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HISTORICAL PERSPECTIVE, CURRENT INDUSTRY PRACTICES AND THE LATEST DEVELOPMENTS IN PUBLIC REPORTING OF MINERAL ASSETS AND PROPERTIES FOR THE EXTRACTIVE INDUSTRY IN SOUTH AFRICA

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A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Mineral Resources Management.

Johannesburg, 2006

DECLARATION

I declare that this dissertation is my own, unaided work. Where use has been made of work of others, it is duly acknowledged in the text. It is being submitted for the Degree of Masters of Science in Mineral Resources Management in the University of the Witwatersrand, Johannesburg. It has not been submitted before in any form for any degree or examination in any other University.



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Godknows Njowa

This 26 day of September 2006

ABSTRACT

South Africa had its first democratic elections in 1994. This give rise to a new dimension in social, economic, political and legal fraternities. As result, a number of new rules governing the extractive industry being introduced over the last ten years. The regulatory environment, which affects the public reporting of exploration information, mineral resources and mineral reserves, has undergone major changes. These include:-

- The impact of the effects of globalization on the mining industry since many large and small operating mining companies have been listed in more than one country;
- Increased regulations introduced by the local JSE as revised listing requirements for reporting and internal controls, not only over financial reporting, but also over the preparation of supplementary information, including mineral resources and mineral reserves statements; and
- Development of new international definitions and standards for the estimation and reporting of exploration information, mineral resources and mineral reserves. This due to the international competition for mineral exploration and development projects by global mining companies, which have lead to proactive jurisdictions to establish regulatory regimes with common fabric..

Mineral resource and mineral reserve classification methods, standards and reporting have undergone many changes since the discovery and commercial exploration of minerals as early as the 18th century. To a certain extent, even today there is still ongoing debate regarding the classification systems, definitions and the public reporting of these assets for internal and external use. Over the years, different interpretation, understanding and classification has led to confusion and misunderstanding which resulted in world class reporting scandals including, but not limited to, Bre-X, Shell and Enron. These scandals have highlighted the necessity of standardising the definitions, classification and reporting of mineral assets. The regulators and investors in the mineral industry have also been awakened and have become biggest stakeholders in the development and implementation of these rules in the industry. The concept of “competent person” was introduced and accountability of reporting was moved to the individuals and directors that report these results into the public domain.

In this research report the mineral resource and mineral reserve definitions and their developments, historical developments in the minerals industry, current standards and their use in the public reporting of exploration results and mineral assets in the South African context are considered and reviewed in some detail. Included in this report were also areas of possible misconception in the interpretation of categorisation of mineral assets.

A practical case study on the Harmony proposal of a hostile take over bid on Goldfields was studied. Information in the public domain on this potential transaction was reviewed during the study, facts were then analysed and formed the basis of an independent opinion. It was concluded that the reporting of mineral assets held by Harmony did not comply with the general reporting principles; hence the report was considered misleading, confusing and materially inconsistent. Hence, in the author’s opinion, Harmony’s offer to Goldfields shareholders was unfair and unreasonable. Given that Goldfields held quality assets compared to Harmony, they should have offered a greater premium for these assets.

To be clear and unambiguous, technical and financial information should be published on a comparable basis by all companies operating in the same industry sector, making the same basic assumptions. Public disclosure of mineral resources and mineral reserves is a logical step towards full disclosure of material information because:-

1) mineral resources and mineral reserves are material to all investors;
2) residency or nationality of an investor should not determine what information is disclosed by a company (need for internationally recognised standards); and
3) mineral resources and mineral reserves are required to be considered in impairment and purchase price allocation in accordance with IFRS.

Lastly stakeholders in the mining industry should be reminded that the codes and rules are written for guidance of professionals in pursuit of their professional work and it was recommended that large mining firms should establish a mineral resource committee at board level to help and advise the board of directors in decision making.

ACKNOWLEDGEMENTS

This dissertation is a culmination of many ideas, information, guidance and encouragement from several people who cannot all be possibly acknowledged for their individual contributions. However, I would like to particularly acknowledge the following individuals and companies for their contributions:-

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Lastly, I am greatly indebted to my parents, brothers, sisters and my fiancé for their love, understanding and encouragement during the times when the research took me away from them.

DEDICATION

Dedicated to my parents (Melody and Claudius Njowa) and my wife to be Tendai

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NOMENCLATURE

AAPG	American Association of Petroleum Geologists
AASB	Australian Accounting Standards Board
ADS	American Depositary Shares
AECI	Explosives and Initiation Systems Company
AIM	A subsidiary of the London Stock Exchange aimed to raise capital for small firms
ASX	Australian Stock Exchange
AusIMM	The Australasian Institute of Mining and Metallurgy
BEE	Black Economic Empowerment
BIT	Bilateral Investment Treaty
CIF	Competitive Investment Framework
CIM	Canadian Institute of Mining
CIMVal	Canadian Institute of Mining, Metallurgy and Petroleum on Valuation of Mineral Properties
CMMI	Council of Mining and Metallurgical Institutions
CP	Competent Person
CPR	Competent Person's Report
CRIRSCO	Combined Reserves International Reporting Standards Committee
CSA	Canadian Securities Administrators
CSR	Corporate Social Responsibility
DCF	Discounted Cashflow
DME	Department of Minerals and Energy
DTA	Double Taxation Agreement
ECOSOC	United Nations Economic and Social Council
ECSA	Engineering Council of South Africa
EFG	European Federation of Geologists
EPZ	Export Processing Zones
FDI	Foreign Direct Investment
GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Product
HDP	Historically Disadvantaged Persons
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IIED	International Institute for Environment and Development
IMM	Institution of Mining and Metallurgy
IODSA	Institute of Directors of South Africa
ISO	International Organization for Standardization
IVSC	International Valuation Standards Committee
JORC	Joint Ore Reserves Committee (Code Governing Australian Reporting)
MMSD	Mining, Minerals and Sustainable Development
MNE	Multinational Enterprise
MPRB	Mineral and Petroleum Royalty Bill
MPRDA	Mineral and Petroleum Resources Development Act
MSA	Mine Safety Appliances Company

NMP	National Mineral Policy
NPD	Norwegian Petroleum Directorate
NSONR	National Sovereignty over Natural Resources
OECD	Organisation for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
PGE	Platinum Group Elements
PLATO	South African Council for Professional Land Surveyors and Technical Surveyors
RBT	Residence-based Taxation
ROPO	Recognised Overseas Professional Organisations
SA	South Africa / South African
SACNASP	South African Council for Natural Scientific Professions
SADC	Southern African Development Community
SAIMM	South African Institute of Mining and Metallurgy
SAMREC	South African Mineral Resources Committee
SAMVAL	South African code for the valuation of Mineral Assets
SARB	South African Reserve Bank
SARS	South African Revenue Services
SCMR	State Commission of Ukraine on Mineral Resources
SEC	Securities and Exchange Commission
SEG	Society of Economic Geologists
SME	Society of Mining, Metallurgy and Exploration
SPE	Society of Petroleum Engineers
SRK	Steffen, Robertson and Kirsten (South Africa) Pty Limited
TBVC	Transkei, Bophuthatswana, Venda and Ciskei
UN	United Nations
UNCED	United Nations Conference on Environment and Development Agenda
UNCITRAL	UN Commission on International Trade and Arbitration Law
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UNFC	United Nations Framework Classification for Energy and Mineral Resources
UNRISD	United Nations Research Institute for Social Development
UNSD	United Nations Statistical Division, N.Y.
US/USA	United States of America
USGS	United States Geological Survey
VALMIN	Code and guidelines for assessment and Valuation of Mineral Assets and Mineral securities for Independent Experts reports
VAT	Value added tax
WBCSD	World Business Council for Sustainable Development
WEC	World Energy Council
WPC	World Petroleum Congress
WSSD	World Summit for Sustainable Development

UNITS

cm	A centimetre.
cmg/t	Centimetre grams per tonne – measure of metal accumulation over a width.
g	Grammes.
g/t	Grammes per metric tonne – metal concentration.
Ha	A hectare.
kg	A kilogram.
km	A kilometre.
km^2	A square kilometre.
koz	A thousand ounces.
kt	A thousand metric tonnes.
ktpm	A thousand tonnes per month.
m	A metre.
m^2	A square metre.
m^3	A cubic metre.
mm	Millimetres.
Moz	A million fine troy ounces.
Mt	Million metric tonnes.
oz	A fine troy ounce equalling 31.10348 grams.
t	A metric tonne.
%	Percentage.
US$	United States Dollar.
US$/oz	United Sates Dollar per ounce.
ZAR	South African Rand.
ZAR/kg	South African Rand per kilogram.
ZARm	Million South African Rand.
ZAR/t	South African Rand per metric tonne.
ZAR/Share	South African Rand per share.
ZAR / US$	South African Rand per United States Dollar

CHAPTER ONE

1 BACKGROUND AND OBJECTIVE OF RESEARCH

This chapter lays the background and details the objectives of this research report. In a world where international competition for mineral exploration and development funds has intensified and where such expenditure is increasingly made by global mining companies, have initiated the momentum of many proactive jurisdictions to move towards establishment of regulatory regimes with a common fabric. This have lead the author to realise the necessity of this type of research in the light of the new regulations governing the reporting of exploration results, mineral resources and mineral reserves in the extractive industry in SA. Based on the findings of the research, the author compiled several recommendations that could be implemented in the area of public reporting of mineral assets in SA.

This research project was to explore the historical, current practices and the developments that the South African extractive industry have gone through in terms of the mineral reserves and mineral resources classification and the public reporting thereof. The study carried out, was specifically on the South African extractive industry, after a realization that the next Bre-X scandal could be just around the corner and no one knows where it will occur, maybe on the JSE. All the codes that have to be compiled with in public reporting of mineral reserves and mineral resources and their valuation were considered. However based on the study carried out, a number of recommendations were suggested, taking into consideration confidential information, the need to protect and provide adequate information to the interested stakeholders and their advisors.

1.1 Introduction

South Africa's independence from the apartheid government in 1994, has given rise to a new dimension in social, economic, political and legal fraternities. The minerals industry is not an exception to these changes. Hence a number of codes, standards and Acts governing the extractive industry have been introduced over the last ten years. "*These codes typically govern the evaluation and valuation of mineral properties as well as the reporting of resultant findings*". (Lilford, 2004).

Over the last ten years many changes have occurred in the mining industry and the regulatory environment, which affect the public reporting of exploration information, mineral resources and mineral reserves. These include:-

- Globalization of the mining industry with most large and many small mining companies operating and being publicly listed in more than one country;
- Changes in the South African regulatory environment resulting enactment of new legislation and codes used in regulating of the extractive industry;
- Increased requirements by the JSE listing requirements for adequate procedure and internal controls, not only over financial reporting, but also over the preparation of supplementary information, including mineral reserves and mineral resources statements; and
- Development of international definitions and standards for the estimation and reporting of exploration information, mineral resources and mineral reserves. These definitions have been accepted by the regulatory agencies of Canada, Australia, South

Africa and Chile, and are being reviewed by regulators in the United Kingdom. The definitions have also been accepted by the United Nations Economic Commission for Europe (UN-ECE).

Several incidences of scandals involving misleading or false public reporting of facts have been witnessed, across the world. This led to some of the all-time greatest cases of companies betraying their investors, resulting in investor's losing a couple of billions of dollars through these scams. Incidence such as Bre-X minerals scandal, Shell and Enron have resulted in the need for the establishment of codes for public reporting in an effort to introduce accountability, responsibility to the directors. The extractive industry and interested stakeholders responded by developing and establishing codes and regulations to be complied with when reporting exploration results, mineral resources and mineral reserves.

Leading mining countries have developed their industry specific frameworks and instruments for regulating the minerals industry and each have their own broadly similar definitions of mineral resources and ore reserves. These include Australia (the VALMIN Code and the JORC Code), Canada (the CIMVaL Code and Canadian National Instrument) and the United States (USPAP).These national agencies define mineral reserves in slightly different ways and sometimes even the same terminology for different properties. "*To become globally competitive and to fully realise the benefits associated with their natural resources, other countries will have to follow suit in terms of introducing similar mineral codes"* (Lilford,2004). South Africa followed suit by developing and establishing the SAMREC Code in 2000 and is currently working on developing the SAMVal code.

In addition, the international financial developments and the globalisation of markets have intensified the need for international valuation and reporting standards. *"It is obvious that without internal agreements regarding valuation standards, there were potential confusions and mistakes to occur. And differences of viewpoints among professional valuer's in different countries could lead to unintentional misunderstanding and misrepresentations of facts"*. (IVSC, 2005). Hence the development of IFRS 6 on extractive industry, SAMVaL code and international valuation guidance note on extractive industries (IVSC) which are internationally recognised and are expected to standardise the world's extractive industry.

It has become abundantly clear that to be globally competitive, the South African extractive industry had to comply with these new set of standards and codes that are being established. Alternatively, it can modify them slightly to factor in local conditions as in the case of the SAMVal code.

In addition most South African mining companies are on the move, to be global and international players in the market, so the need to develop internationally accepted codes. This will go some way towards harmonise these codes that are being developed in different parts of the world and come to the common interpretation of the mineral resources and mineral reserves statements. Because of globalisation, the world has become one big market; dual listing on the different stock exchanges and the Bre-X scandal has necessitated the development of more stringent and comprehensive reporting codes.

"*Potential implications for minerals industry professionals include issues of education, training, as well as qualifications and licensing for those wishing to appraise the value of minerals industry assets"* (Ellis, 2005).

1.2 Motivation of the Research

The international extractive industry realised the need for establishing standards for classifying and publicly reporting mineral resources and reserves as early as 1909. During this period Herbert Hoover, a mining engineer who was to become president of the United States of America, published "*Principles of Mining*", in which he recommended a three-fold division of ore reserves into proved, probable and prospective. Since then substantial progress has been made over the last century in the development of national and international standards covering the definition, estimation and public reporting of mineral resources and mineral reserves. Such standards will form the basis of the principles and guidelines that have to be adhered to by professionals that are involved and responsible for the whole process of estimation, classification and final reporting of mineral resources and mineral reserves. This would enable the professionals in the extractive industry to have common language and understanding to facilitate communication between all the stakeholders and improve on the quality and confidence that can be placed on the information released to the public.

