sustainable development benefits of the project impacts on a number of issues:
 - Establishment of a profitable business on the mine premises that will continue after mine closure
 - Job creation after mine closure
 - The possibility to supply power to the water pumping after the life of the mine
 - Assistance in the implementation of the mine's environmental management plans especially regarding land use post mine closure
 - The possibility of phyto-remediation on areas of the mine property that may be contaminated.
 - The project could offer a solution to the Gold Au solid waste disposal problem.
- **Greenhouse Gas Mitigation:** The project could earn carbon credits in a number of ways:
 - The displacement of Eskom electricity can earn in the order of 1 ton of CO₂ equivalent per MWhr generated. These credits can be earned under the Clean Development Mechanism (CDM) of the Kyoto Protocol
 - The planting of energy crops could earn afforestation credits, either under the CDM or under a voluntary standard such as the Voluntary Carbon Standard (VCS)
 - The project could further impact on the ability to earn voluntary carbon credits for other projects under the VCS scheme

According to the project leader this project had a potential of producing power ranging from 2.5 to 10 MW of electricity, either through direct generation, through displacement of Eskom power through absorption chillers, or a combination hereof. He also mentioned that The project can generate up to 60,000 tons of CO_{2e} emission reductions per year through

the replacement of Eskom power. In addition to this, credits can be earned from the planting of trees.

In presenting the concept to Gold Au management, it was received with enthusiasm as a potential project to solve several of the mine’s challenges. Figure 20 below was presented as a summary slide depicting the benefits this project could yield for the mine. Based on this presentation Gold Au management approved funding for the pre-feasibility study. The pre-feasibility study was concluded in December 2009 and a full feasibility study was to be conducted in 2010.

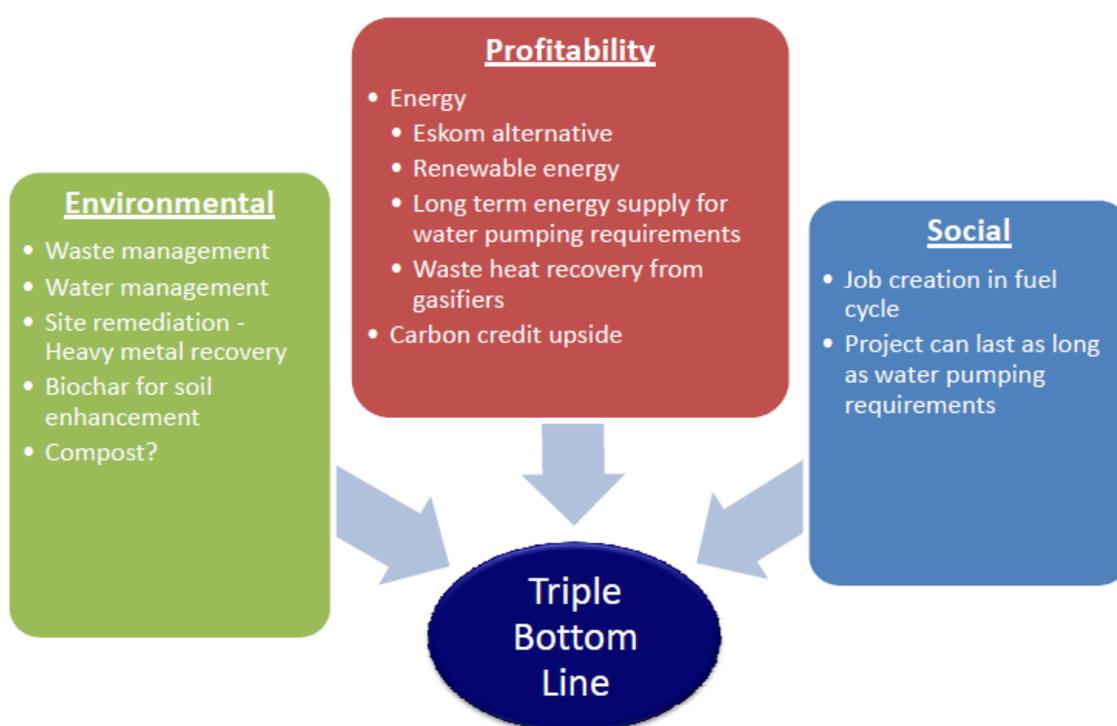


Figure 20: Illustration of Gold Au waste to energy project benefits

Source: Internal Gold Au document

On presenting a motivation to Gold Au management for funding the full feasibility study, the project team was informed that due to financial constraints that were prevalent at the mine at the time the project needs to be shelved for a later date and the project team should come back to management in July 2010. In July 2010 the project team was informed that the financial situation has not improved and therefore the project will be considered in 2011. 2011 came and now the project team has been informed that the project will be considered for 2012.

The total amount requested for the full feasibility is in the region of R4 million and if the study proves full feasibility, setting up all the necessary elements to implement the project would cost in a region of R200 million over several years.

4.5.3 Community Programme¹⁰

By July 2010 Gold Au had 12 waste rock dumps across the 10000ha property. Most of these waste rock dumps have been on surface for more than 20 years. With the democratic government insisting on proper environmental management and sustainable development, the mine is obligated to mitigate the negative impacts of these rock dumps. These negative impacts include:

- Surface and groundwater contamination
- Acid Rock Drainage
- Dust generation
- Radiation impacts
- Visual impacts

Gold Au initiated a programme addressing the negative impacts associated with these rock dumps. This programme involves developing a community project that would develop skills, generate income and conduct rehabilitation of the land. The rehabilitation part of this programme was envisaged to dovetail with the waste to energy programme described above. Figure 21 is an illustration of the full project. The project has three components: screening, crushing and community programme and was developed to be a partnership project between Gold Au, communities and another private service provider.

Screening: Before any rocks can be released for use, screening needs to be done for gold, therefore the screening part of the project is meant to screen all the rocks that are gold bearing and those rocks would be delivered to the gold plants for processing. Gold Au to pay

¹⁰ The information presented in this section is from confidential internal company documents, that I have access to but not accessible to the general public. I am directly involved in the conceptualisation and execution of this project.

for the rocks delivered to the plants (this part of the project is done by a private company specialising in production of ballast, aggregate and ready mix).

Crushing: All the rocks that are bigger and are not gold bearing are crushed to produce various products, such as sand, ballast, road and/or construction making material, etc. The crushed products would be marketed and sold to the construction industry and railway and also be sold to Gold Au for their underground crushed stone needs.

The screening and crushing processes would be managed by a competent private company. A social fund would be created that will have contributions from this private company whereby Rx/ton of rock sold to Gold Au or other entity and also Rx/ton of gold bearing rock delivered to Gold Au plants would be deposited into a community development fund that will assist in developing local economic development projects.

Community Programme: Processing of the waste rock dumps has a dual role, that of environmental management and reduction of Gold Au's footprint, the second role is with land rehabilitation providing for viable and sustainable end land use. These programmes are covered by the community aspect of this project. The social fund together with direct contribution by Gold Au, would provide various training programmes for the community in terms of eradication of alien invader trees around the area where the rock dumps are. The felled trees to be bought and used as input biomass for the waste to energy project described above. Various other projects such as establishment of a tree nursery for planting "energy trees" in the land cleared of rock dumps. These "energy trees" to again support the waste to energy project. Other community development areas include communities participating and benefiting fully in the aggregate production process through gaining permanent employment and skills development.

Project Benefits:

In discussion with the project leader, this project provides several benefits on the economic, social and environmental fronts. The economic benefit to Gold Au is with the fact that most of the waste rock can be reprocessed for Gold and therefore Gold Au can generate income from them. The environmental benefits include the fact that removal of these rock dumps reduces ground and surface water pollution as the dumps have a radioactivity potential with uranium being the major heavy metal that can contaminate surface and ground water. The

elimination of dust that gets generated at these rock dumps is a major environmental benefit and also has benefits for the surrounding communities through reduction of exposure. Further benefit to the environment is in the land rehabilitation programme whereby alien invader trees are removed and replaced by other trees that are can be used as a resource for the waste to energy project. IN all these processes the major beneficiaries are communities in that the projects generate alternative employment and skills development that can continue beyond the life of mine as described in the waste to energy project above.