In 1997 the need for international standards and stronger control of the reporting of mineral information was made completely obvious by the Bre-X scandal concerning the fictitious Busang gold deposit in Indonesia. According to Miskelly (2003) who commented on the scandal "*Even though it was recognised that regulations alone could not have stopped Bre-X from happening, the lack of standards, and the lack of procedure to ensure that these standards are followed, was perceived as a significant contributing factor"*.

This research project was to explore the historical, current practices and the developments that the South African extractive industry have gone through in terms of the mineral reserves and mineral resources classification and the public reporting thereof. The study carried out, was specifically on the South African extractive industry, after a realization that the next Bre-X scandal could be just around the corner and no one knows where it will occur, maybe on the JSE. All the codes that have to be compiled with in public reporting of mineral reserves and mineral resources and their valuation were considered. However based on the study carried out, a number of recommendations were suggested, taking into consideration confidential information, the need to protect and provide adequate information to the interested stakeholders and their advisors.

Leading mineral producing countries, like Australia, Canada, South Africa and the US each have their own broadly similar definitions of mineral resources and mineral reserves. These agencies define reserves in slightly different ways, often using the same terminology or even the same terminology for different concepts.

1.3 Objectives of the Research

The aim of the research was to:-

1. Review and comment on the historical practices in public reporting of mineral assets in the extractive industry.
2. To give a detailed account of the current industrial practices in this subject.
3. Assess the latest developments in regulating the extractive industry that is the new codes and standards.
4. Evaluate the preparedness, challenges and the requirements necessary for the smooth transition in complying with these new regulations.
5. Study and analyse one practical case study on public reporting on a proposed transaction between two established mining houses. i.e. Harmony's hostile bid to Goldfields.
6. Enumerate the advantages for complying with the new legislation.

1.4 Research Methodology

A literature survey was done to review the historic and current industrial practices and norms with regard to mineral property reporting for different purposes to different stakeholders.

Research on the current new developments on the subject was done through the use of the libraries, internet, attending workshops and seminars. Mining houses and professionals in the industry were consulted.

An analysis of data was done using the readily available information on the public domain, as this is the information that the investors, analysts and shareholders use to make their investment decisions. The data was accessed through reading press statements, annual reports, technical journals and commentaries.

CHAPTER TWO

2 PERFORMANCE OF THE SA MINERALS INDUSTRY

2.1 South Africa's Mining Overview

South Africa is one of the most geologically blessed regions in the world with an abundant supply of natural resources. Figure 1 shows a map of the simplified geology and selected mineral deposits in SA. The existence of a wide variety of minerals, over the years has resulted to a well-developed financial, legal, communications, energy and transport sectors, a modern stock exchange and modern infrastructure supporting an efficient distribution of commodities, throughout the region. The JSE ranks among the ten largest and well administered stock exchanges in the world. As a result of the mineral wealth in the country, the mining industry has been a major driver of growth, economic development and FDI. According to the mining industry overview published by the South African Chamber of Mines in 2004 it is stated that "*mining's contribution to total fixed investment was 9.9% of the total in the country and accounted for 14% of total private sector investment in South Africa. Mining continued to act as a strong magnet for investment on the JSE and accounted for around 35% or R534 billion of the market capitalisation of the JSE at the end of 2004*" (p 4).

The South African mining industry continues to be one of the most important industries fuelling the growth and development of the economy. The sector mined 60 different minerals of which the vast majority were exported to over 100 countries in the past decade alone and hence the industry remains one of the major foreign currency earners. This compliments a comment made by Botha in 2004:"*mining has always formed the backbone of South Africa's economy and, in the last ten years of democratic rule, the industry has continued to play an important role as a foundation of growth and development in the country*."

The discovery of diamonds in 1867 and gold in 1886 spurred wealth and immigration and intensified the subjugation of the native inhabitants resulting in massive economic imbalances. This was because the country operated under a policy of apartheid (the separate development of races). Democracy established in 1994 brought an end to apartheid politically and marked the beginning of a new SA. In order to correct these social-economic imbalances, in the new SA drastic changes were evidenced in the way new SA deals with the different aspects of the nation and the introduction of new legislation to compliment these efforts.

South Africa's economic policy is fiscally conservative, but pragmatic, focusing on targeting inflation and liberalising trade as a means to increase job growth and household income. However, growth has not been strong enough to lower SA's high unemployment rate, daunting economic problems remains from the apartheid era, especially poverty and lack of economic empowerment among the disadvantaged groups.

Hence democracy gave rise to a new dimension in social, economic, political, and legal fraternities and the minerals industry was not an exception to these changes. A number of codes, standards and Acts governing the operation and administration of the minerals industry have been promulgated in the last decade. Just to mention a few these include:- the Minerals and Petroleum Resources Development Act, 2002 (MPDRA), the SAMREC code, Broad-Based Black Economic Empowerment Act (BEE), Mine Health and Safety Act No. 26 of 1996, Nuclear Energy Act No.46 of 1999 and

National Nuclear Regulator Act No.47 of 1999. Only codes, Acts, guidelines and standards that regulate the public reporting of mineral assets and properties for the minerals industry in the South African context was explored in detail in this research project.

2.2 South African Mining Industry

The discovery of world class diamond and gold deposits in the late 19th century laid the foundations for transformation of SA from an essentially agro-based economy to a modern economy. After a century of mining activity in SA, the country remains one of the most geological blessed regions in the world. SA has more than half of the world's reserves of manganese, chromium and PGE. It has more than 40% of the world's vanadium, gold and vermiculite reserves and is also a major supplier of aluminium, antimony, coal, ferromanganese, fluorspar, iron ore, nickel, silicon, titanium minerals, uranium and zirconium. Table 1 shows the South African reserves and production in key minerals as a percentage of the world's reserves and production as it stood in 2001.

Apart from being the world's largest producer of gold, platinum, manganese, chromium and vanadium, the sector has being a major player in the minerals industry since the discovery of the world class deposits. Table 2 and Figure 2 below show the world's gold production between 1972 and 1981 and 2005 alone respectively, comparing the major producers and regional production.

The dominant producing country for much of the 20th century was SA, which in the early 1970s was producing 1 000t per annum, representing over 70% of the world total at that time. "*This position has been eroded in the past two decades, however, as SA production has dropped (due in part to ageing mines and reduced flexibility because of depth), while other nations have expanded their output considerably*" (World Gold Council, 2006). Nevertheless, in 2005 SA remained the world's largest producing nation, with just over 296t and 12% of the total, but Australia was not far behind with almost 263t (10%), closely followed by the US with 262t. According to the article published in the Mining weekly, South Africa's gold mining industry produced 50 055t of gold between 1884 and 2004, accounting for 33% of all gold above surface (Comberge, 2006).

Figure 1: Simplified Geology and Selected Mineral Deposits

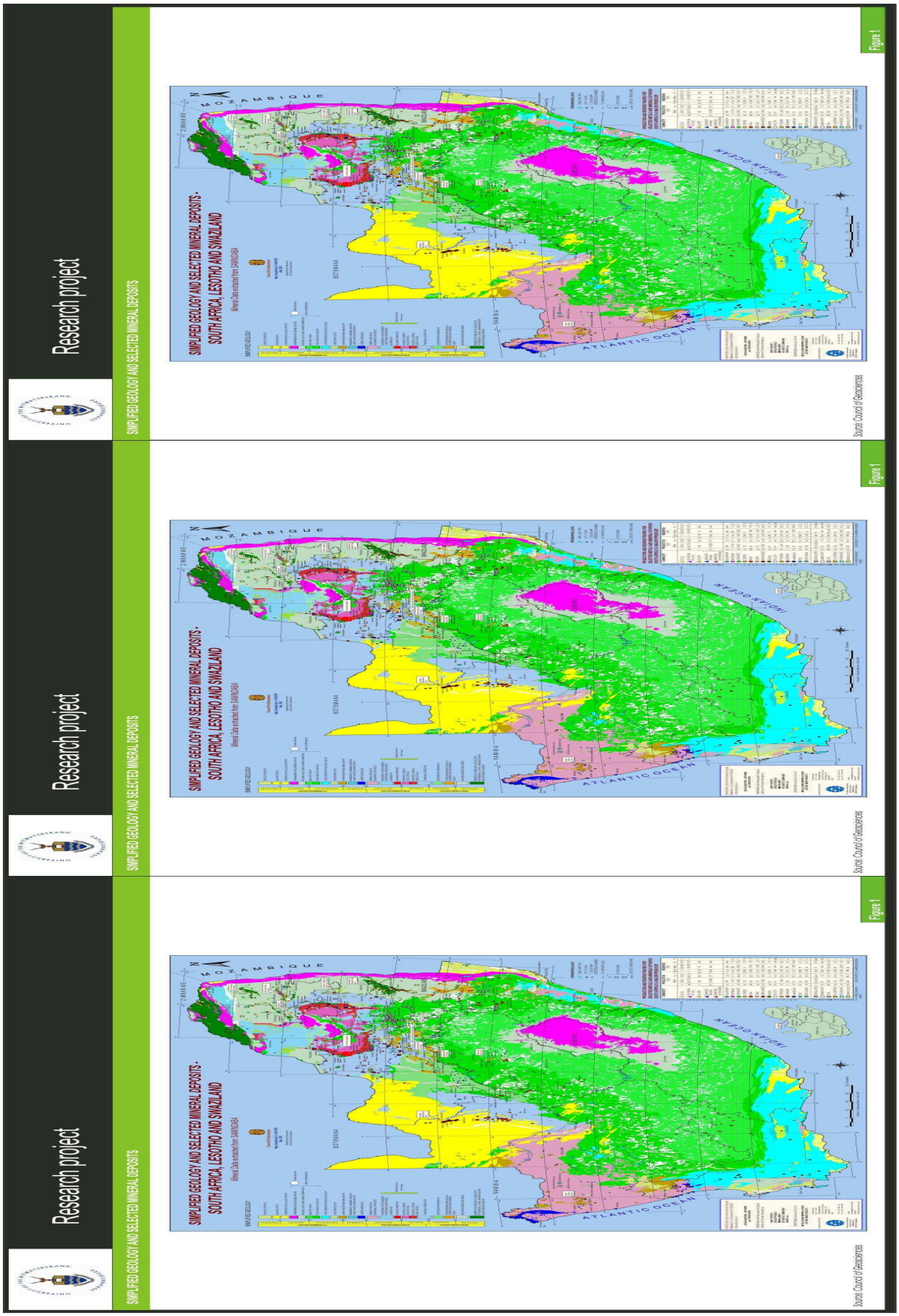

Table 1: SA role in World Mineral Reserves, Production and Exports

South Africa's Role in World Mineral Reserves, Production and Exports, 2001												
Commodity	**Reserve Base**				**Production**				**Exports**			
	Unit	**Mass**	**%**	**Rnk**	**Unit**	**Mass**	**%**	**Rnk**	**Unit**	**Mass**	**%**	**Rank**
Aluminium	kt	689	*	*	kt	662	2,7	8	kt	476	3,3	6
Alumino-silicates	Mt	51	37,4	1	kt	183	35,9	1	kt	130	45,9	1
Antimony	kt	250	7,8	4	t	4 827	4,3	3	t	7 588	46,0	1
Chrome	Mt	5 500	72,4	1	kt	5 502	37,0	1	kt	932	24,1	1
Coal	Mt	55 333	10,9	5	Mt	223	5,8	6	Mt	67	10,0	2
Copper	Mt	13	2,0	13	kt	142	1,1	13	kt	66	*	*
Ferro-chromium	-	-	-	-	kt	2 141	47,5	1	kt	1 867	49,5	1
Ferro-Mn/Fe-Se-Mn	-	-	-	-	kt	783	11,4	3	kt	616	24,2	1
Ferro-silicon	-	-	-	-	kt	174	2,9	6	kt	89	6,7	5
Fluorspar	Mt	80	18,2	3	kt	286	6,3	3	kt	259	11,8	4
Gold	t	36 000	45,7	1	t	395	15,2	1	T	383	*	*
Iron Ore	Mt	1500	0,9	9	Mt	35	3,5	9	Mt	24	4,3	4
Lead	kt	3 000	2,3	5	kt	51	2,7	13	kt	50	4,7	11
Manganese	Mt	4 000	80,0	1	kt	3 266	19,9	1	kt	1 528	21,0	1
Nickel	Mt	12	8,1	6	kt	36	2,9	11	-	*	*	*
PGMs	t	62 816	55,7	1	kg	228 747	50,5	1	kg	193354	*	*
Phosphate Rock	Mt	2 500	5,3	4	kt	2 420	1,9	9	kt	555	1,9	9
Silicon Metal	-	-	-	-	kt	39	2,9	7	kt	41	6,5	5
Silver	kt	10	*	*	t	110	0,6	18	-	*	*	*
Titanium Minerals	Mt	146	20,7	2	kt	1 090	22,8	2	t	170	4,3	5
Uranium	kt	284	9,1	4	t	1 065	2,5	9	-	*	*	*
Vanadium	kt	12 000	44,4	1	kt	25	57,9	1	kt	18	71,3	1
Vermiculite	Mt	80	40,0	2	kt	157	33,6	1	kt	154	94,9	1
Zinc	Mt	15	3,5	5	kt	61	0,7	25	kt	12	0,3	19
Zirconium	Mt	14	21,1	2	kt	262	28,1	2	kt	289	51,7	1

Source Chamber of mines

Figure 2: World Gold Production by Region

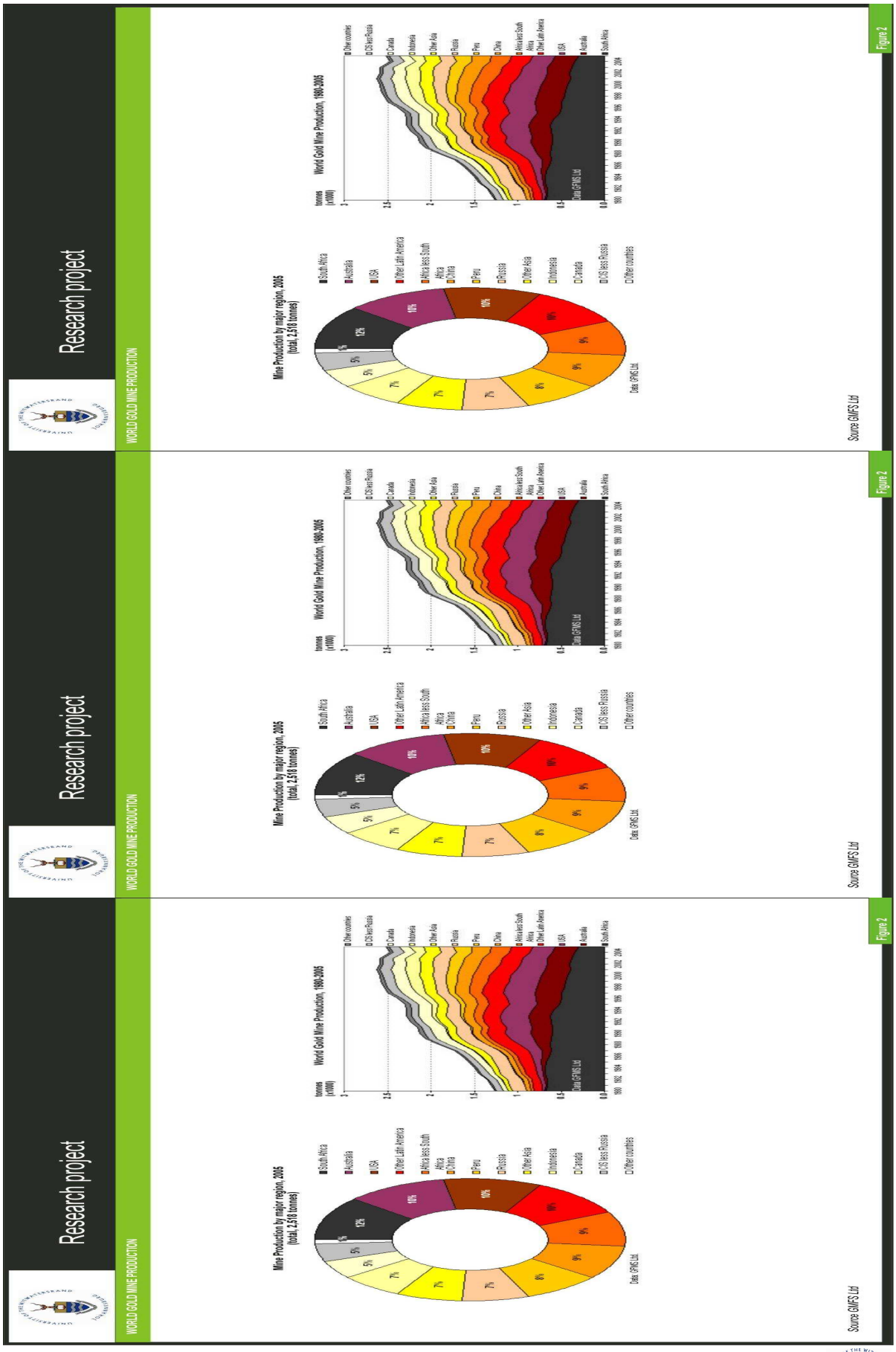

Table 2: World's Gold Production 1972-1981

WORLD'S GOLD PRODUCTION 1972-1981(METRIC TONS)										
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
South Africa	**909.6**	**855.2**	**758.6**	**713.4**	**713.4**	**699.9**	**706.4**	**705.4**	**675.1**	**657.6**
Canada	64.7	60	52.2	51.4	52.4	54	54	51.1	50.6	49.5
U.S.A	45.1	36.2	35.1	32.4	32.2	32	30.2	30.2	27.6	40.6
Other Africa										
Ghana	22.5	25	19.1	16.3	16.6	16.9	14.2	11.5	12.8	13.6
Zaire	2.5	2.5	4.4	3.6	4	3	1	2.3	3	3.2
Zimbabwe	15.6	15.6	18.6	18.6	17.1	20	17	12	11.4	11.6
Other	1.7	1.7	1.5	1.5	1.5	1.5	2	2.5	8	12
Total Other Africa	**42.3**	**44.8**	**43.6**	**40**	**39.2**	**41.4**	**34.2**	**28.3**	**35.2**	**40.4**
Total Latin America	34.8	35.2	36.9	41.8	55	55.9	37.7	66.6	85.9	96.1
Total Asia	32.7	30.3	27.7	26.5	27.1	30.1	30.7	29	31	34.4
Europe	13.2	14.3	11.6	11	11.4	13.2	12.5	10	8.6	8.5
Total Oceania	39.4	40.3	38.9	36.4	38.2	43.3	44.6	39	32.3	34.5
Non-communist World Total	**1,181.80**	**1,116.30**	**1,004.60**	**952.90**	**968.90**	**969.80**	**975.30**	**959.60**	**946.30**	**961.60**
SA's contribution	77%	77%	76%	75%	74%	72%	72%	74%	71%	68%

Source: Chamber of mines of South Africa Statistical tables 1981 pp15

2.3 Mining's Contribution to the Economy

The mineral discoveries had a major impact on the subcontinent as a whole. A railway network linking the interior to the coastal ports revolutionised transportation and energised agriculture. Coastal cities such as Cape Town, Port Elizabeth, East London and Durban experienced an economic boom as port facilities were upgraded. Hence the mining industry has been called the backbone of the SA's economy. The contribution of the mining industry to the entire economy is highlighted in the following sub-sections.

2.3.1 Development of Mining Related Industries

Since the discovery of the world class deposits in the 19th century, mining has continued to play an important and crucial role as the foundation of growth and development in the country. However, the existence of these world class deposits and reserves has attracted the world mining giants in gold, platinum, diamond, chromium and base metals. The need for technical and engineering expertise to solve and improve productivity in these mining houses and their different operations has lead to the development of new skills, knowledge, technological development and innovation. One of the developments that the SA mining industry is proud of, is that they operate the deepest mines with the least fatalities in the world.

Using mining activities as the base, SA has nurtured strongly competitive sectors providing sophisticated inputs and services to the global mining industry. With experience and knowledge acquired over a century of mining, South African firms have claimed a position as a global centre of mining technology, specialist services and supplies. Hence these firms have become prominent in basically three areas:-

- Mining technology providers;
- Provision of knowledge-based services and supplies; and
- Specialist mining contractors and consultancies.

These firms are among the world leaders in mining explosives, drilling equipment and abrasives, metallurgical processes and plants, and delivering knowledge-based services to mines globally. In simple terms it can be said SA is one of the “mining technology base” and hence a good training ground for mining experts.

For instance, AECI and Sasol are the leading suppliers and manufacturers of mining explosives, Boart International is a world leader in abrasives and South African mining consultancy firms SRK, Bateman and MSA are among the most renowned mining consultancies in the world.

The JSE to be ranked among the top ten largest stock exchanges in the world had its foundations laid on this mining industry and the associated upstream and downstream activities. A century of the learning curve has led to a well developed stock exchange, financial, legal, communications, energy and transport sectors. These sectors are comparable to the first world nations, in terms of modernisation and technological sophistication.

Mining activities have led to the establishment of big towns for example Johannesburg directly translated as “Egoli”- meaning a place of gold, derived from one of the world’s largest gold reserves in the Witwatersrand Basin. It is clear that the sector from which the mining industry draws the bulk of its supplies is all heavy industries- for example chemicals, metal fabrication, ‘special industrial machinery’ and so on. This has obviously been one of the resulting interlinkages created from the mining industry. Basically the mining industry has facilitated the creation of a successful heavy engineering and industrial chemical sector which otherwise would not have been viable. Other important business linkage of mining includes the forestry, energy and transport sectors.

The contribution of mining to the economy must be seen as coming not only from mining operations but also from upstream and the downstream activities that are indirectly or directly linked to the mining activities. Indeed, mining constitutes what is surely the most successful ‘cluster’ in the country’s economy.

2.3.2 Foreign Currency Earning

Mining continues to be one of the country’s most important earner of foreign currency, totaling 41% of total exports in the 90’s. Even though in recent years, the relative importance of mining’s contribution in percentage terms is declining (54%in the 1970’s to 41% in the 1990’s), mining remains the critical and strategic foreign currency earner in SA. According to the figures released by the governor of the SARB, Mr Mboweni reiterated that the “exports of Gold have receded from 51% of total visible exports in 1980 to 9.4% in 2004”.

This clearly shows that the commodity has already played its part in transforming South African economy from a country depending on primary industries into a more

developed economy. “The industry, for example, has been a crucible for the creation of an advanced financial sector and also given birth to three of the six largest gold-mining companies in the world – Anglo Gold Ashanti, Goldfields and Harmony” (Cromberge, 2006).

Table 3: Contribution of different sectors in foreign currency earning

SECTOR	AVERAGE FOR DECADE		
	1970s %	1980s %	1990s %
Agriculture and Forestry	6.9	3.5	4.2
Mining	54.0	61.3	40.9
Manufacturing	24.6	23.6	40.3
Electricity, Gas & Water	0.1	0.1	0.1
Construction	0.0	0.0	0.0
Services	14.4	11.5	14.3

Source: Statistics South Africa

These statistics undervalue the contribution of the mining sector to export earnings. This is because beneficiated products that are directly produced from minerals are not included as being produced from the mining sector. For instance mineral products such as ferroalloys and aluminium, if these were included, the mining sector’s contribution to exports would be around half of all exports.

2.3.3 Mining contribution to the GDP

Mining still contributes significantly to the value added in the South African economy in terms of the GDP. For instance the proportional contribution of the mining sector to total value added in the economy has declined from 13.9% in 1975 to 9.9% of the private sector’s GDP in 1998 and shown in Table 4 and Table 5.

Table 4: Percentage contribution of sectors to the GDP

SECTOR	1975	1980	1985	1990	1995	1998
Agriculture, Forestry & Fishing	5.4	5.7	5.4	6.1	5.3	6.4
Total Mining	13.9	13.3	13.0	11.3	10.5	9.9
Total Manufacturing	30.1	32.8	29.4	29.6	29.3	28.3
Electricity, Gas & Water	3.1	3.6	4.6	5.1	5.6	5.9
Building & Construction	6.3	5.0	4.4	4.0	3.4	3.3
Services	41.1	39.6	43.2	43.9	45.9	46.3

Source: SA Reserve Bank

The decline in relative importance of mining to aggregate output is consistent with international patterns of economic development. It is what the mining houses, economists and governments of the day have envisaged should happen as the country develops to a manufacturing and services based economy. What emerges from comparative studies is that for countries with higher per capita GDP the share of primary activities in the economy becomes lower and the share of manufacturing and services higher. Cawood (2005) highlighted the reason for the conversion of an economy from primary industry driven to secondary industry driven as follows:- “*because minerals are wasting assets it is necessary to compensate for the loss of mining’s contribution to the economy by steadily growing the manufacturing industry and ultimately, converting economic sectors from being commodity-based to becoming knowledge-based.”* In this light a declining primary sector

reflects a typical transformation of an economy in the course of economic development. Most importantly such transformation and economic development, has been primarily driven by the primary industry and related industries.

However, Figure 3 above shows that this transformation has not happened in SA, “since the manufacturing industry’s contribution to the economy follows the same declining trend as mining, which could spell some degree of ‘Dutch Disease” for the future SA”.(Cawood, 2005) To prevent this trend to progressively continue happening, government intervention is required urgently through implementation and enactment of appropriate policies and legislation to foster the development of the secondary and tertiary industries in the economy.

2.4 Summary

The mining industry in SA was and still is one of the most important sectors in the economy, as demonstrated in this chapter. This sector has been the mainstay of economic growth and development for more than a century, hence the importance that is placed on this industry. Over the years the need for proper and efficient regulation and public reporting of the mining activities has led to the development of mineral resources and mineral reserve classification systems and definitions. This was aimed to bring common interpretation and understanding in the estimation classification and public reporting these mineral assets to the interested stakeholders in the global industry. The development of the different such classification systems will be discussed in detail in the next chapter.