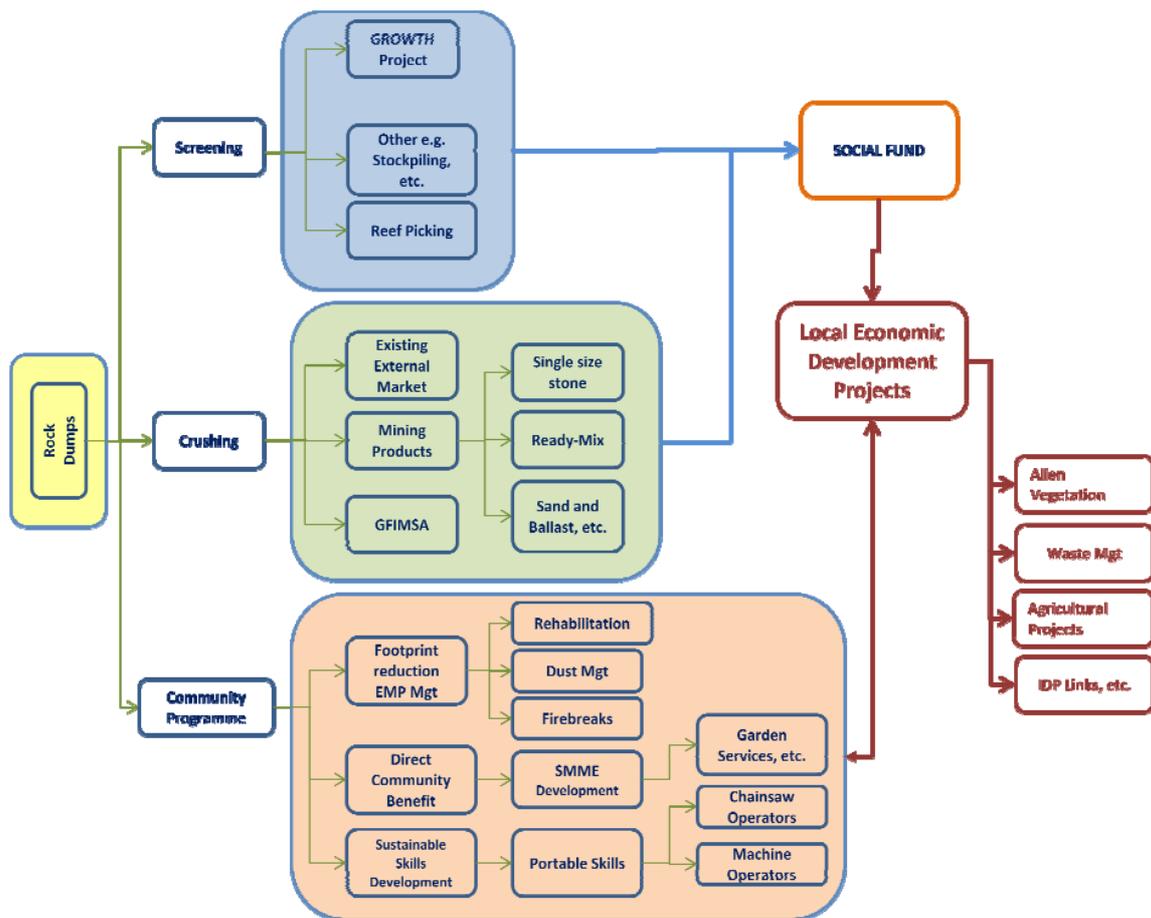


Figure 21: Overview of Gold Au community project

Source: Internal Gold Au document

According to the project leader the project was received with enthusiasm by Gold Au leadership when the full concept was presented. A process was embarked on to appoint the private partner with competence in the area of screening and crushing. In January 2010 a contract was awarded to a private company to do screening and crushing, however an oversight was committed during the contracting phase whereby the clause to force the

private company to establish the social fund was omitted. Therefore the social fund has not been established. Gold Au has promised that the community development part of this project will be funded in January 2012. The total amount required to establish this part of the project is R5.3 million.

4.6 Chapter Summary

This chapter has presented the case of Gold Au. It started with giving a demographic information regarding Gold Au in terms of location of the mine, when it started its operation, the total number of employees, etc. This demographic information is followed by a general description of gold mining in South Africa and its current and previous importance to the economy. This importance of gold mining to the economy led to a development of a relationship between government and the industry.

This relationship is presented in three distinct phases. The first phase is the colonial phase characterised by extraction of the minerals with no consideration for the environment and people the focus was on generating profits for the colonisers. This phase also was also the forerunner of many of the policies in the mining industry that are still visible today, such migrant labour policy, discriminatory policies on housing and skills, etc. The colonial phase was followed by the apartheid phase where the government and the industry related as partners and created structures that were meant to shield themselves from any liabilities, be it environmental or social. Some of the discriminatory policies continued during this phase. The apartheid phase is followed by the democratic phase where the government is starting to regulate the industry rather than be a partner. This phase is fraught with complexity because of poor understanding of the new government of operating structures within the industry that were started and implemented during the previous phases. However the democratic phase is slowly introducing new policies such as the new Act and the mining charter which are based on sustainable development principles. Throughout the discussion of the various phases, examples are provided, where possible, of the implications and consequences as seen currently at Gold Au.

The findings from observations, conversations, focus group discussions and interviews are presented. The theme of these findings revolves around impact of mining on employees, community, environment and the role of leadership. The leadership interviews are presented to elucidate the dominant approach of leadership when it comes to sustainable development. The interviews were conducted based on two models, the first being the UN global compact gearing up model and David Rooke and William Torbet's seven transformations of leadership. The results of this leadership assessment is that most people at leadership believe that sustainable development initiatives are done for compliance and risk avoidance purposes, so that the mine does not get any penalties from the regulators or the public and also the mine is seen by the investors as a good company. The majority of leaders at Gold Au fall within the Achiever and Expert logics as per David Rooke and William Torbet's model.

The last section of the chapter presented sustainable development initiatives at Gold Au. The first looked at Gold Au's training academy specifically regarding sustainable development courses or training and the results are that there is none. The assessment went on to Wits CSMI and the mining engineering departments. The mining engineering department does not have sustainable development course at the undergraduate levels and there are no established partnerships with other academic institutions or faculties. The CSMI on the other hand presents several sustainable development courses, however there is no firm contract or a relationship with Gold Au.

Two other initiatives are presented one an environmental initiative which is a project to convert waste to energy for Gold Au. This project covers all the principles of sustainable development and has a potential to continue beyond the life of mine. The project has as yet not been fully funded by Gold Au. The second initiative is a project that is meant to benefit both Gold Au and the communities also covering the full spectrum of sustainable development elements. The project currently is not fully funded and is meant to be funded in 2012.

5 Chapter 5: Discussion, Conclusions and Recommendations

This chapter of the case study presents the discussion, conclusions and recommendations based on the findings presented in Chapter 4 above. The case study had the following four research objectives with the overall objective being a development a suggested Sustainable Development Leadership Framework that can possibly be tested further at Gold Au.

- an understanding of the gold mining industry in South Africa from an historical perspective,
- the perception of workers in our company on the impact of our gold mining activities on themselves, community at large and the environment,
- understanding the role of leadership as related to sustainable development challenges; and
- examination of sustainable development programmes within our gold mine

5.1 Gold Mining Industry: An historical perspective

It is clear that gold mining industry is still very important to the South African economy with the contribution of more than R49 billion in 2009. The importance of gold mining in South Africa cannot be looked at in isolation of other commodities, such as chrome, platinum group metals, iron ore, coal, etc. The Gold mining sector is one of the oldest in the mineral-energy complex and one of the earliest to be explored in South Africa thus it set the tone for the approach to mining in South Africa, which is still going to continue for the foreseeable future.

This approach to mining is still dominated by extreme loyalty to the investors and the shareholders not by ensuring that the industry is doing the right thing when it comes to managing the environment for the present and future generations. The historical relationships between government and the gold mining industry is still felt today by gold mining companies such as Gold Au. The relationship developed between government and the industry over several decades and in different phases has shaped the way the industry perceives its role regarding the environment and communities. It is possible that the majority of leaders within the industry are not aware that their behaviour is influenced by

the historical relationships especially that, committees such as the FWRDWA and IDC are still continuing though in a different format. An example is that the constitution of the FWRDWA has not been amended ever since it was adopted in 1968 and this constrains the activities of this committee. The high prevalence of HIV/AIDS and TB within the employees, local communities and communities where the workers are sourced from, the informal settlements, the housing policies of Gold Au, the approach to environment (and its negative legacies) and community development have all in one way or the other been influenced by the historical relations between government and the gold industry.

The challenges that the 21st century society is facing need all sectors of society to pull together to address them, these challenges include intractable poverty, inequalities between people and nations, constraints that are posed by natural resources, such as scarcity of potable water, general deterioration of ecosystem services, climate change, all these challenges have been raised in chapter 2. Gold Au demonstrated that when challenges present themselves, such as the electricity crisis, we do not hide behind history, commitment and actions are put in place to solve the challenge for the benefit of all. However some sustainability challenges do not present themselves in a dramatic fashion like the energy crisis did, but in a slow prolonged manner. The resource intensity trends as illustrated in chapter 2 are giving a signal of an impending collapse unless action is taken.

The leadership at Gold Au has demonstrated their ability to commit in addressing challenges that present themselves. In addressing the environmental and social challenges I suggest an education and awareness process to the leadership at Gold Au. The education and awareness process to cover an understanding of the impact of the historical relationships have in Gold Au operations today, the awareness also to cover the current global sustainable development challenges and the role our mine can play in participating in global initiatives to solve these challenges.

I would like to argue that this approach will be able to locate much better the origins of the legacies of gold mining and the global sustainability challenges when a call for sustainable futures is made all will rally behind the call because all will be well informed.