Table 5: Annual Value Added by Industry and GDP at Current Prices

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ANNUAL VALUE ADDED BY INDUSTRY AND GROSS DOMESTIC PRODUCT AT CURRENT PRICES

Industry	1998	1999	2000	2001	2002	2003	2004
Agriculture, forestry and fishing	24,686	26,213	27,451	26,558	28,292	27,700	27,223
Agriculture	19,952	21,350	22,412	21,469	23,187	22,643	22,478
Forestry	4,130	4,257	4,406	4,430	4,435	4,331	4,007
Fishing	604	606	633	659	670	726	738
Mining and quarrying	65,011	64,116	63,391	63,325	63,927	66,502	88,356
Coal	12,061	11,950	12,069	11,962	11,776	12,554	13,000
Gold	18,405	17,809	16,949	15,616	15,674	14,784	13,483
Platinum group metals	15,164	16,417	15,681	17,348	17,946	19,979	21,536
Other metal ores	13,214	12,120	12,839	12,407	12,489	12,622	12,861
Other mining and quarrying [1]	6,167	5,819	6,053	5,993	6,043	6,563	7,475
Primary industries	**89,697**	**90,329**	**90,842**	**89,883**	**92,219**	**94,202**	**95,579**
Manufacturing	146,336	147,179	159,106	164,131	168,729	166,405	174,036
Food, beverages and tobacco	24,007	23,206	24,614	25,582	26,094	24,990	25,889
Textiles, clothing and leather goods	7,840	7,551	7,793	7,503	8,108	7,919	8,570
Wood and paper; publishing and printing	16,196	15,915	16,839	16,605	16,614	16,381	17,430
Petroleum products, chemicals, rubber and plastic	31,055	33,692	38,222	40,140	39,550	39,478	40,714
Other non-metal mineral products	5,371	4,869	4,900	4,989	5,470	5,446	5,590
Metals, metal products, machinery and equipment	29,279	29,116	30,313	30,875	34,777	34,456	35,833
Electrical machinery and apparatus	4,653	4,845	5,204	5,133	5,079	5,084	5,097
Radio, TV, instruments, watches and clocks	2,176	2,043	2,098	1,822	2,020	2,116	2,208
Transport equipment	11,929	12,200	14,380	16,134	15,925	15,271	16,349
Furniture, other manufacturing [1]	13,830	13,742	14,743	15,348	15,092	15,264	16,356
Electricity, gas and water	22,206	22,097	22,788	21,956	22,722	23,151	23,698
Electricity and gas	18,945	18,737	19,431	18,730	19,514	19,960	20,712
Water	3,261	3,360	3,357	3,226	3,208	3,191	2,986
Construction	20,260	19,985	21,114	22,154	23,441	25,053	27,725
Secondary industries	**188,802**	**189,261**	**203,008**	**208,241**	**214,892**	**214,609**	**225,459**
Wholesale and retail trade; hotels and restaurants	105,518	113,553	122,705	125,017	127,870	136,138	143,931
Wholesale trade	34,744	36,917	39,610	40,299	40,329	41,885	43,612
Retail trade; repairs of household goods [1]	49,594	54,137	59,113	59,987	62,032	66,720	70,017
Motor trade; repair of motor vehicles	13,000	14,277	15,490	16,121	16,306	17,890	19,888
Hotels and restaurants	8,178	8,220	8,490	8,608	9,201	9,641	10,412
Transport, storage and communication	70,983	74,705	80,873	85,646	93,390	98,864	103,380
Transport and storage [1]	45,655	47,064	50,004	52,024	54,082	57,783	61,800
Communication	25,328	27,641	30,869	33,622	39,308	41,081	41,580
Finance, real estate and business services	144,074	151,437	156,253	169,015	179,623	187,062	201,170
Finance and insurance	57,898	65,165	68,648	77,354	83,818	87,530	99,760
Real estate	52,934	52,305	51,694	51,899	53,153	53,233	52,827
Business Services [1]	33,242	33,967	35,911	39,762	42,652	46,299	48,583
General government services	135,560	134,403	133,158	131,914	133,054	134,915	136,376
Central government [2]	49,647	48,445	47,303	46,093	46,352	47,071	47,587
Provincial government [2]	68,123	67,949	67,560	67,189	67,469	67,779	68,081
Local government [2]	17,790	18,009	18,295	18,632	19,233	20,065	20,708
Personal services	47,194	49,020	51,382	52,537	53,852	56,073	56,841
Tertiary industries	**503,329**	**523,118**	**544,371**	**564,129**	**587,789**	**613,052**	**641,698**
All industries at basic prices	**781,828**	**802,708**	**838,221**	**862,253**	**894,900**	**921,863**	**962,736**
Taxes on products	86,763	86,376	87,816	89,119	91,576	93,967	98,498
Less: Subsidies on products	3,623	3,719	3,886	3,999	4,149	4,274	4,463
GDP at market prices	**864,968**	**885,365**	**922,151**	**947,373**	**982,327**	**1,011,556**	**1,056,771**

1 Includes estimates of the informal sector.
2 Not available prior to 1998

Source: Http://www.statssa.gov.za/publications/publicationsearch.asp?PN=fquur&PM=&PY=&PS=1

Table Y

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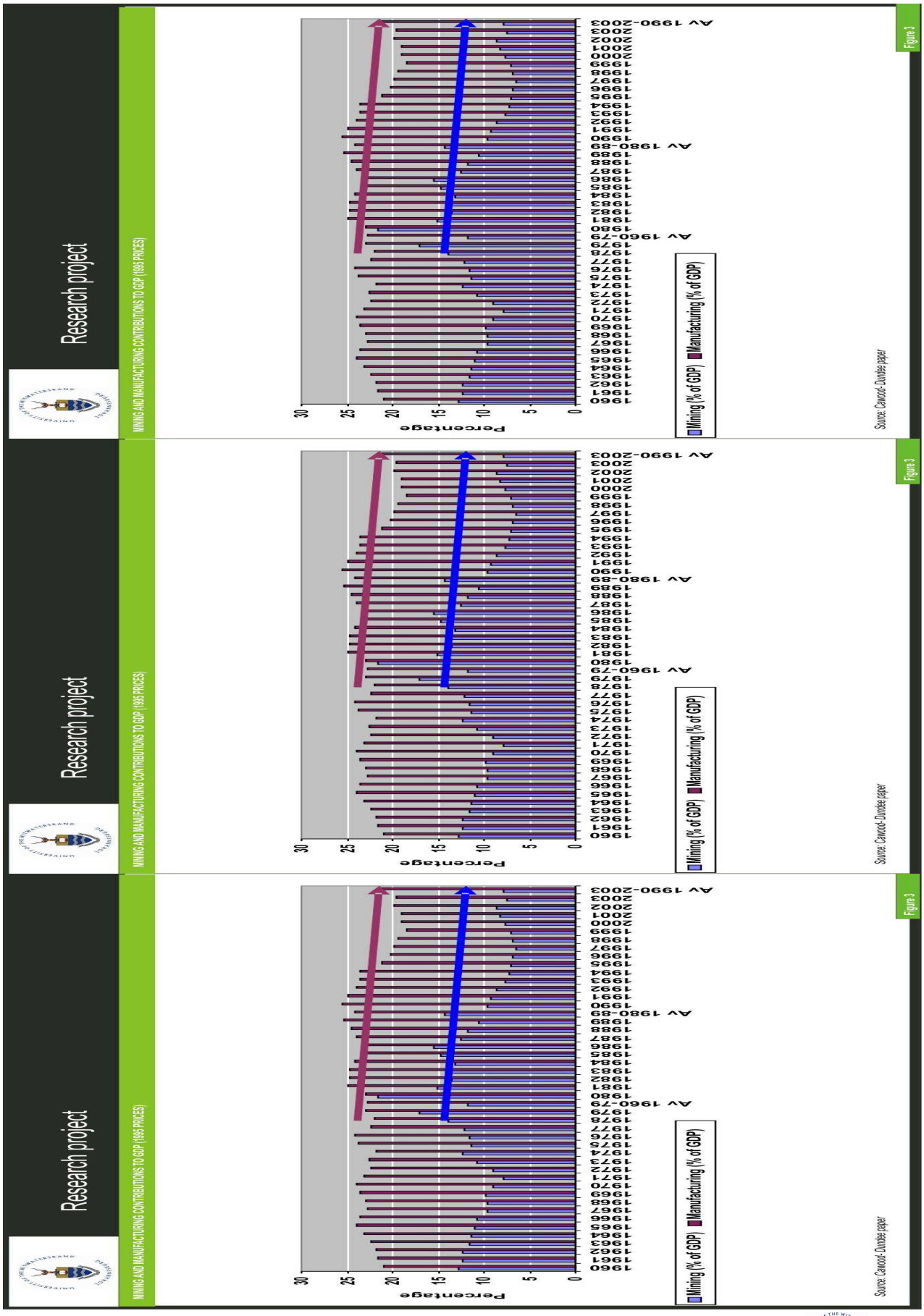
2 Not available prior to 1998

Source: Http://www.statssa.gov.za/publications/publicationsearch.asp?PN=fquur&PM=&PY=&PS=1

Table X

Figure 3: Mining and Manufacturing Contributions to GDP (1995 Prices)



CHAPTER THREE

3 MINERAL ASSET AND RESOURCE CLASSIFICATION SYSTEMS

The chapter will explore the definition of a mineral asset and the different classification system used in the extractive industry to categories mineral resources and mineral reserves. The fundamental requirement for a mineral property to be classified as an asset is the ability to generate positive cashflow for the organisation involved in the extraction and processing of this mineral resource. For a mining or exploration company the mineral resources and the mineral reserves are the most valuable element of the mineral asset and this forms the basis of value of a mining company. Therefore, the major classification systems that have been developed world-wide, over the years were discussed in detail in this chapter. These classification systems were used for the classification of the mineral resources and mineral reserves depending on the geological confidence, feasibility and economic viability.

3.1 Mineral Asset

According to the IFRS *an "asset" is defined "as being an economic resource controlled by the enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise"*. (AC 000.49)(GAAP,2003). Assets are economic resources used to carry out an enterprise's normal business activities. The primary characteristic of an asset is the future economic benefit which eventually results in net cash inflows to the enterprise. Based on the same framework as the IFRS definition of an asset, a mineral asset should satisfy the following criteria for it to be recognised as an asset in financial statements:-

- minerals are a concentration of materials of economic interest in or on the earth's crust in such a form, quality and quantity that there are reasonable prospects for eventual economic extraction, hence future economic benefits are expected;
- legal right to the minerals and the implied rights of legal and/or economic ownership as provided for in chapter 4 of the MPRDA No 28 of 2002 (the future economic benefits should be within the control of the enterprise); and
- it should be recognised as a result of the past event i.e. application and granted with the mining or prospecting right, exploration.

An asset in the 1993 SNA, in paragraph 10.2 was defined as: "*The assets recorded in the balance sheet of the system are economic assets. These are defined as entities:-*

- *Over which ownership rights are enforced by institutional units, individually or collectively; and*
- *From which economic benefits may be derived by their owners by holding them or using them over a period of time"*

There are basically two types of ownership of assets namely:-

1. Legal ownership – the legal owner of an asset is the enterprise entitled in law and sustainable under the law to claim the benefits associated with the asset.
2. Economic ownership – the economic owner of an asset is the enterprise which is

entitled to claim the benefits associated with the use of an asset in the course of economic activity by virtue of accepting the associated risks.

For an entity to claim that they have an asset in their hands, they should have either both types of ownership or at least one. For it to be an asset there, is need for certainty in the inflow of economic benefits from the ownership but also there are risks associated with the asset. "*It should be noted that legal ownership of an item is not essential for its recognition as an asset; the right to future economic benefits is a requirement for asset recognition and providing the enterprise control of these benefits, then a right to use an item is classified as an asset*" (AC 0057) (GAAP,2003).

"Similarly, physical form is not essential to the existence of an asset that is patents, mineral rights and copyrights, for example, are regarded as assets if future economic benefits are expected to flow from them and they are controlled by the enterprise" (AC 00056) pg 9. With the introduction of the MPRDA No 28 of 2002, the government claims legal custodianship of all mineral rights on behalf of the community at large. The objectives of the Act are to give the state the sole custodianship of the South Africa's mineral wealth by changing the mineral rights system, so that all minerals rights are effectively state-owned and it is only the state that has the authority in the granting of legal rights on mineral and petroleum properties. This is provided for in section 2 (a & b) of the same Act.

According to the above explained framework on the definition of an asset, under the new mineral rights system a mineral asset can only be recognised as such, only when the Minister of Minerals and Energy have granted you the legal rights of the property. This property can then be recognised as an asset in the hands of the holder of the permit. All the three requirements for the item to be recognised as an asset will have been satisfied.

Based on the definition of an asset described above, a mineral asset can be defined as *"a naturally occurring, homogeneous substance having a definite characteristic chemical composition and physical properties, formed or deposited in its present position through natural agencies alone, and which are located on or below the earth's surface and that are economically exploitable now or in the foreseeable future with the existing technology".* In addition subsoil assets are defined in the 1993 SNA (p 309) as "*proven reserves of mineral deposits located on or below the earth's surface that are economically exploitable, given current technology and relative prices… Subsoil assets consist of coal, oil and natural gas reserves, metallic mineral reserves and non metallic reserves…"* In conclusion, using the same framework as the one used by IFRS on the definition of an asset, a mineral asset should satisfy the following:-

a) Minerals are a concentration of material of economic interest in or on the earth's crust in such a form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction (provision of future economic benefits).

b) Legal right to minerals and implied rights of ownership as provided for in chapter 4 of the MPRDA (reconnaissance permission, prospecting right and mining rights etc).The new system of ownership was also illustrated in the royalty bill that is based on the principle that SA's mineral rights belong to the nation and can only be leased by private companies for the right to exploit the resources;

c) It should rise as a result of the past event that is pre-production expenses costs of exploration, application of rights and feasibility studies and the knowledge arising from such activities; and

d) Individually identified purchases and self-constructed assets such as draglines, processing plants, shafts etc.

3.2 Mineral Asset Classification

The classification system that is applied for mineral assets/property depends largely of measure on the quantity and quality of data available about the project. The quantity and quality of geological, and mining information would determine the confidence that can be assigned on the ore body/deposit for eventual economic extraction. All this would be summed up to determine the stage of development for the property in the mining life cycle.

The author identified that there are four main classifications of mineral property or assets and these include:-

a) **Speculative properties** – these are deposits or prospects which have been recognised for a mineral of interest but the level of geologic information, measurement and confidence remains very low. That is to say very little/no work has been done to establish continuity and confirmation of the mineralisation;

b) **Exploration properties**- these are mineralisation where a slightly greater geologic confidence than the speculative properties has been established as a result of the exploration techniques identified as appropriate and used for the type of mineral being prospected e.g. for iron ore: aeromagnetic surveys. The level of geological information, measurement and confidence remains low on such properties but have shown enough potential that expenditure for a detailed exploration program is warranted. The other side might be that the economic forecasts indicate that development of the deposit is not economically viable at the present time due to market conditions and the available technology;

c) **Development properties** – these are properties that are the outcome of a successful exploration programme, where reserves have been measured and favourable economic studies have either been completed as construction has commenced in an effort to bring the project into production. Such properties have mineral resources estimated with some level of confidence and some feasibility studies (technical and economic evaluation) have been carried out and have reveal that its viable to develop the property into a mine; and

d) **Producing property** – are properties and assets that are in operation, which have a production history, substantial reserves or identified resources, and a capital and operating cost structure is in place. The geologic information and measurement are known with high level of confidence and certainty. Since the assumptions made in the economic or feasibility studies have been tried and tested in real mining operation in that peculiar geologic conditions. Hence this is less risk than all the other mineral property classifications.

Figure 4 is a schematic diagram that shows the different types of mineral property and the type of permission or permit that has to be granted according to the provisions of the MPRDA and the value profile of the mineral asset as the geological confidence level increases. Historically, a

value was attached to the individual component that makes a mineral asset (cash generating unit) this include the value on the mining right, NPV for the advanced projects and the Rand per hectare was used for the valuation of the speculative and early project. The classification of mineral property is not discrete; therefore there are various overlaps between the classifications described above. Hence in certain circumstances it will be difficult to draw a line between any two classes.

A certain school of thought say "*All assets appear on the balance sheet of the enterprise*". This, together with the requirement that the asset entail future benefits, implies that all assets can be represented by a monetary value. This value represents the markets view of the total of the benefits embodied by the asset. The next subsection will envisage how the value of the mineral asset can be established.

3.3 Valuation of Mineral Asset

In mining, valuation is the process of determining the value or worthness of a mining property. Mineral property classification and the purpose of the valuation will generally determine the valuation approach to be adopted for a specific property. Generally, a range of valuation approaches are applicable to different assets in different stages of development, these approaches have to meet the requirements of the international valuation codes recognised in the extractive industry such as the VALMIN, CIMVAL,IVSC, IASB and the draft SAMVAL Code. These approaches include:-

- cost approach;
- market comparable approach;
- income approach;
- discounted cash flow analysis, and option pricing techniques; and
- combinations of the above approaches

The above mentioned valuation approaches are used in the valuation of mineral assets and this is done using one or more of these types of models:-

1. **Relative value models** - these models determine the value based on the market prices of similar assets even though in the extractive industry the assets are unique, but approximate comparable assets are used.
2. **Absolute value models**- these models determine the value by estimating the expected future earnings from owning the asset discounted to their present value (DCF analysis).
3. **Option pricing models** - are used for certain types of financial assets (options) and are a complex present value model.

In an efficient market, the value of the mineral asset should be the fair market value. The fair market value is defined as the price an item would sell or exchange hands between a willing buyer and willing seller assuming they both have knowledge of the relevant facts and they have no compulsion to buy or sell. Fair value is used in different contexts and has multiple meanings. Some people use the term to mean the same thing as fair market value. Fair value is also a term used in accounting and law. It is used in GAAP for financial reporting and in law in shareholder rights legal statutes. Fair

value may be different than fair market value in the accounting and legal contexts. Intrinsic value is an asset's "true" value regardless of the market price and this maybe very subjective because it might be a matter of personal opinion and varies among individual analysts.

In the valuation of mineral assets and mining rights, mineral asset valuers integrate their activities with other specialists in an effort to consider the knowledge and information available and apply the above mentioned models and approaches, to determine a professional opinion on the value of a mineral asset. The specialised disciplines include geology, geostatistics, mine engineering, metallurgical process engineering and environmental sciences to define the economic basis and attributes of each mineral bearing land parcel. A detailed examination of the technical circumstances peculiar to the ore body and constraints relating to the mineral asset factoring in and combined with the realities of realistically achievable parameters in operational economics, metals marketing and commodity pricing form the basis for the development of sophisticated financial model that evaluate and determine the value of the mineral asset.

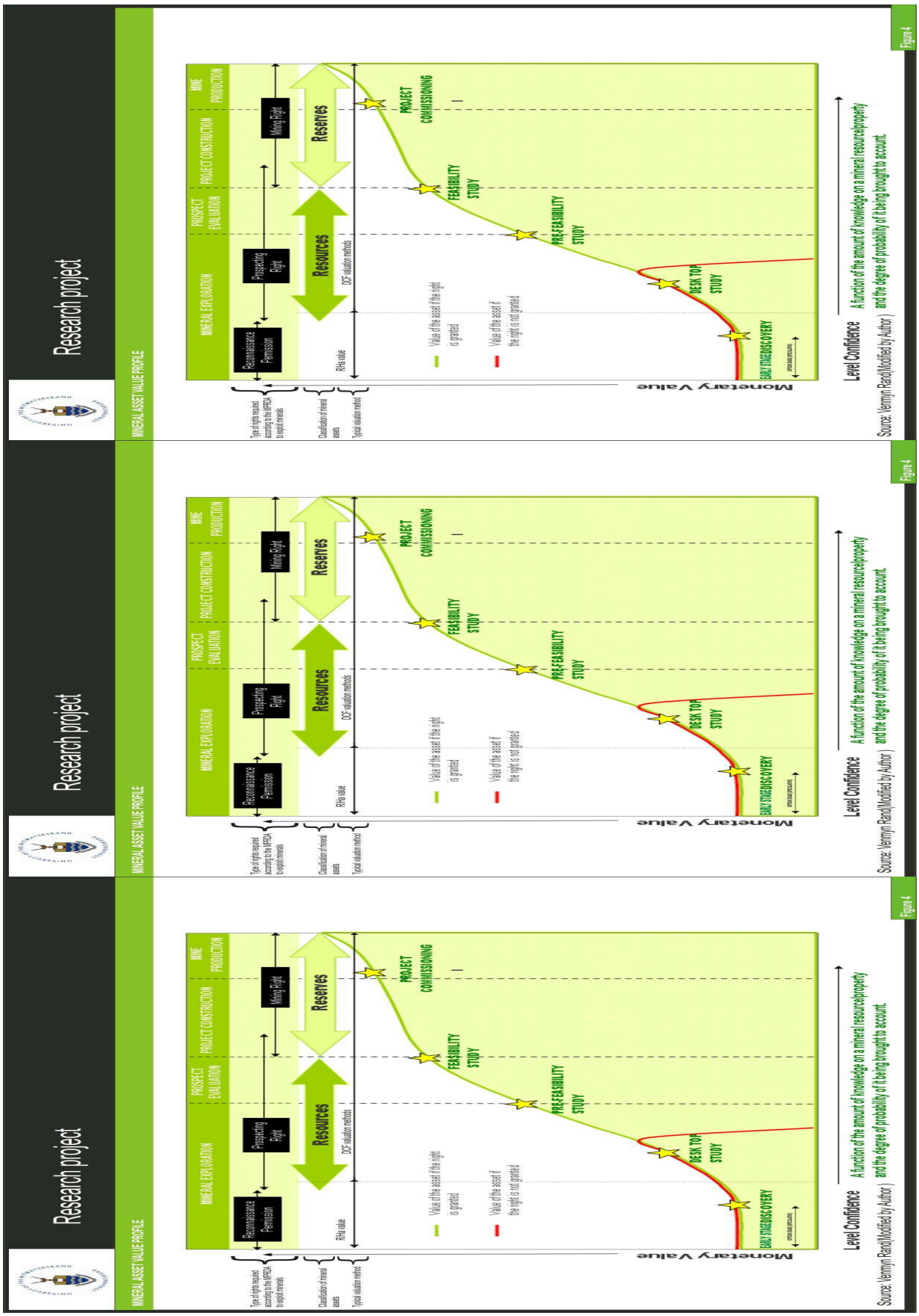
3.3.1 Theory of Mineral Asset Valuation

The factors involved in the valuation of a mineral asset are so complex and include inherent uncertainty in the estimation of parameters used in the valuation. A classic example would be the shape and attributes of an ore body that can only be known with certainty after the ore body has been mined out. The value of the asset depends mainly on the amount of ore, its grade and the geologic confidence attached to these estimates and the economic modifying factors. Baxter and Parks (1933), defined the value of a mineral asset as follows "*a mineral property has a definite value only by virtue of its ability to produce a profit over a term of years*". And Hoover (1933) defined the value of a mineral asset as "*the process of estimating future profits, and here as elsewhere, prophecy is dangerous. However, if the engineering method is applied with care and intelligence, an approximation may be made that will place the value of the mine within certain rather wide, but definite, maximum and minimum limits".*

Based on the theory of mine valuation suggested by Hoover in 1933, it was suggested that the ore in the mine must ultimately pay for the following:-

1. Purchase price;
2. Development of the deposit;
3. Plant and equipment;
4. Costs of operation and treatment;
5. Interest on the money invested; and
6. Profit to the organisers and investors

Figure 4: Mineral Asset Value Profile



It surprising that in the recent years the environmental and the social is being given more emphasis especially in SA through the enactment of the MPRDA, BEE, where the labour, social and environmental plans are a prerequisite before granting the new mining right. This have an impact on the value of the mineral asset since it is an additional cost to mine development and operating mines. But the concept of considering the social issues is not new since it was suggested by Agricola as early as 1556. Georgius Agricola, the author of the 1556 De Re Metallica, is quoted by Crowson (2003, p59) as writing "*now a miner, before he begins to mine the veins, must consider seven things, namely: the situation, the conditions, the water, the roads, the climate, the right to ownership and the neighbours."* Since then no one realised the importance of the social and other soft issues in the valuation of a mineral asset.

Over four centuries later Agricola advise is still pertinent, although new factors of concern have arisen as suggested by Crowson, formely chief economist at Rio Tinto, "*believes there are eight preconditions for mineral exploration investment, namely favourable geology to host mineral deposits, political and social stability, a clear and enforceable mining code, guaranteed property rights, an appropriate administrative and legal framework, a satisfactory tax regime, the transferability of dividends and income, and reasonable exchange rate stability*" (Otto,2006)

The same theory or principle, have been developed over years and was redefined by Davis (2002) as follows: "The value of a mineral asset regardless of the property type equals the total value of its recoverable in-ground reserves less the installed capital cost associated with recovering the mineral from the ground". One can subjectively divide the mineral asset's total value between the two types of assets, typically deducting the cost of installed capital (e.g. cost of development and production) from the total asset value to derive the value of the extractable mineral. But such accounting is arbitrary since the extractable mineral is worth nothing without the installed capital, and the installed capital is worth nothing without the extractable mineral. That is, "there is nothing inherently valuable about a drill hole, and so one cannot value it at cost especially when it adds no value to my property". Davis (2002).

A valuation principle applied to the mineral assets is that the deposit should have reasonable prospects of eventual economic extraction of the mineral for a profit. If the mineral asset is never expected to generate a cent, it has no value. Therefore it is the responsibility of the mineral resources manager to develop and identify portions of the resource that creates value for the shareholders. Then the mining plan is developed to extract these mineral reserves.

Valuing the extractive firm's position, or the mineral asset, the volatility of mineral price means that value will vary widely from day to day. In an interesting study of gold mining assets, Peter Tufano of Harvard University measured the sensitivity of gold company value to changes in gold price. He found that a 1% change in gold price typically caused a 2% change in mining company value. Gold prices are highly volatile, with daily changes of 1% or more is a common occurrence. In mineral asset valuation, therefore,

especially for purposes of public reporting and litigation, it is vital to establish a date on which the asset was valued, or to use the metal price forecast based on market's prevailing rates on the valuation date.

The quantity of ultimately recoverable reserves is only known upon permanent abandonment of the asset, and at the date of valuation the amount of mineral reserves is always uncertain. This provides a challenge for valuation, as not knowing the amount of mineral reserves means that the productive life of the asset must be estimated. Nevertheless, in order to perform a fundamental valuation, the mineral resources manager must have some estimate of the quantity of valuable material that can be extracted based on the technical and geological knowledge, experience of such deposits. The uncertainty surrounding the estimate of extractable reserve is called reserve risk. As illustrated graphically that the bottom base of the mineral asset valuation triangle is riskier than any other process in the valuation of a mineral asset as shown in Figure 5. All the sub-processes that follow depend on the results of the mineral resources and mineral reserve estimation that is done by the CP in compliance to the SAMREC code. The output of this section is a mineral resource and mineral reserve statement (public information) with mineral resources classified into different categories depending on the geologic confidence and some of the categories can the be converted to mineral reserves using the modifying factors. Because these values are used as the basis of value for a mining company, a small error that occurs at this stage would be cumulative in the process till it's a material misstatement at the end of the valuation process.

The next level takes the mineral reserve statement as an input into the mineral asset valuation process; this is carried out by the Competent Mineral Valuer in compliance with the SAMVAL (yet to be enacted). The estimate of the value of the mineral asset is the output of this section. The apex of the triangle would make us of the two outputs and produce a compliant Annual report or CPR that would be compliant to the IFRS, King II report and the JSE listing requirements.

The SAMREC/JORC code uses the terms Inferred Resources, Indicated Resources, and Measured Resources to indicate increasing geological confidence. For example Inferred Resources, is so uncertain and so unlikely to translate one for one into more certain reserves that no income projections can reasonably be made. This is not to say that these types of mineral resources have no value, but that their value is highly speculative, and are worth little per unit until upgraded to the indicated or measured categories through additional exploration work. The appropriate valuation approaches and methods applied depend upon the stage of exploration or development of the property. Therefore, in conclusion, the value of the mineral asset increases as the confidence and knowledge of the deposit increases *ceteris paribus* as shown in Figure 4. Hence the value of mineral reserves is much higher than the value of a mineral resource because of the uncertainty involved.