5.2 Exploring Gold Au worker perceptions

5.2.1 Mine Employee health and safety

The discussion of this objective is based on the observations, conversations and the focus group discussions. Mining has impacted workers especially those that work underground in several ways. It seems that the most important concern revolve around the impact of mining on health and safety. There is however a sense of helplessness when it comes to safety, though the role mine management can play has been emphasised. It is interesting to observe however that most workers did not raise the fact that that they are empowered to control and manage their own safety. It was evident that safety issues are all mine management responsibilities, not theirs.

Figure 22 below illustrates the various interactive agents that play a role in safety. Safety can therefore not be discussed in the context of worker and management dynamic but have to be looked at within all the five dimensions illustrated in figure 22 below.



Figure 22: Levels of information emerging from the literature on the Human Aspects of Mining Safety

Source: Friedman, M., & Higson-Smith (2008)

Hansen (2000) states that unsafe behaviours are involved in most accidents and these unsafe behaviours are driven by organisational processes rather than the all too common approach of blaming workers. The point made in the group discussions that the workers have to work overtime shifts to get a bonus and that in their opinion salaries are kept low, if true, can be regarded as part of the organisational processes mentioned by Hansen and one can argue that the processes will have a negative impact on safety as the driver is to meet

production targets above safety. LaBelle (2005) confronts the conflicting reward systems that confront the workers, an example of this may be what he terms the mismatch between rewards for safety versus reward for increased productivity. These and other conflicting rewards may push the behaviours that one wants to reward into the background, while the more immediate and pressing needs are met first. According to the employees of Gold Au production is rewarded above safety of workers.

The issues of organisational culture also play a role in the sense that, if the culture of Gold Au is based on giving instructions by management without empowering the general workers to take decisions, workers would always wait for an instruction even though they can see what needs to be done and they will follow the instruction irrespective. The perception of general workers is that management do not care at all about them, they are treated like the machinery and can be replaced anytime. If this perception is true one can argue that workers at Gold Au may be less loyal to the organisation and would not be committed to manage or be concerned about issues beyond their own environment. Sustainable development concerns may possibly be viewed as organisational issues that are of no concern to them as workers. If leadership (management) at Gold Au is aware or can be made aware of this perception, steps or initiatives could be put in place to first and foremost change the behaviour of management to address workers in a more acceptable manner than the current perceived manner. By so doing, it may be possible to influence the behaviour of the workers to take initiatives that can protect themselves, the community and the environment.

The issues of job and personal characteristics are also important aspects of how safety is perceived. The fact that there is a perception that *“mining is not for sissies”* unconsciously puts people in a situation where they feel helpless in the conditions where they work. The workers go underground knowing clearly that they may not come back alive or if they do come back they may be permanently disabled. The thinking that you may not come back alive is the one that creates the ‘bravery’ that it is actually not for ‘sissies’ because the self motivation of being strong and brave propels you to go underground under all circumstances. With the knowledge that the worker may not come back alive on top of their

minds, it makes sense to therefore argue that sustainable development related issues may be far from the workers mind with no concern for the environment and utilities.

One of the major complaints by the workers is the exposure to dust. The workers concern regarding dust exposure is legitimate. Hnizdo and Murray (1998) conducted a study on the Risk of pulmonary tuberculosis (PTB) relative to silicosis and exposure to silica dust in South African gold miners. Their study looked at a cohort of 2255 white South African gold miners who were followed up from 1968 to 1971, when they were 45-55 years of age, to 31 December 1995 for the incidence of Pulmonary Tuberculosis (PTB). They concluded that “Exposure to silica dust is a risk factor for the development of PTB in the absence of silicosis, even after exposure to silica dust ends. The risk of PTB increases with the presence of silicosis, and in miners without radiological silicosis, with quartiles of exposure to dust. Of concern the study also discovered that “the diagnosis of PTB was on average 7.6 years after the end of exposure to dust” (Hnizdo & Murray 1998).

The concerns by the engineers to keep the integrity of the shaft infrastructure again talks directly to the ability of doing everything possible to reduce dust exposure to workers. Also the notion that “you cannot work at the mine and go back home with your health intact” has relevance especially within the context of dust exposure. In another study still by Hnizdo of 2209 of ex-goldmine workers, he found that gold miners appear to have a greater loss of lung function from 50 to 55 years of age than that predicted for a general population (Hnizdo 1992).

The concern of Gold Au management when it came to the energy crisis was production. They said that if the mine cannot conserve electricity it is running a risk of closing and people losing their employment. That is one of the major reasons for putting everything into conserving electricity.

As mentioned in chapter 1, my motivation for conducting this study was seeing the effort that management put in managing the electricity crisis and I asked myself what would be the tipping point for the environmental and social elements that would render a response of this scale. As mentioned in chapter 4 - *“Approximately 65% of these employees have been*

working for the mine for more than 20 years and live in single sex hostels”, if such a sizeable number of employees have been with Gold Au for such a long time, there is a high possibility that most of them are exposed to TB/Silicosis and their health is badly affected (as per Hnizdo studies described above). One can draw an argument that continued disregard of the protection of employee health may be the next big disaster for Gold Au, unless measures are taken seriously to prevent exposure to dust. Is leadership at Gold Au going to wait for such disaster or measures can be put in place now to prevent collapse from happening. The studies by Campbell and Churchyard (in chapter 2) relating to the health impacts of working in gold mines in the migrant communities nullifies the notion that the general employees can be easily replaced if they get sick or injured. The likelihood is real that sick workers could be replaced by other people who themselves are sick.

These perception of workers need to be shared with management of Gold Au with the purpose of setting up programmes to address them, these programmes need to be set up in such a manner that they are not disjointed but show the interdependencies of the social, environmental and economic systems that are embedded within Gold Au. A sustainable development leadership framework that covers all these aspects may be a possible solution.

The instructional culture of Gold Au disempowers workers from being accountable and responsible for their own health and safety. A consultative approach by management would empower the workers to take decision and be fully responsible for the areas where they work and this could provide a platform where workers can prevent wastage of utilities and device ways of reducing the impact of their actions to the environment, themselves and communities in general.

5.2.2 Impacts on Mine Communities

The perception of the workers on the impact of Gold Au on the communities has been mixed, with some workers believing that the mine is positive for the community because it provides work and others complaining about HIV/AIDS, dust, etc. The impact of HIV on mining communities is well known especially as a result of the migrant labour system, see (Williams & Campbell 1998). Corbett and Churchyard (2000) investigated the combined

effects of HIV infection and silicosis on TB in a South African Gold mine. They concluded that “TB remains as much a silica-related occupational disease in HIV-positive as in HIV-negative miners, and HIV- positive silicotics have considerably higher TB incidence rates than those reported from other HIV-positive Africans. The increasing impact of HIV over time may indicate epidemic TB transmission with rapid disease development in HIV-infected miners” (Corbett and Churchyard,2000).

These findings have a much broader implications because most of the fact that some of the workers at Gold Au come from different parts of Southern Africa, such as Swaziland, Mozambique, Lesotho and Botswana therefore the affected communities may be hundreds of kilometres away from a mine site.

The impacts related to sterilisation of land due to waste rock dumps and tailings storage facilities covering vast areas of land, forms part of the biodiversity impact whereby vegetation is removed and in turn alters availability of food and shelter for wildlife though this impact was not specifically mentioned during the discussions, the impact is still significant. The resignation by some workers of Gold Au that anyway the communities are dependent on the mine and will disappear when the mine closes, therefore there is no need to invest in communities, is again premised on the poor understanding by the workers of sustainable development.

The understanding that, were it not for the mine the surrounding community would have been poorer is a well known perception that mining will provide much needed employment and thus contribute to the wellbeing of the community. There is no argument that for a previously unemployed person, receiving employment from the mine is a significant contribution to his or her family. However at a community or regional level the contribution of mining to poverty alleviation is contested. According to some people, mineral wealth is part of a nation’s natural capital and the more the nation has this capital the richer it becomes (Davis & Tilton, 2003). However, even the benefits of mining in a region are not always equitably shared and local communities closest to the mine can suffer most. This argument is not readily apparent in most Gold Au workers that the presence of the mine in communities does not necessarily translate to better quality of life for the community. Lack

of this understanding is the one that leads to arguments that there is no need for government to impose mine community development programmes on the mine.

In addition, communities that come to depend on mining to sustain their economies are especially vulnerable to negative social impacts, especially when the mine closes. Mining tends to raise wage levels, leading to displacement of some community residents and existing businesses, and elevated expectations (Kuyek and Coumans, 2003). Mining may also trigger indirect negative social impacts, such as alcoholism, prostitution, and sexually transmitted diseases (Miranda et al., 1998). The latter issues seemed not to bother most of the interviewees only because the majority fully understood that they are temporary and seemed to be comfortable with the fact that the mine will close and therefore these communities would also disappear.

The challenge facing a company like Gold Au that is mining a non-renewable natural resource, is what will happen to the communities after the resource is depleted? Understanding the global challenges of poverty, it should be a priority for a mining company to initiate programmes that will ensure that communities are not negatively affected when the mine closes. On top of setting up programmes to prevent the negative health impacts to communities, the mine needs to put structures in place to create alternative economic sources for the communities. The democratic government as described in chapter 4 is putting legislation to force mining companies to develop these alternatives. Enforcement by government may not be the most effective approach, however an understanding by the management at the mine about the importance of developing these alternative sources is more sustainable. These alternative economic sources may even be beneficial to the mine itself while addressing long term community needs even beyond closure (see discussion below under Sustainable Development initiatives). What is required for such programmes to succeed is committed leadership

5.2.3 Impacts on the environment

Though the environmental impacts were well understood, the understanding is very localised and immediate. Such as water pollution for the local communities, sterilisation of land affecting the ability to farm now and when the mine ultimately closes. Of significance was the fact that there was no sense of understanding the limits to growth posed by natural resources. In the eyes of the workers the natural resources are limitless and can be exploited further and further to create employment.

The notion of limitless natural resources falls within what Dunlap and Valierre (1978) in Boiral, Cayer and Baron (2008) calls the dominant social paradigm. They list eight characteristics of the dominant social paradigm as related to natural resources:

- *Humans have the right to modify the natural environment to suit their needs*
- *Humans were created to rule over the rest of nature*
- *Plants and animals exist primarily to be used by humans*
- *Human ingenuity will ensure that we do not make the earth unliveable*
- *The earth has plenty of natural resources, only if we can learn how to develop them*
- *The balance of nature is strong enough to cope with the impacts of modern industrial nations*
- *The so called ecological crisis facing humankind is greatly exaggerated*
- *Humans will eventually learn enough about how nature works to be able to control it.*

As discussed above, the general workers have varied understandings and the implications of the impacts of mining on themselves, the environment and the society at large. However, there is a sense of powerlessness in terms of what can be done to change the conditions. The environmental conditions within the mine of having to always be given instructions to do things permeated throughout the way the general workers conduct their lives. There is no sense that they themselves have the power to change their own conditions, they have the power to influence the impact their mine has on themselves, the community and the environment.

It is their firm belief that it is the responsibility of the appointed leadership to influence change in the mining environment. A sense of leadership in them is non-existent. Education is also understood only from a point of view of formal education to improve literacy and be able to get “better” employment outside the mining industry. There is no sense of a need for education for sustainability.

5.3 Exploring the role of leadership

The managers at the operational level of Gold Au see sustainable development as a compliance issue that however needs to be conducted to avoid reputational risk and protect the impact of sustainable development imperatives on business. The approach is *“if we do not manage the environment and develop/protect the communities our social licence to operate is in trouble and our reputation is at stake”*. *“If the reputation is at stake the investors may view Gold Au in a bad light”*. This is the dominant approach at the operational level. However, higher up in the organisation there is an acknowledgement of the need to manage sustainable development in partnership with other stakeholders and manage it in a proactive manner. Based on the views of Gold Au’s management the dominant approach to sustainability, based on the Gearing Up model is one where the company is on a transition between stage two to stage three (i.e. moving from volunteering as a risk management strategy to partnerships and proactive management of sustainable development imperatives).

In their case studies in the South African Platinum and the Zambian Copper Belt mining industries, Hamann and Kapelus (2004), concluded that *“In contrast to the business case argument for CSR, critical perspectives argue that CSR is primarily about green-wash, or the projection of a caring image without significant change to socially or environmentally harmful business practices”*. The argument here is that - Does Gold Au fall into the category of greenwashing? Though empirically the business value of CSR is debatable, the debate is not compelling enough not to do it. The business value of CSR is that it can help safeguard license to operate; facilitate access to capital; contribute to reputation, and enhance stakeholder engagement, including with employees.

CSR can help companies contribute to sustainable development, but at its most basic stages it is a risk mitigation technique – and not practicing it could contribute to damaged public trust, raise questions with policymakers, cause unfavorable comparisons with competitors, increase community unrest, and potentially impact project financing. This is the approach adopted by Gold Au, however the question remains – is this greenwashing or not? The leadership responses to sustainable development provide a clue to whether Gold Au is genuine in its approach or not.

Based on the gearing up model the approach adopted by Gold Au on sustainable development is one of pursuing compliance and avoiding any reputational risk to the company. The conclusion reached by Hamann and Kapelus discussed above, that the CSR with their case studies was more about green-washing can be reached when one considers the case of Gold Au.

Jay Westerveld, a New York environmentalist, coined the term green-washing in a 1986 essay, referring to deceptive use of marketing where companies disingenuously spin their products and policies as environmentally friendly (Sullivan, 2009). The term is generally used when significantly more money or time has been spent advertising being *green* (that is, operating with consideration for the environment), rather than spending resources on environmentally sound practices.

Gold Au's approach to sustainable development falls within the ambit of green-washing. This is substantiated by the fact that Gold Au is a signatory to the ICMM, UN Global Compact, the Cyanide Code and the AA1000 stakeholder engagement standard, however the majority of managers at Gold Au do not even know what these organisations are, let alone knowing that the company is a signatory to them. Whenever Gold Au issues any statement to the media or any document that goes to the public, the footnote almost always reflects that the company is a signatory to a host of "green organisations" on top of the securities exchange it is listed on around the world.

The reality on the ground is however different, with their own workers working in environments that are continuously swamped with dust that affects the worker's health.

With waste rock dumps and tailings facilities that continuously impact on the surrounding communities and the environment, with employees who live in hostels with all the associated effects of TB and HIV that do not only affect the workers but near and far communities. Some managers confirmation that to be signatory to these standards is done to impress the investors, is a confirmation that it is done only for profit purposes.

Looking at the leadership assessment both the objective and the subjective assessments say that the majority of leadership approach at Gold Au is based on the Achiever and Expert logics. During the focus group discussions and throughout the leadership interviews what comes out clear is that positional leadership at Gold Au influences every aspect of the mine. Looking at the strengths of Gold Au’s Action Logics of environmental leadership, one can easily see that as Experts and Achievers technological approaches and measurable environmental management systems would dominate the approach to environmental management at Gold Au. Table 6 below illustrates the strengths and limitation of the various leadership action logics. It is clear from the table that the strengths of the two dominant leadership types at Gold Au are that they are good as individual contributors and are action and goal oriented. The limitations state that Experts may lack integration of environmental issues and may have difficulties with collaboration on the other hand Achievers may lack the ability to think “out of the box”.

Leadership Action logic	Environmental Implication	Strengths	Limitations
Opportunists	Little sensitivity to environmental issues, except only when they represent a gain or a threat to the manager.	May seize certain environmental opportunities, or react quickly to a crisis, superficial actions may be showcased opportunistically.	Pursuit of individual interests without regard for environmental impacts, comprehension of environmental issues limited to immediate benefits or constraints
Diplomat	Supports environmental concerns due to concerns for appearance or to follow a trend in established social conventions.	Reactive attitude with respect to environmental pressures, consideration of regulatory constraints and the impact on the organisational image	Superficial conformity to external pressures. Absence of reappraisal of how things are done, statements often contradict actions.

Expert	Considers environmental issues from a technical, specialises perspectives, seeks scientific certitude before acting, prefers proven technical approaches.	Development of environmental knowledge within the organisation and implement environmental technologies	Limited vision and lack of integration of environmental issues, denial of certain problems, has difficulty with collaboration
Achiever	Integration of environmental concerns into organisational procedures and objectives, response to market concerns with respect to ecological issues.	Efficient implementation of ISO14001 type management systems, follow up environmental performance; more widespread employee involvement, pragmatism	Difficulty in questioning management systems in place, conventional environmental goals and measurements, lack of critical detachment with respect to conventions,
Individualist	Inclined to develop original and creative environmental solutions, questions preconceived ideas, development of participative approach requiring greater employee involvement, more systemic and broader views of issues.	Active considerations of the ideas and suggestions of diverse stakeholder, personal commitment of the manager, more complex systemic and integrated approach	Discussions that may sometimes seem long and unproductive, idealism that may lack pragmatism, useless questioning of issues, possible conflict with Experts and Achievers
Strategist	Inclined to propose a pro-environmental vision and culture for the organisation, more in-depth transformation of in-house habits and values, development of more proactive approach conducive to anticipating long term trends, interest in global environmental issues, and integration of economic social and environmental aspects.	Changes in values and practices, harmonisation of the organisation with social expectations; real integration of the principles of sustainable development, long term perspective.	Approach that may seem difficult to grasp and impractical, risk of disconnect with pressures to produce short term profits, scarcity of strategists.

Alchemist	Re-centring of the organisation's mission and vocation with regard to social and environmental responsibilities, activist managerial commitment, involvement in various organisations and events promoting harmonious societal development, support for global humanitarian causes.	Active involvement in the comprehensive transformation of the organisation and society, concern for authenticity, truth and transparency, complex and integrated vision.	Risk of scattering managerial and organisational efforts, to the benefit of the common good, losing touch with the primary vocation of the organisation, extreme rarity of Alchemists.

Table 6: The seven action logics of environmental leadership.