It is also very important to note that valuation is more an art than a science because it requires professional judgment:-

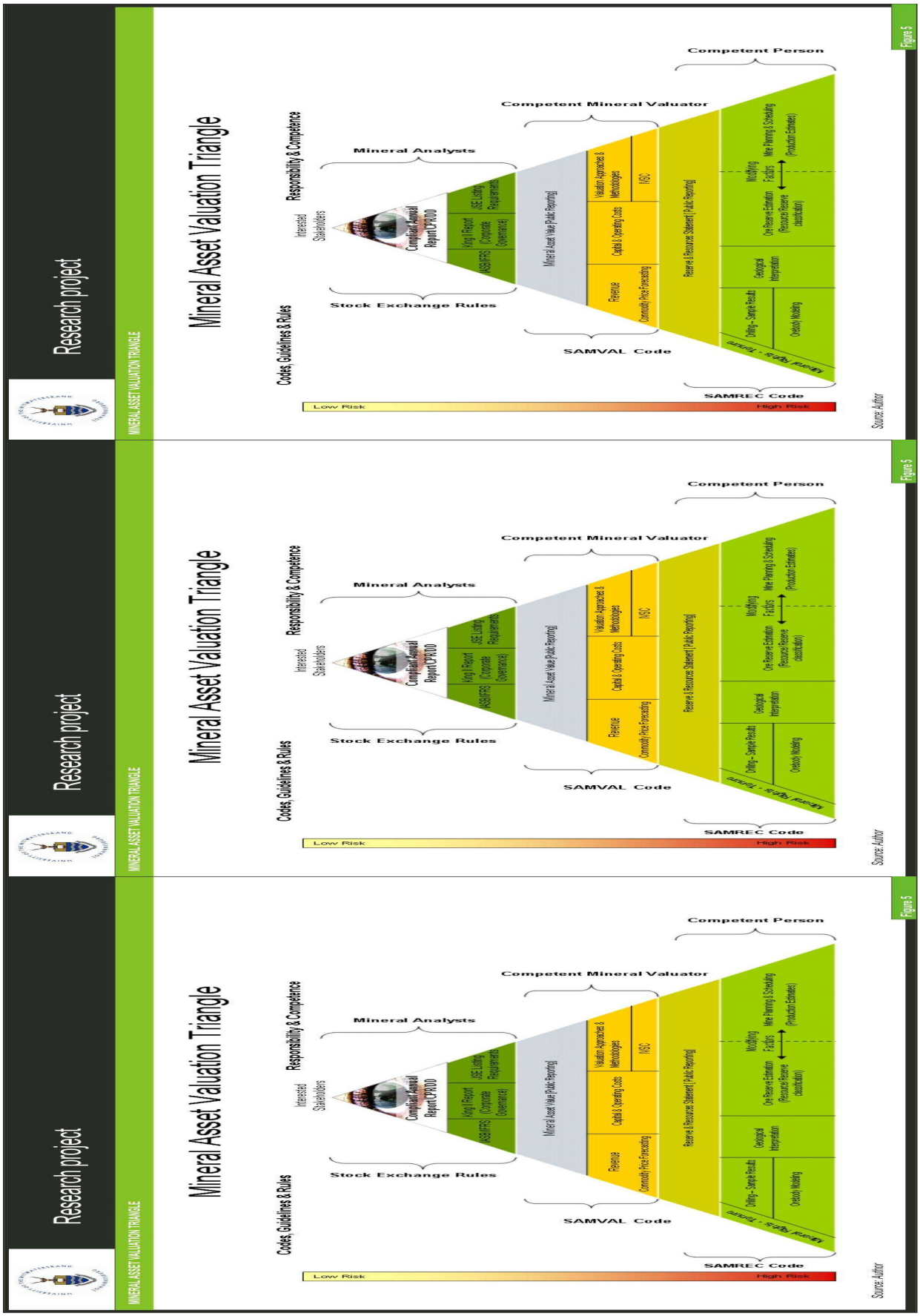
- there are very different situations and purposes in which mineral assets are valued. (e.g. company in distress, tax purposes, mergers & acquisitions, quarterly reporting). In turn this requires different methods or a different interpretation of the same method each time;
- all valuation models and methods have their limitations (e.g., mathematical, complexity, simplicity, comparability) and could be widely criticised. As a general rule the valuation models are most useful when you use the same valuation method and similar economic fundamentals resulting is a comparable valuation exercise. Usually the method used is industry or purpose specific; and
- In all valuation models there are a great number of assumptions that need to be made and things might not turn out the way you expect. The industry norm is that the CP should be able to explain and stand for each fair and reasonable assumption that they have incorporated in the valuation model to their professional peers.

When a valuation is prepared all assumptions should be clearly stated and the greatest challenge for the mineral asset valuator is to consider all the above mentioned inputs, principles and concepts that have to be inbuilt into the valuation model to come up with the value of the asset, yet all these items are subject to a certain degree of uncertainty. And there are no two mines that are exactly alike and since the circumstances of each sale may differ widely, these problems vary for each and every project. In short, it is necessary that during mineral asset valuation, to assess both the physical characteristics of mineral asset, the social and political feasibility of mining them and the potential profitability of extracting and marketing them before a value can be attached to a mineral asset.

3.3.2 Purposes of Valuations

Cawood (2004) identified that “the purpose of mineral property valuations in South Africa can be grouped under two main headings, namely those required by industry and those dictated by government policies”. “Mineral assets are valued for a diversity of reasons, and hence no simple mathematical formula or recipe can be used without critical appraisal of the specific situation at hand”. (Van der merwe, 2006). In this research both groups will be considered but more emphasis will be on the industry’s and general stakeholders perspective. The complexity of valuing mineral assets is as a result of uncertainty associated with the mineral asset and the facts that there are no two deposits that are identically the same, hence market comparison is subjective. Because of this fact there is no way a general valuation model can be built to cover for all situations, since each project or asset is unique in its own respect.

Figure 5: Mineral Asset Valuation Triangle



Therefore the extractive industry's market is an inefficient market, resulting in the fact that the valuation results may be different for the same asset because of the difference in the purpose for which the valuation is being carried out for. This could be because of the imperfect information about the mineral asset that the different stakeholders have. It is clear that mineral asset valuations are performed for a number of purposes as highlighted below and depending on the purpose of the valuation, the results may be different. This is as a result that of the complexity of factors influencing the valuation and the weighting applied by the valuator to each contributing factor. This weighting is subjective and at the discretion of the valuator's professional judgment. Hence the value differs depending from which perspective you are looking from and in whose hands and therefore for what purpose but under normal circumstances this shouldn't be the case.

Lilford (2004) identified four main reasons of mineral property valuations in the extractive industry. These were to:-

- *"highlight to potential investors the value, viability and uncertainty of a project;*
- *provide management with economic, technical and operational guidelines for efficient exploitation of the property. The analysis will suggest an operating strategy for the project, while providing the necessary outcome to help guide the design process. The possible outcomes are often identified through the use of real options, decision tree analysis, simulation analysis or simple sensitivity analysis. The design process can then be entered based on probability distributions dictated by the above valuation method;*
- *form the basis of an investment decision relating to mergers and acquisitions, project financing, regulatory factors and taxation considerations. It provides management with tools and results necessary to compare and measure the relative financial merits of completing projects; and*
- *improve operating standards and control operating variances by affording management flexibility".*

Other Reasons:-

- allow informed investment decisions to be made on capital allocation for the purpose of recommending development, or installation of metallurgical equipment and the most efficient use of capital. This does not necessarily mean that the project offering the greatest return will be the primary investment, since it may not be the most efficient use of the available capital;
- providing the project's numerous stakeholders, especially the management team, with critical information to allow them to calculate the impacts associated with taxation including transfer duties, estate duties, capital gains tax and other forms of taxation since these will decrease the value of the mineral asset; and
- obtain information for routine periodic reports such as annual reports. The current developments in the mineral asset valuations and reporting are moving in the direction where the asset value has to be reported in the annual reports in compliance with the

IFRS, King II Report and JSE listing requirements.

In conclusion Mineral Asset Valuations are required for various purposes, which are summarised as follows:-

- Statutory filing and public reporting;
- Purchase / Sale of mineral property (Change of ownership);
- Mortgage or loan purposes;
- Insurance purposes;
- Financial Accounting and Financial Reporting purposes;
- Good business practice (Corporate Governance);
- BEE empowerment transactions;
- Capital Gains Tax (GCT) purposes;
- Compensation purposes; and Decision making purposes i.e. Joint Ventures (Pool and Share arrangements), Feasibility studies.

The critical factor in the valuation is the competence and professional judgement of the competent valuator since all valuation exercises in the extractive industry are time and circumstance specific and there is no one best method. Attempts to set up guidelines for the valuation of mineral properties, the Australian Institute of Mining and Metallurgy established the VALMIN code and SA is busy drafting the SAMVal Code for the SA mining industry.

3.4 Resource and Reserve Classification Systems

Attempts to establish standards for classifying and publicly reporting mineral resources and mineral reserves go back centuries. In “De Re Metallica”, published in 1556, Georgius Agricola discusses the evaluation of deposits, the relationship between miner and owner, and fraudulent behaviour in mining. In 1909, Herbert Hoover, who was to become president of the United States of America, published “Principles of Mining”, in which he recommended a three-fold division of ore reserves into proved, probable and prospective.

Mineral reserves and mineral resources are the most valuable asset of a mining or exploration company. This forms the basis of value in the company, in other words this forms the “heart” of the extractive industry. In a survey report on Financial Reporting in the Global Mining Industry compiled by Deloitte and Touche Tohmatsu in 2003, they defined the importance of disclosure about mineral reserves as follows “*although its mineral reserves are arguably the most valuable asset of a mining company, they do not appear as an asset on the balance sheet except to the extent they were purchased. Even then, the cost of mineral reserves is often not disclosed separately from other mining related fixed assets*”.

Without the mineral in the ground, there is no mining to speak about, now or in the future. There is little or no value attributable to the ground alone. It is important to appreciate that the main reason why mineral resources and mineral reserve estimates are classified is to provide company executives, stakeholders and others who are involved in making mining investment decisions concerning mineral resources or mineral reserves with the same framework for assessing relative merits and risk of a project.

It is of paramount importance to disclose mineral resources and mineral reserves using a recognised classification system, to enable common interpretation and understanding of the mineral asset in question. Once the reserves and resources or just a potential mineral occurrence has been established, with reasonable prospects for eventual economic extraction, then a mineral asset comes into existence.

The aim of resource and reserve classification systems is to provide a common framework for estimating quantities and quality of minerals in the ground with the corresponding geological confidence that can be attached to a particular ore body or a subdivision of that same ore body or reef. The classification system should be broad enough to cover mineral assets ranging from exploration results (mineralisation) upto producing mineral assets. Crowson (1998) in his book titled Inside Mining gave a clear distinction between resources and reserves. He defined "*a resource as simply the identified or probable physical presence of minerals in the earth, which may or may not be exploitable economically with presently available technology and reserves represent that portion of the resource that has been more precisely measured and which is, or might be available for production over a specified time period.*" This distinction between resources and reserves is graphically illustrated in Figure 6. "*The ore reserve is that part of an orebody of economic interest which is clearly delimited and which is mostly ready for mining*" (Storrar, 1981).

The degree of certainty on the quality (grade) and quantity (tonnage) values of ore discovered is a direct function of the efforts made in the estimation process in establishing the continuity of the orebody. It is this basis that will be used in the classification of resources and reserves for present and future use. Because of the high cost involved in exploration and evaluation of mining projects, it is the extractive industry norm that only the minimum ore reserves needed to justify mine development are determined initially, while other parts of the deposit or district are left for better evaluation later in the mine life through on-going exploration. "*Geologic assurance, technical feasibility and economic viability are the main criteria for classification of resources and reserves*. (Gocht et al., 1988). Most of the classification systems used by different organisations and nations are based on the concept and the classification approach recommended by Mckelvey in the early 1970's and is illustrated graphically in Figure 7 below. This concept or classification scheme was developed in the 1970's by the US Geographical Survey and US Bureau of Mines.

In this classical diagram, the horizontal axis from right to left denotes geological certainty while the vertical axis denotes the degree of economic feasibility from bottom to top. Hence the resources and reserves can be grouped into three major categories: undiscovered, discovered sub-economic and discovered economic.

"*United Nations developed and recommended a classification scheme for international adoption in 1978/79, but little international consensus was achieved and a large and confusing variety of classifications and terms is used by national and international government agencies*" (Gocht et al., 1988).The United *Nations* classification system, while very similar to the Mckelvey box, measures the geological assurance as the level of certainty of the estimate and the economic feasibility as exploitability. The terms resource and reserve were defined by Gocht and Zantop (1988) as follows:-

- *"Resources define currently or potentially exploitable mineral commodities and should only be used only with reference to a given set of economic and technological*

parameters; and

- *Reserves are defined as measured quantities of ore which are economically exploitable under present day technological and economical conditions".*

The above two terms were the most difficult to agree upon on the technical meaning and implication in the classification systems. The understanding of these definitions forms the basis of any mineral resource and mineral reserve classification system.

"Research carried out by the UN, based upon questionnaires to many nations revealed that more that 150 different classification systems existed" (Kelter, 2006). The classification systems used different principles and definitions. Additionally, for historical reasons, different objectives for classifying the mineral resources, together with semantic problems made attempts to agree upon a universal classification system impossible. To get around these obstacles and to facilitate a global common understanding in the mineral reserve/resources reporting, the CRIRSCO was established. Using this vehicle, a number of conferences and discussions were held by experts in reserve and resource classification and reporting in an effort to resolve these issues. Denver Accord or agreement was as a result of meetings for this forum, a set of definitions regarding the classification, definitions were agreed upon for use in reporting of mineral resources and mineral reserves.

3.5 Main International Classification Systems

3.5.1 The UN framework for Energy and Mineral Resources (UNFC)

At the beginning of the 1990's, Russia proposed that the UN should draw up an international classification system for coal and minerals. This was partly because of the need to disseminate information on the relative quantities, qualities and potential of these mineral resources to international companies and investors. It was realised that many classification systems developed under centrally planned economics were inadequate for promoting business opportunities for international investments and exploration or exploitation of mineral and energy resources. Hence there was a need for a system that could handle the needs for the market economy. The UNFC for extractive industries was developed under a programme that started in 1992 with the aim of assisting countries to reach a common understanding on the mineral resources and mineral reserves and their classification. The UNFC was originally developed to support consistent reporting of coal resources but was later extended to apply to all minerals.

In 1997 and July of 2004, the UN Economic and Social Commission ("ECOSOC") recommended that this new system be adopted by the member countries and international organisations. Considerable focus has subsequently been placed on this system as a possible replacement of existing systems. This was particularly after concern had been raised in the media regarding the way in which certain oil companies had reported information on mineral assets to the Stock Exchange.