Source: Boiral, et al, 2009

The dominant action logics within Gold Au are congruent with the environment in which the mining company operates and in a way compatible with the perception of general workers that Gold Au's approach is to issue instructions that need to be followed (*see limitations of the Achiever Logic in Table 6*). It is the expectation of the mine that on a daily basis production must be achieved and production targets are measured daily, thus the action and goal oriented logic. At the same time because of the technical nature of mining, technical expertise are always required.

The sustainable development requirements pose a challenge to the dominant action logics for Gold Au. Experts would be well adapted to managing the technical aspects of environmental challenges. The technical aspects could mean the ability to set up a monitoring station that gives real time quality of water that gets discharged from the mine. These measures are well for reporting and audit purposes. The engineers can easily set up the system to do the monitoring, but the requirements of environmental measurements are to prevent pollution from source. To try and control environmental management at the end of the pipe is no longer an expectation more than the prevention at source. The prevention at source requires more complex approaches and collaborations that involve broader stakeholders. Experts may have challenges in this collaborative approach in preventative

management as it is the expectation that inter-disciplinary teams would need to collaborate for the environment to be managed. Experts may also have difficulties in applying measures like the precautionary principles because of lack of scientific/technical proof of the consequences.

According to Boiral et al (2009), the Expert Action Logic is not suited for managing the uncertainty of environmental questions and their systemic, interdisciplinary, complex and multi-layer character. The Expert Action Logic dominates at the operational level at Gold Au and therefore one can expect that the approach to environmental management would be congruent with the Expert logic. The implications for Gold Au therefore are that the views of other stakeholders such as the surrounding communities, the unions, employees, environmental organisations, etc, will not receive the full considerations they deserve.

The Achiever logic at Gold Au is dominant at the executive level of the company and according to Boiral, et al's framework this logic is most suited for issues like improving organisational efficiencies, integrating the demands of different services, establishing goals and meeting them. These principles are the basis for instituting environmental management systems like ISO14001. However the systematic approach may have limited ability to address the complexity and diversity of environmental issues, which mostly require solutions that are contextual based rather than generic approach. The Achievers may have difficulties in conciliating organisational objectives with environmental needs.

With these two dominant approaches at Gold Au, this implies that environmental management in the eyes of officials and some auditing principles like ISO 14001 external auditing would be good. In the eyes of various stakeholders the views might be different. The cornerstone in addressing the sustainable development challenges is stakeholder engagement. With stakeholder engagement, feedback to the stakeholders plays a crucial role. Table 7 below describes how the different leadership action logics would react to feedback (Cook-Greuter,2004).

Magician: View feedback (loops) as a natural part of living systems; essential for earning and change; and take it with a grain of salt.

Strategist: Invite feedback for self-actualisation; conflict seen as an inevitable aspect of viable and multiple relationships

Individualist: Welcome feedback as necessary for self-knowledge and to uncover hidden aspects of their own behaviour.

Achiever: Accept feedback especially if it helps them to achieve their goals and to improve

Expert: Take it personally, defend own position; dismiss feedback from those who are not seen as experts in the same field (general manager).

Diplomat: Receive feedback as disapproval, or as a reminder of norms

Opportunist: React to feedback as an attack or threat

Table 7: Description of feedback reactions linked to the different action logics

Source: Susanne R. Cook-Greuter (2004)

It is clear from table 7 above that Gold Au's approach to feedback from stakeholder engagement would pose several challenges because of the way the Achiever and Expert action logics leaders would respond. The stakeholder feedback may be ignored if it is not from experts or only accepted if it is in-line with what the company seeks to achieve.

Sunde (2008) argues that interactions between stakeholders are guided by their underlying ideologies, which could either be dialectical or dialogical. The goal of a dialectic process is to merge point and counterpoint into a compromise or other state of agreement via conflict and tension. In a dialogic process, various approaches coexist and are comparatively existential and relativistic in their interaction.

Whether the interaction is driven by a dialectic ideology or dialogical ideology it is dependent on the belief systems of people involved. Belief systems "...determine the data that we collect, the questions that we consider 'interesting' and the ways in which we change our views of the world to accommodate new results" (Cumming and Collier 2005).

Glaser (2006) describes three kinds of belief systems as eco-centric, anthropocentric and interdisciplinary belief systems. She describes them as follows:

- *“Where the social system is considered part of the natural system and/or social needs as subordinate to ecosystem requirements, belief systems of the human-nature relation are ecocentric;*
- *Anthropocentric belief systems of the human-nature relation define nature either as the product of social and cultural perceptions or in terms of the goods and services nature provides to humanity;*
- *In interdisciplinary belief systems - ‘The natural’ — in anthropocentric, and ‘the social’ — in eco-centric belief systems are portrayed as merely instrumental for their respective primary reference systems.*

Taking Sunde’s ideological approaches to dialogue and Glaser’s belief systems as described above and link them to the case of Gold Au, the compliance and instructional approach to sustainable development prevalent at Gold Au falls within the dialectical ideology and the anthropocentric belief system. The dialectical framework follows what Manuel-Navarrete, et al (2008) describes as a normative discourse that happens where human-ecosystem is separate and viewed as such. The normative discourse divides the planet into natural zones and areas of human occupancy (Manuel-Navarrete, et al, 2008). De Leo and Levin, 1997 describes the type of management style used in the normative discourse as that of:

- Command and control
- Coercion to enforce law
- Objective scientific research.

These three practices require a professional kind of engagement e.g expert, bureaucrat or manager, which discourages personal meanings creativity and emotionality (De Leo & Levin 1997).

The Expert and Achiever environmental action logics at Gold Au fit in well with the management style described by De Leo and Levin above. The normative discourse believes that the solution to the environmental crisis would be derived from scientific truths and morally correct analysis (Manuel-Navarete, et al, 2008). Therefore, what is needed is the

application of policies, that are based on scientific proof and also the regulators need to be influenced to enforce tools that have been developed towards actions promoting ecological integrity. The application of scientific proof would lead to protection of the environment and that the environment would continue to provide various services to enhance human and social wellbeing. The notion of nature providing services to human beings is the anthropocentric world view.

The 'nature-for-humanity' belief system supports the idea that nature exists exclusively to serve humanity and that we will continue to be able to dominate nature for our purposes, this approach is alternatively called "resourcism" (Glaser 2006). Resourcism has been heavily criticized for ignoring the natural limits to societal use of nature and for confining the importance of ecosystems to their functions in the fulfilment of human and societal needs. Proponents of resourcism however advocate the use of scientific indicators to avoid overexploitation of natural resources (Glaser 2006). The scientific approach of resourcism and the normative discourse is however incomplete. The incompleteness becomes evident when one asks – What if the scientific findings are controversial? What if decision makers are not only guided by scientific findings? What if some people believe that ecological integrity cannot be achieved without dealing with issues such as cultural evolution, and spiritual wellness? (Manuel-Navarete, et al, 2008). The normative discourse and the anthropocentric belief systems are the dominant views within the Gold Au leadership.

With the Expert logic dominant at the operational level, it is not surprising that the issues that have long term effects like the long term impacts of human behaviour on the climate may not be taken seriously, because the Expert has a mental model that think that the dire assessments of ecological problems are exaggerated. The Expert would point to the high degree of scientific uncertainty about the pervasiveness, severity and human consequences of environmental problems. The expert will also believe that through technology and science some of the problems that are being faced can be sorted scientifically without making significant changes to human behaviour.

The belief that science and technology is the only approach that determines what is right or good is a general societal paradigm brought about by modernism. Sunde (2008) describes

this paradigm as monism and he says “monism is displayed in the attitude that there exists one authority, a common law and a way of living and knowing that is upheld as the best and the most truthful claim on reality and this reality is absolute and universal”. With this paradigm clearly dominant at Gold Au, it poses a challenge for different views of other stakeholders to be taken into consideration.

The response to the electricity crisis at Gold Au was driven by the executive management team of the mine. Understanding of the belief system of this team and the operational management team provides an understanding on how to engage with them when dealing with other sustainable development issues. In developing a sustainable development leadership framework this understanding of the belief systems and the theories behind them empowers the development to take them into consideration.

5.4 Gold Au’s Sustainable Development programmes

Education

With all the challenges facing Gold Au as seen during the conversations and observations and the focus group discussions, from safety and health related challenges to the mining impacts at large and the leadership challenges, a solution is definitely needed. From both the focus groups and conversations, education is only viewed as a means to get out of the industry or get out of the underground working environment. Education is not viewed in the context of educating workers and management on sustainable development imperatives that would improve the working conditions and improve Gold Au’s impact on the community and the environment.

One of the major issues raised in many sustainable debates deals with promoting education, public awareness and training. The education issue was addressed in the United Nations Conference on Environment and Development (UNCED) in 1992 in a document called Agenda 21. Chapter 36 of the agenda 21 defines education as a process by which human beings and societies can reach their full potential. It sees education as embracing all the ways in which people learn about the world around them. To be effective environmental

education should be integrated in all disciplines, employ formal and non-formal methods and effective means of communication (UNESCO, 2001).

The agenda 21 approach to education is not fully embraced by workers and management at Gold Au, and I would like to argue that education should be central in addressing all the challenges facing Gold Au. That education does not need to be formal in nature any interaction should be embraced as an opportunity to educate.

UNESCO further states that both formal and non-formal education are seen as indispensable in Agenda 21 to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns. Due to the fact that formal education is slow to change, non-formal education (including public awareness) is presented as a key instrument. Non-formal channels are capable of delivering new information and tapping new approaches and methods for teaching and learning more easily. Non-formal education is seen as a complement to formal education (UNESCO, 2001).

It is of concern that Gold Au's business and leadership academy does not have any training geared towards sustainable development, though the academy has indicated that they are in a process of developing sustainable development training in collaboration with an external service provider. It is important to recognise that there is no plan at the academy to revise the current courses in order to embed sustainable development principles throughout all the courses offered.

The non-formal educational approach is encouraged at WITS through the student driven Saturday seminars and the encouragement of students to observe the impacts of mining and trigger a thinking process on how they would have done things differently. However there is a lack of broader involvement of other stakeholder and a structured approach for an inter-disciplinary approach to sustainable development. The university does not seem to have any plans for a much broader approach to sustainable development beyond what the students do, such as involvement of other faculties or departments within the university.

One of the approaches adopted by the CSMI is in providing sustainable development training to regulators, this approach will bear fruit in a long run because the regulators will

have a broader and deeper understanding of the sustainable development as related to mining and therefore provide improved regulations and monitoring and evaluation processes.

Sustainable development challenges are complex, in an industry that is more than a century old with social and environmental legacies that seem to be insurmountable, it is understandably a daunting task for leadership to address effectively all the challenges. Genuine address of the challenges is further complicated by the historical relationships and approaches that were adopted as norms, such no care for the environment and communities. Education therefore would play a crucial role in raising the importance of addressing these challenges to leadership of Gold Au, education should be looked at both formal and non-formal levels. With this understanding, any sustainable development leadership framework should have an education aspect embedded in it.

Environment

The electricity crisis provided a glimpse of how natural resources could be binding constraints to economic growth. At a mine level this simply meant that the business could not be profitable or could not continue with the required levels of production in order to maintain profitability. From a sustainable development point of view that is how the crisis was viewed, however from purely a management view, the crisis was viewed as incompetence and poor management by Eskom management. Whatever views that were held, it was clear that the electricity crisis was going to last for a long time and also the days of cheap electricity were fading. The waste to energy project at Gold Au was initiated as a result of both views.

This project is a perfect sustainable development project which benefits the socio-political, ecosystems and economic spheres of sustainable development. The enthusiasm and support shown by Gold Au management at a conceptual phase of the project was encouraging. However as the electricity crisis became manageable through the implemented initiatives, the enthusiasm to support the project to the end also dropped. The “delays” to fully fund the waste to energy feasibility is due to, in my opinion, leadership that does not fully understand the implications of the energy crisis or leadership that holds the

view that the energy crisis was due to poor management rather than an environment issue. It will be through a concerted education awareness on the interrelatedness and interdependencies of sustainable development issues that will probably assist in getting the leadership at Gold Au to understand that funding the project fully is not only going to assist with energy crisis but has larger implications such as contributions towards global challenges like climate change and alternative economic activities for the surrounding communities beyond the life of mine.

Community

With the vast amount of land sterilised by waste rock dumps at Gold Au, a project to create value for the community while benefiting the mine with reducing the liability should be received and implemented without delay. However the enthusiasm shown at the conceptual stages and the first two elements of the project has faded when it comes to implementing the third phase of the project (community development part). This is again, in my opinion, a typical delay that is due to the legacies of the relationship between the government and the mining industry where the gold mines are interested in making money and avoid liabilities.

The two projects discussed above have received partial support from leadership, though they both have enormous potential for addressing sustainability issues that would benefit Gold Au directly, the communities directly and the environment directly. I would like to argue that the lack of full support or the delay in supporting these projects fully is as a result of inadequate understanding of sustainable development by leadership at Gold Au.

So far in this chapter the centrality of leadership on all aspects of Gold Au activities is emphasised. The perception of workers is that for improvement of health and safety at the workplace management has to be committed, this also includes community and environmental management. Understanding of leadership belief systems also serves as a vital clue on how issues of sustainable development could be raised at Gold Au.

The next section will provide a suggested sustainable development leadership framework that is informed by the findings and the discussions above.

5.5 Suggested Sustainable Development Leadership Framework

Sustainability is one of the greatest challenges that leadership has to deal with amongst many other challenges that the information age has brought. The gold mining industry in particular faces this challenge from a weaker position of generally being regarded as an industry that has a long history of bad environmental and human impacts. As illustrated in the chapters above Gold Au faces these sustainability challenges as well.

I would like to argue that the findings from this case study represent in general what is happening in the gold mining industry. The literature review in chapter 2 informs the basis of my argument, where the impact of gold mining to the environment and society at large in various parts of the world is depicted. The attitudes and perceptions of workers and management at Gold Au is a microcosm of the general attitudes and perceptions in the gold mining industry in general.

When it comes to leadership, the literature review again illustrated the kind of leadership that is required to genuinely address sustainability challenges. The genuineness of the leadership is couched in the belief systems or action logics of the leader not on the leadership style (see section 2.7 above). The current belief system of the majority of Gold Au leadership as discussed above is not congruent with genuine sustainability leadership. There is half-hearted effort by Gold Au to genuinely address sustainability challenges as discussed in 5.4 above. It is however important to recognise that the environment under which these leaders find themselves in have an influence on their own behaviour and approach to sustainability.

Chapter 4 examined the historical basis of gold mining in South Africa specifically looking at the relationship between government and the industry and the impact of that relationship on the environment and communities. It is clear from chapter 4 that the current approaches and attitudes by the Gold Au towards environment and society is heavily influenced by the historical perspectives explored in chapter 4.

I would like to propose that for Gold Au to begin a journey towards sustainable futures is to have a sustainability framework anchored on leadership. The suggested framework could be tested, to begin with, at Gold Au and its impact be monitored and evaluated over a period of time. The framework could at a later stage possibly be implemented throughout the mining industry.

5.6 Theoretical Basis of the suggested Framework

The theoretical basis of the suggested framework could be embedded on what Simon Western describes as “eco-leadership” (Western, 2008). He describes eco-leadership as that which conceptualises leaders as being agents distributed throughout organisations, taking holistic, systemic and ethical stance and eco-leadership works well in organisations that are conceptualised as “ecosystems within ecosystems” (Western, 2008). The case of Gold Au illustrates the kind of organisation the company is, an organisation where command and control is the norm, where the perceptions of workers are that management conducts themselves in a manner that does not care about people nor the environment but only concerned about profits.

The first point in adopting eco-leadership within Gold Au would be the understanding that eco-leadership is non-hierarchical and non-positional. Unlike the current state at Gold Au where leadership emphasis is on the position held. Eco-leadership is a capacity rather than a position and more a lifestyle adopted after deep reflection than a skill gained through specialised training (Satterwhite, 2010). The existing paradigm within Gold Au of leadership focused on leadership style, characteristics and qualifications embedded in an organisational structure with efficiencies the driving force behind management has to be modified. The modification must come through asking ourselves as leaders within Gold Au, larger questions about our place in the world and our responsibility with the environmental challenges the world faces. What is our relationship with the world around us?

In order to understand our role and responsibility towards the environment and to understand our relationship with the world around us, I will discuss two concepts,

autopoiesis and structural coupling. These two concepts would form the education and awareness basis of the framework.

Maturana and Varela (1987) cited in Satterwhite (2010) defines *autopoiesis as a defining characteristic of living beings, which are distinctive as organised systems in that their organisation is such that their only product is themselves with no separation between the producer and the product. Biologically, autopoiesis is the chief process of a living system, without it, the structural unity of an organism ceases to exist and the system perishes* (Satterwhite, 2010). Maturana and Varela describes structural coupling as a history of recurrent interactions between two or more systems. The environment as a system and human beings as autopoietic systems are structurally coupled as will be described below.

The autopoietic system and the environment interact in such a manner that the environment would trigger certain reactions and changes in the autopoietic system. The nature of these changes and reactions would be determined by the structural constraints of the autopoietic system and would not be directed or specified by the environment. The same applies with the impact of the autopoietic system to the environment. The interaction between the two systems would continue in perpetuity if the structural changes triggered by their interactions are congruent and do not disintegrate.

To simplify the above description, human beings, in the process of continually reproducing themselves draw resources from the environment. In the process of drawing these resources they affect the environment. In its own autopoietic system the environment reacts in a predetermined way to preserve itself whenever resources are drawn or deposited to the environment.

Rather than seeing the electricity crisis as poor management from Eskom, I chose to look at it as an indication of what could happen when natural resources reach their limits. In the course of the mining process, Gold Au produces waste in the form of waste rock, tailings and process water. This waste is deposited in the environment and its negative impacts to the environment is known, however the total environmental reaction cannot be fully determined because of the autopoietic nature of the environment. The trigger of a total

collapse of the system is not immediately visible, however, with ecosystems reaching their limits (see the millennium ecosystem report and in chapter 2), leadership is required to put systems in place to avoid further deterioration of the ecosystem.