Figure 6: Reserves and Resources

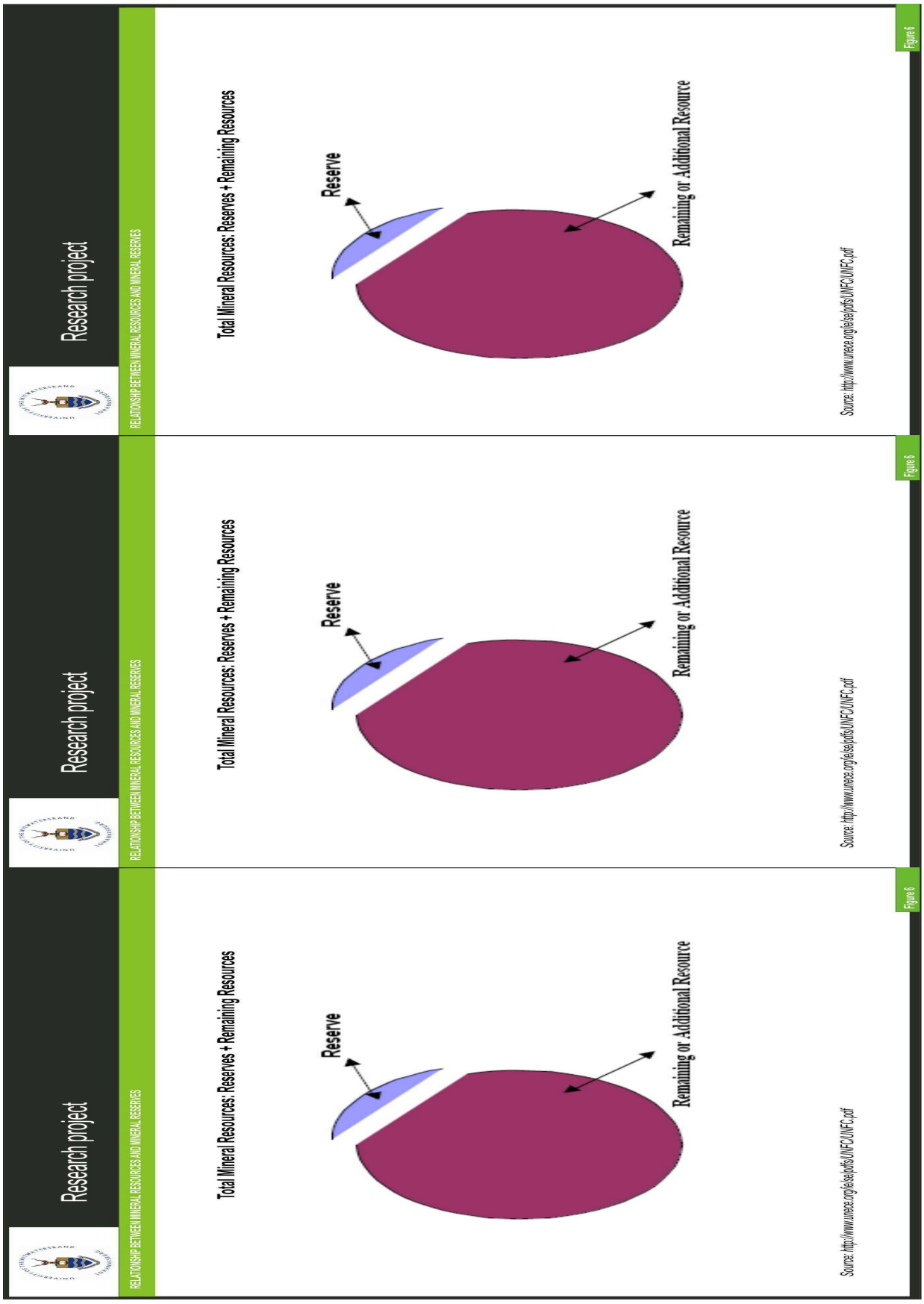
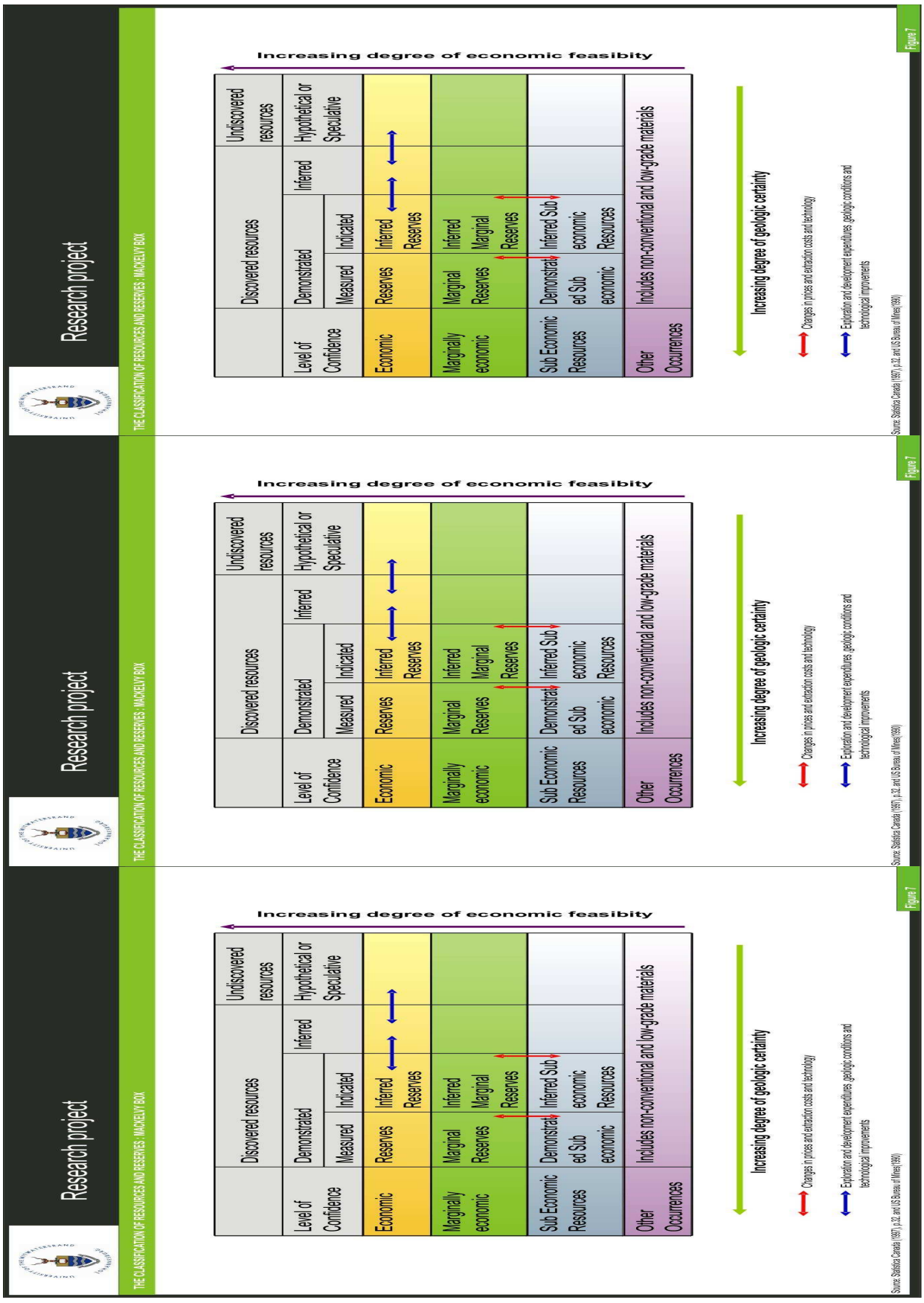


Figure 7: Mckelvey Box



A decision was made by the UN to construct a classification system that allows nations to still keep their national system but report resources according to fairly simple code. Historically '*Eastern Systems*' focus upon geologic activities and feasibility while 'Western Systems' focus upon recovery and feasibility. By combining these structures, a three-dimensional system was constructed. The three main axes were economy, feasibility and geology ("EFG") as graphically illustrated on Figure 8. The cube within the system is uniquely determined when the categories are referred to in alphabetical order; E-F-G e.g. 111 denotes deposits that fit E1, F1 and G1. The categories are numbered where '1' denotes the best. The maximum number of cubes is 36, however most of them are not relevant and for practical use one is left with 8 to 10 cubes to classify mineral resources and mineral reserves. Also further subdivision of the axes makes the system more difficult and complex to use. Therefore these subdivisions should be applied with care.

The UNFC system was used in 2004 for the classification for energy resources (coal, petroleum and Uranium) for the purposes of the World Energy Survey. The definitions of terms used in the principal categories of the UNFC for the classification of mineral resources and mineral reserves – solid fuels and mineral commodities are tabled in Appendix 1 of this report.

3.5.2 The SPE/WPC/AAPG's Classification of the Petroleum Resources

Through the 1980's and 1990's a number of professional organisations made a considerable effort to develop useful classifications of petroleum. The SPE and the WPC jointly published a classification of resources in 1997. The effort continued in cooperation with the AAPG, and in 2000 a system for classifying the total petroleum resources was published, known as the SPE/WPC/AAPG classification as shown in the Figure 9.

The system is based on the in-situ deposits, which are divided into discovered and undiscovered volumes. The main classes are the recoverable volumes, which include reserves, contingent resources and prospective resources. In addition to these classes, the system covers produced quantities and quantities that cannot be recovered, that is to say quantities which, for physical, technical and financial reasons, will remain in the rocks after production has ceased.

3.5.3 CRIRSCO based Classification of Mineral Resources

Until the beginning of the 20th century, little progress was made towards establishing an international standard for the classification and reporting of mineral resources and mineral reserves. There were two significant international groups that were working independently toward the development of international definitions for mineral resource and mineral reserve classification. These two groups where, the CMMI and the UN-ECE. The first most important breakthrough and significant move were in 1989 when the JORC Code was published. The code was immediately incorporated into the ASX listing rules.

In 1991, the US SME published “A Guide for Reporting Exploration Information, Resources, and Reserves”. Also in 1991, the IMM in the UK revised its standards for reporting of mineral resources and reserves. The US Guide and UK revisions were both based on the 1989 JORC Code. In 1993 the CMMI set up a Mineral Resources/Reserves International Definitions Working Group, with representatives from Australia (AusIMM), Canada (CIM), South Africa (SAIMM), the United Kingdom (IMM) and the United States (SME). The CMMI Group as it was initially called, now known as the CRIRSCO first met during the 1994 Fifteenth CMMI Congress in South Africa. After several years of negotiations, a provisional agreement, known as the Denver Accord, was reached in 1997 in Denver, Colorado, on definitions of the two major categories, mineral resources and mineral reserves, and for their respective sub-categories, measured, indicated and inferred mineral resources, and proved and probable mineral reserves.

Independently, starting in 1992, the UN–ECE was developing a UNFC to enable comparison of different national mineral resource and mineral reserve classifications. These two groups soon came to the realization that their efforts would be more fruitful if the results of those efforts were merged. The CMMI Group and the UNECE met in Geneva in 1998 and 1999 and produced an agreement to incorporate CMMI standard reporting definitions into the UNFC for categories common to both systems. Following the Denver and Geneva meetings, the agreed definitions were first incorporated into the 1999 JORC Code and subsequently, largely unchanged, into similar codes for the other four participating countries, South Africa, Canada, the United States and the UK. The Australian code (the JORC Code) and the South African code (the SAMREC Code) are recognised by their respective stock exchanges and must be followed by companies listed on these exchanges. Effective February 2001, the CSA issued National Instrument 43-101 (NI 43-101), “*Standards of Disclosure for Mineral Projects”*. These standards require compliance with the CIM definitions of mineral resources and mineral reserves, and that a Qualified Person estimates such resources and reserves.

The success of the CRIRSCO initiative is such that the participating countries and other international organisations have agreed on the common definitions of mineral resources and mineral reserves in the Denver Accord and the consideration now is actively being given to developing an International Template. “*This would include the formulation of an international definition for a CP, reciprocal recognition of CPs between participating nations, a list of principles which would constitute minimum requirements for professional rules of conduct for CPs, and an international reporting code and guidelines”(Miskelly, 2003).*