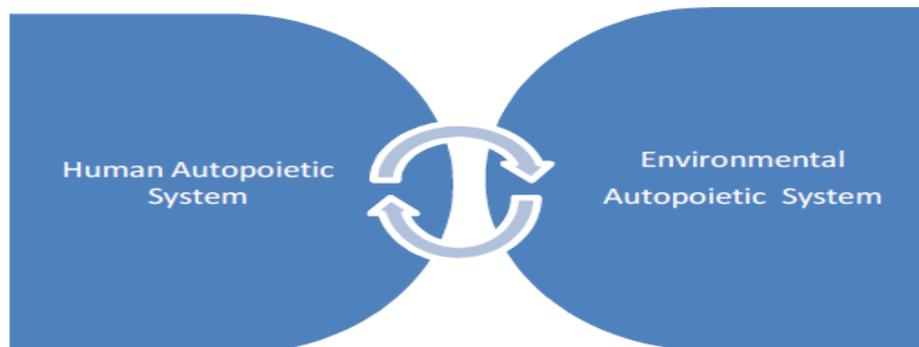


Figure 23: Illustration of structural coupling of human and environmental autopoietic systems

Source: Personal depiction

We are therefore intrinsically linked to the environment and other autopoietic systems through structural coupling. Autopoiesis is thus the fundamental act of conservation (conservation of self). With this understanding the aim for human beings should be to conserve that which makes us whole. Structural coupling tells us that for us to be conserved we need to conserve the environment we are dependent on. We must therefore prevent changes in the external environment that threaten the finely tuned interaction between internal self and external world. Structural coupling and autopoiesis talks directly to the discussion in chapter 1, whereby a systems approach to sustainability was described that the economic, socio-political and ecosystems are embedded in each other rather than separate systems.

With the description above it would be easy for human beings to look at their immediate environment and try by all means that the relationship between the person and the immediate environment is not strained. However, the extent of the environment is not known and its reaction to the external stimulus brought about by human beings is only known by its own autopoietic system. Systems theory informs us that everything is related and interdependent to other and therefore an action at a certain locality could lead to a reaction kilometres away.

Taking this discussion of autopoiesis, structural coupling and systems theory back to Gold Au. There is a need for the people within Gold Au to have this understanding in order for the mine to modify its approach to sustainable development. This approach will not be an emergent phenomenon, but it will emerge through leadership that is willing to listen, through education system that embeds the three concepts described above in their curriculum not only for the mining industry education departments but all educational facilities (formal and non-formal). The interactions and the feedback loops between the various agents within the mining industry, civil society, communities and educational institutions would lead to the emergence of eco-leadership as described so far in this section.

5.7 Sustainable Development Framework

5.7.1 Sustainable Value Framework

Hart and Milstein (2003) developed a sustainable value framework which is based on their shareholder-value framework illustrated in figure 24 below.

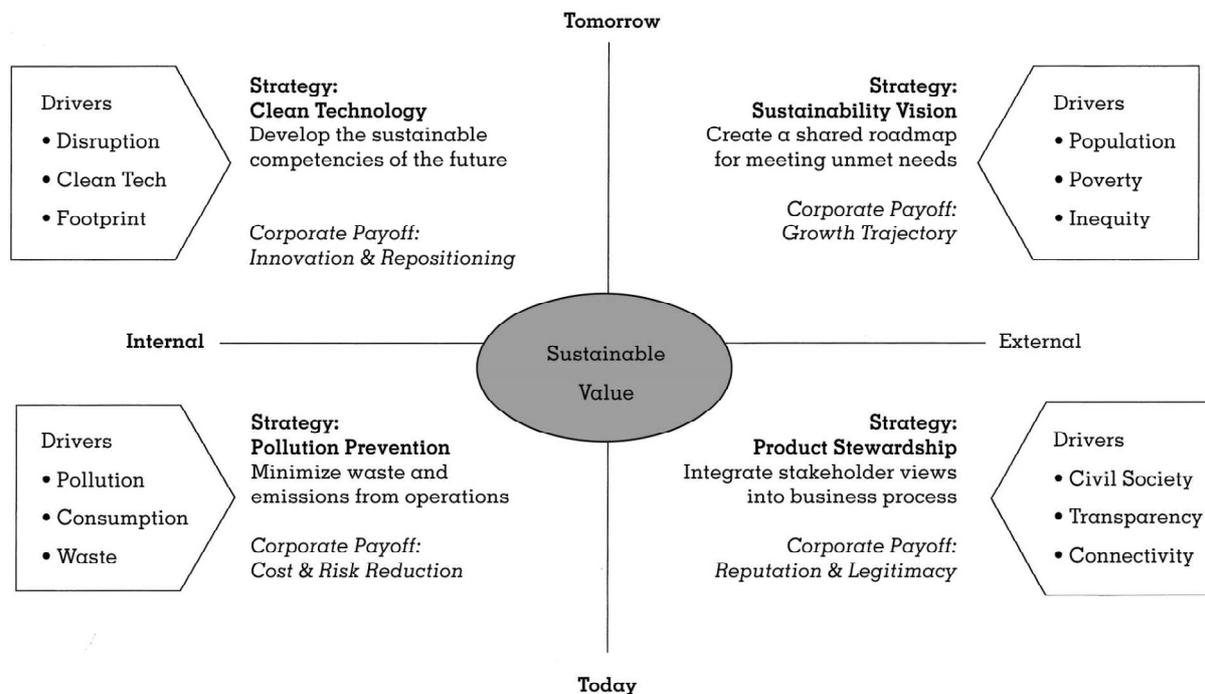


Figure 24: Sustainable Value Framework

Source: Hart and Milstein (2003)

Hart and Milstein state that “the challenge of global sustainability is complex, multidimensional, and emergent in character. Firms are challenged to minimize waste from current operations (pollution prevention), while simultaneously reorienting their competency portfolios toward more sustainable technologies and skill sets (clean technology). Firms are also challenged to engage in extensive interaction and dialogue with external stakeholders, regarding both current offerings (product stewardship) as well as how they might develop economically sound solutions to social and environmental problems for the future (sustainability vision)” (Hart and Milstein, 2003).

This framework is premised on opportunities that the sustainable development challenges present to companies. Its underlying approach is that, by doing business in a more sustainable manner presents an opportunity to increase the value to the shareholders. The framework however perpetuates the same notion of pursuing profits by companies above all else, the primary driving philosophy is profit making not the understanding of limits to growth posed by the environment, the structural coupling and autopoietic systems.

Hart and Milstein concluding remarks on the framework is that “The framework’s simplicity, however, should not be mistaken for ease of execution: understanding the connections is not the same thing as successfully implementing the strategies and practices involved. The tasks are very challenging and complex indeed, suggesting that only a few firms will be able to successfully carry out activities in all four quadrants simultaneously, especially those that require the greatest efforts in terms of vision, creativity, and patience” (Hart and Milstein, 2003).

The weakness in Hart and Milstein’s framework is the lack of emphasis on the role leadership plays in execution of their own framework. They do not provide any comment on challenges that the firms can encounter in implementing the framework. I would like to argue that any sustainable development framework is incomplete if it does not include at least two concepts. The first concept that needs to be in any sustainable development framework is the interdependency of the various systems (structural coupling) and the second concept is the required leadership to implement the framework.

If Hart and Milstein’s framework were to be tested and implemented at Gold Au, it would face various challenges. The first challenge would be the shallow understanding by management of Gold Au at the operational level the value in investing time and effort on waste minimisation, pollution prevention and investing resources for the future developments because an Achiever action logic would not be concerned about such issues other than just using all effort to produce kilograms of gold that would make money for the company today. The Expert action logic, also prevalent at operational level at Gold Au would not be concerned much about product stewardship and stakeholder engagement because of the need for concrete “scientific” proof of any engagement undertaken, let alone being concerned about meeting and addressing poverty, inequality and population challenges.

However, a different sustainable development framework that takes into consideration the belief systems of the operational teams and shortages in sustainable development knowledge could possibly bear different results.

5.8 Suggested Sustainable Development Leadership Framework

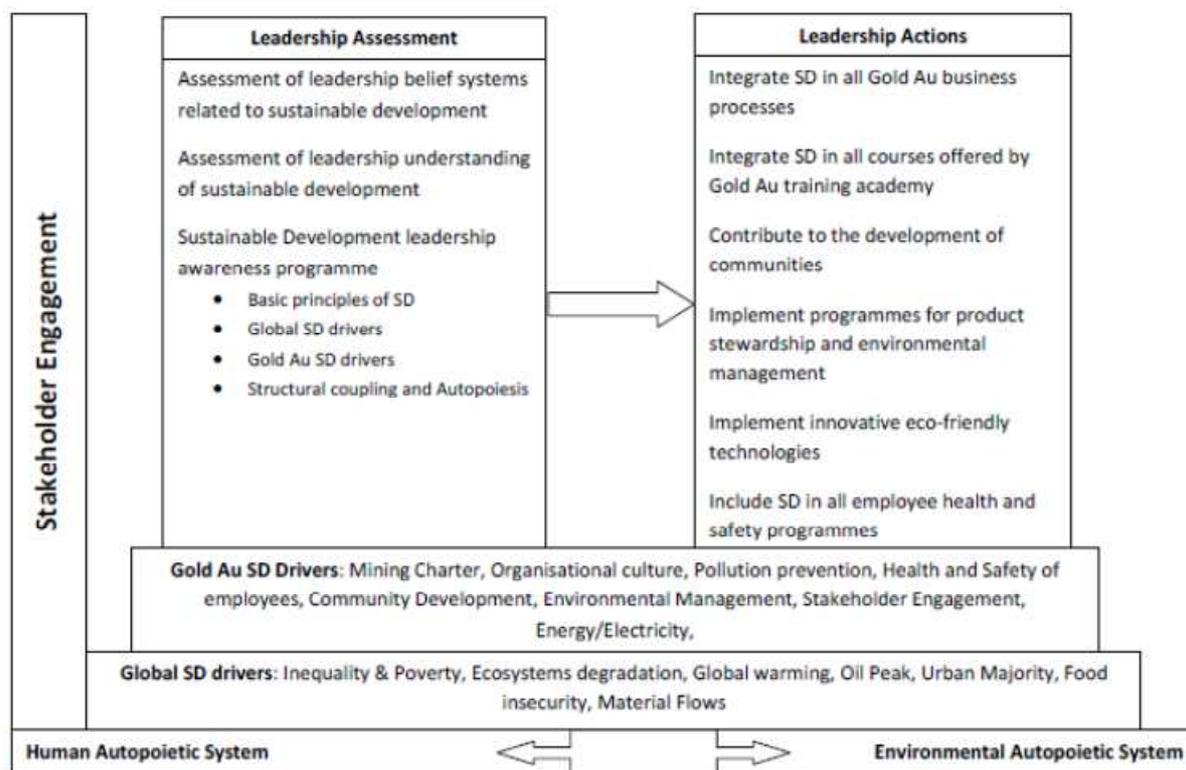


Figure 22: Suggested Sustainable Development Framework for Gold Au

Source: Personal Depiction

The foundation for this suggested sustainable development leadership framework is the structurally coupled human and environmental autopoietic systems. The structural coupling and autopoietic systems form the basis of any activities that human beings undertake that impact on the environment. Understanding of that linkage could influence the actions by Gold Au management on the approach that needs to be adopted in the process of mining gold. However the understanding alone is not enough to influence the required behaviour.

The second step in the framework is highlighting the fact that whatever Gold Au does, it is contributing to the global sustainable development challenges that are shaped by the seven documents mentioned in chapter 2. It is important therefore for leadership at Gold Au to always be cognisant of the fact that when it comes to sustainable development, local actions influence and/or may have global implications. This step is followed by the internal drivers of sustainable development at Gold Au. These drivers include the findings discussed in chapter 4, particularly mining charter requirements, organisational cultural issues (whereby, it is the opinion of workers that management does not care and the instructional nature of the interactions between management and the rest of the workers) environmental and community issues.

In the suggested framework, sustainability leadership is considered not from a positional or hierarchical point of view, but more from a lifestyle adopted and leaders as agents being distributed throughout organisations, taking holistic, systemic and ethical stance. Therefore the first assessment at Gold Au that needs to be conducted is the understanding of the belief systems, action logics and sustainability views of statistically significant number of all employees (management and general workers at all levels). Assessing the belief systems would reveal whether Gold Au is dominated by ecocentric, anthropocentric or interdisciplinary belief systems and the associated action logics. It is important to also to assess leadership understanding of sustainable development.

The understanding gained from sustainability leadership assessments would provide a basis for developing an educational/sustainable development awareness programme for Gold Au leadership. However education on sustainable development will not only be informed by the sustainability leadership assessment, but should contain the basic understanding of autopoiesis and structural coupling and sustainable development principles. The sustainable development principles need to cover amongst others, the generally accepted WCED definition of sustainable development, the MEA findings, climate change, the systems approach to sustainable development mentioned in chapter 1, etc. The content of education to also include the current initiatives to address sustainable development challenges such as the decoupling initiatives by the IRP. Understanding these initiatives could assist Gold Au in actively playing a role towards achieving the ideals of these initiatives.

The sustainable development awareness processes should be conducted both in formal and non-formal contexts. The understanding gained from sustainability leadership assessments would play a significant role in the approach to presenting the contents of the impacts of gold mining to society and the environment at large. Embedding sustainable development education in all aspects of Gold Au processes and systems should form the basis of removing the need for always using formal educational approaches in addressing sustainable development issues.

The role played by the currently known dominant action logics (Achiever and Expert) at the management levels coupled with the broader understanding gained from education on structural coupling and autopoiesis would possibly elevate implementation of cleaner production mechanisms and Eco-Efficiency approaches as both these processes require experts for designing such systems and in some cases in implementing the systems. The question that should be embedded throughout Gold Au processes could be *“Can this be done in a much more efficient way?”*

The sustainability leadership assessment would also inform the dominant logic in terms of stakeholder engagement, whether its dominated by dialectic or dialogic engagement approach. The dominant engagement logic would inform the approach that needs to be

taken in engaging with communities, regulators, employees and other stakeholders on issues pertaining to Gold Au activities. Governance and reporting forms the bedrock of implementing sustainable development, governance talks to having appropriate standard operating procedures and systems on all aspects of sustainable development implementation.

The full understanding of the autopoiesis, structural coupling and all the sustainable development drivers by leadership at Gold Au, coupled with the assessment and awareness provides a platform for a more genuine and committed implementation of sustainable development. For the implementation to be effective, it has to be driven by management (with the same vigour and commitment displayed during the energy crisis), from the top levels.

A call for Leadership towards more Sustainable Futures at Gold Au is to:

- Integrate SD in all Gold Au business processes
- Integrate SD in all courses offered by Gold Au training academy
- Contribute to the development of communities
- Implement programmes for product stewardship and environmental management
- Implement innovative eco-friendly technologies
- Include SD in all employee health and safety programmes

5.9 Opportunity for Further Research

This case study has basically highlighted the realities and/or perceptions facing the employees of Gold Au and also possible environmental and community impacts of the mine activities. The study also highlighted the historical context of gold mining in South Africa with the associated leadership approaches and educational approaches. The findings from the study provide a firm basis for action to address the challenges facing Gold Au. The suggested sustainable development leadership framework provides an opportunity for further scholarship through testing it within Gold Au, the mining industry or in any other industrial or non-industrial sector.

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7 Appendix 1

Gold Au approach to Environmental Management and Community Development			
Company Name: Gold Au			
Interviewee : Gold Au Leadership			
Interviewer: Hlombe Makuluma			
Interview Period: July - September 2010			
In your opinion why is Gold Au a signatory to the UN Global Compact?			
Is it important for Gold Au to manage the environment and to do community development? If so, Why? If not Why?			
How important are partnerships in environmental and community management programmes?			
Please share your views regarding integrating sustainable development throughout all business processes at Gold Au?			
What is your view regarding Gold Au getting involved in Sustainable Development initiatives beyond the mine, as one of its priorities?			

Current Gold Au approach to Environmental Management and Community Development			
Company Name: Gold Au			
Questinnaire to : Gold Au Operational Excellence Leadership			
Return Questionnaire to: Hlombe Makuluma			
Period: July - September 2010			
	Agree	Disagree	Comment (if any)
Primarily Gold Au Stakeholder Engagement approach is:			
Done for compliance purposes			
Largely one way dialogue(GF talking to the stakeholders mostly related to Gold Au supplying information)			
Largely two way dialogue and the engagement mostly a constructive one (with GF and the stakeholders fully & constructively engaging).			
To develop full partnership with civil society and regulators for collaboration on societal issues towards common goals			
For looking at possible business opportunities that can add value both to the stakeholder and Gold Au			
Relationship with Government is:			
Largely to comply with legislation			
Largely to comply with legislation and lobbying			
For partnership purposes			
For full collaboration as equal partners towards various initiatives			
For working together in creating conducive business and market conditions			
The Primary Objective of Environmental Management and Community Development is:			
For compliance and avoiding activism and media attention			
To ensure that GF does not lose the status on voluntary standards such as ISO14001, ICMM, Global Compact and AA1000			
To build a good reputation, pro-active risk management and looking for solutions			
To manage risk and be eco and socio-efficient			
To embed Environment and Community issues in all business processes			
To be on par or be the benchmark for our peers in the industry			
To develop new business opportunities for Gold Au			
The most critical department on Environmental Management and Community Development outside of the SD department is			
Human Resources			
Legal			
Finance			
Communication			
Other: Please specify			
	In your opinion what is the one thing that Gold Au needs to do to move it beyond its current reality? ☐		

Focus Group discussions themes			
Company Name: Gold Au			
Discussion group : Shaft Task teams			
Discussion Leader: Hlombe Makuluma			
Discussion Leaders Assistant: Kenny Molalo			
Scribe: Lorraine Mazibuko			
Impact of our mine on Employees and the role of			
Impact of our mine on communities			
The role of leadership in Sustainable development initiatives			
The role of education in sustainable development at our mine			