Figure 8: UNFC Classification System

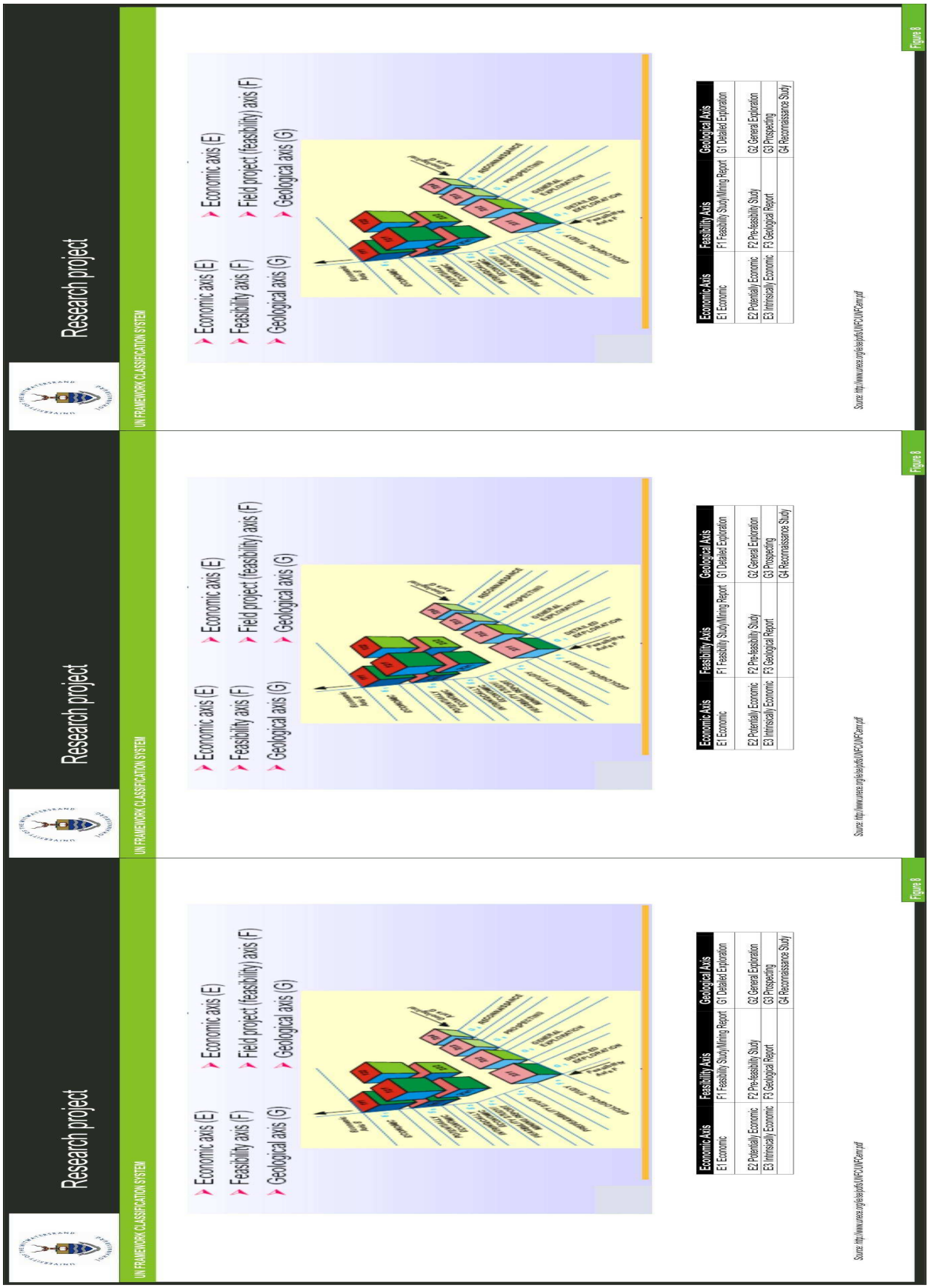


Figure 9: The SPE/WPC/AAPG's classification of petroleum resources

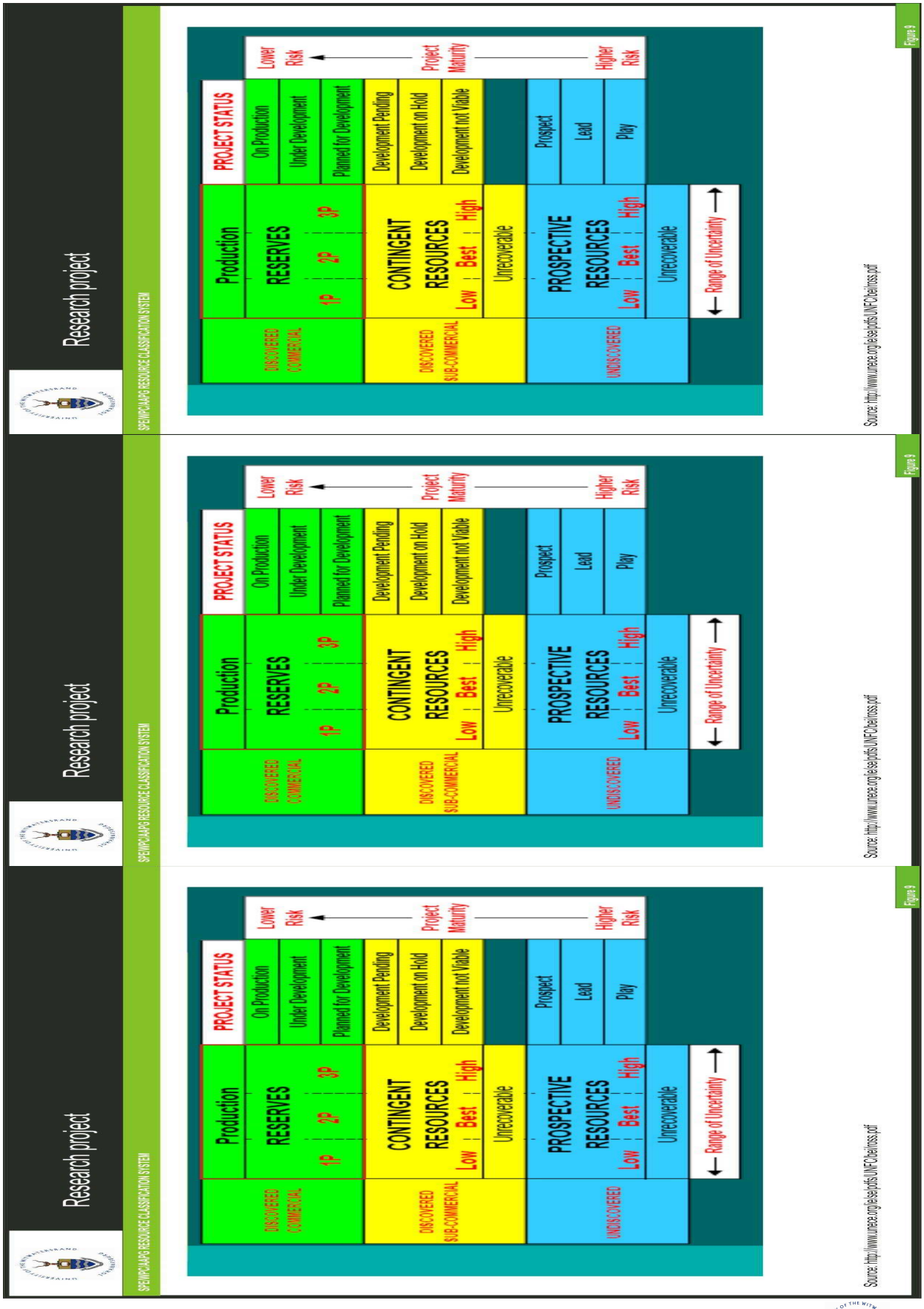


Figure 10 illustrates the framework for classifying Exploration Results, Mineral Resources and Mineral Reserves based on the CRIRSCO definitions agreed upon in the Denver Accord. A mineral resource must be classified as measured, indicated or inferred, a mineral reserve as proved or probable. These classifications reflect different levels of geological confidence and different degrees of technical and economic evaluation. The choice of the appropriate category of mineral resource or mineral reserve must be made by a CP, based on the experience and knowledge on that particular type of deposition, continuity of the orebody and the surrounding geology. When mineral resources or mineral reserves are publicly reported, the person reporting on the mineral asset must be aware of the differences which exist between various jurisdictions. For example the US SEC do not allow the use of the term “mineral resource”. A mineral resource can be estimated mainly on the basis of geoscientific information with some input from other disciplines that are used during the exploration programme aimed at increasing the geological knowledge and confidence. A mineral reserve, which is a modified sub-set of a measured or indicated mineral resource, requires consideration of all modifying factors affecting extraction, including mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors, and should in most instances be estimated with input from different disciplines.

“A deposit may be classified as a measured mineral resource when the nature, quality, amount and distribution of data are such as to leave no reasonable doubt, in the opinion of the Competent Person, that the tonnage and grade of the deposit can be estimated within close limits. Confidence in the estimate is sufficient to enable an evaluation of economic viability” (Miskelly and Rendu, 2002). In certain situations a measured mineral resource could convert to a probable mineral reserve rather than to a proved mineral reserve because of uncertainties associated with the modifying factors which are taken into account in the conversion from mineral resource to mineral reserve. This relationship is shown by the broken arrow in Figure 10, in certain situations, a previously reported mineral reserve could convert back to a mineral resource because of new information according to which a mineral reserve can no longer be reported. The resulting two-way relationship is shown by the two-headed arrows in Figure 10.

3.6 The need for public reporting of Mineral Assets

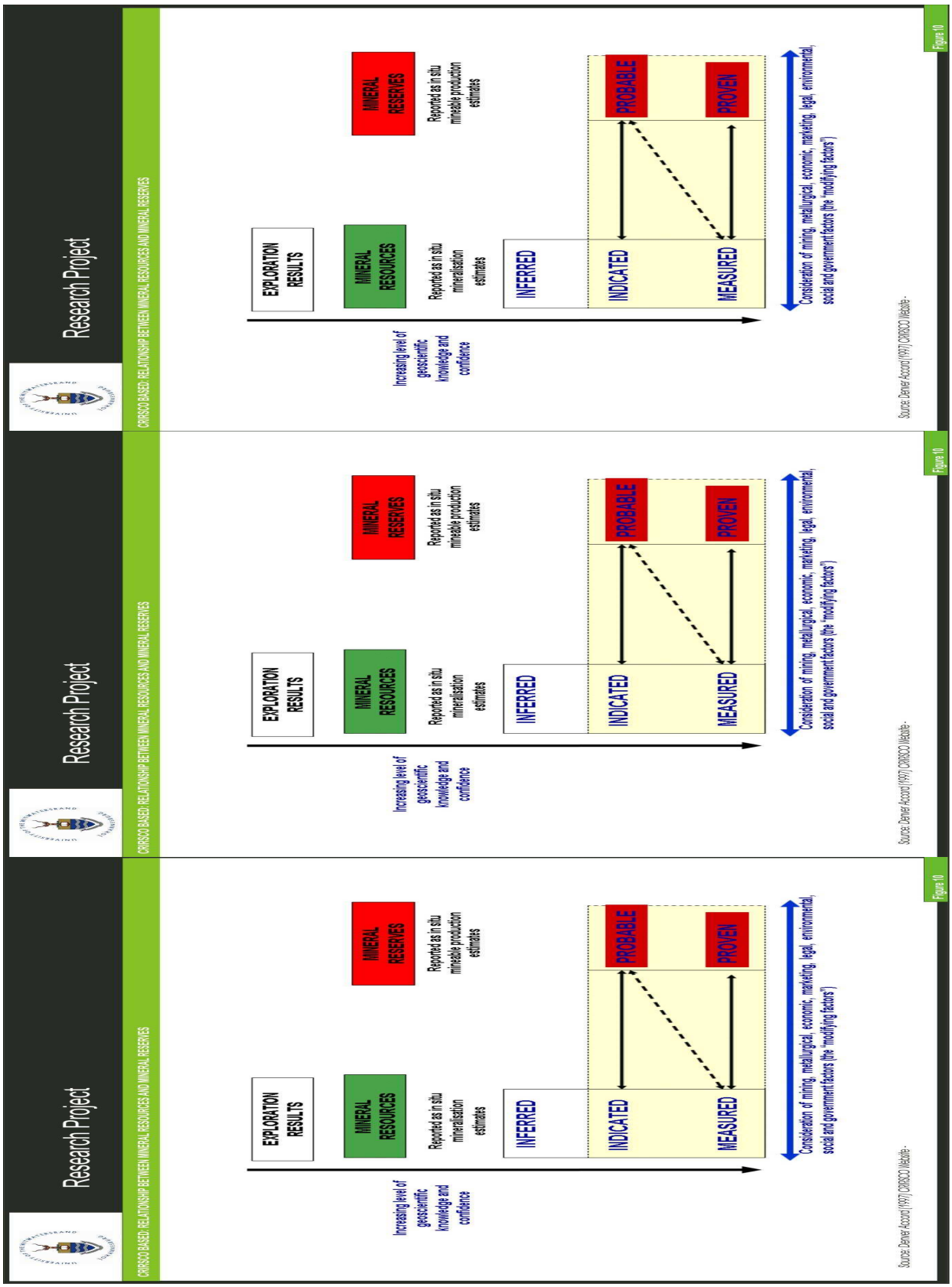
There are several reasons why, over the centuries of exploitation of natural resources, lately arose the need for public reporting of mineral assets, and mineral resource and mineral reserve classification systems which led to the establishment of different reporting codes in the extractive industry. The fundamental reason for public reporting of mineral assets was to communicate the results to the interested stakeholders in such a way that could be understood by everyone of average intelligence and knowledgeable in the field of mineral exploitation. However, in an effort to satisfy this fundamental issue, then arose another issue on the classification of the mineral resource and mineral reserve. This was the need to establish common definitions of the sub categories and hence common understanding on the classification system. The same reasons led to the formation of the CRIRSCO, JORC committees to look at these issues and make recommendations. The Denver Accord was the foundation of global common understanding on the definitions of the mineral

resource and ore reserve classification systems.

Besides the above mentioned reasons, there are other reasons that also facilitated the realisation that there is need for public reporting of mineral assets world-wide and these include:-

- when mineral assets changed hands, the new owners would want to consider the future of their long-life asset and give serious attention to planning ahead. The scale of forward planning has to be based on the assessment of the size, quality of the orebody and the geological information that is gained through on-going exploration on the orebody ahead of active production areas;
- the key planning parameter of a mining operation is the ore reserve. As a result, debate began as to how to classify and define ore reserves, a matter which is still subject to some debate even today;
- The reports on mineral assets had to be standardised as far as possible. This came as a result of globalisation and the fact that mining is a global industry, hence common international reporting codes will bring common understanding and interpretation of exploration results and this will make the mining industry one big global village;
- provide a framework for performing and reporting of exploration results in an internationally recognised categories and classifications;
- companies tended to classify and report mineral reserves according to local terminology, and this led to a confusing multiplicity of terms which made a complete understanding of companies' reports and comparison of one mineral asset with another a difficult task; and
- Share speculation sparkled by the mere discoveries of minerals that would then be announced to the public and this resulted in some investors saw fortunes made and lost on the merest whisper of a new find. This brought geologists, drillers, mining engineers, company representatives and companies themselves under the public spotlight.

Figure 10: CRIRSCO based: Relationship between Exploration Results, Mineral Resources and Mineral Reserves



CHAPTER FOUR

4 HISTORY OF PUBLIC REPORTING AND MINERAL RESERVE CLASSIFICATION

4.1 Introduction

The history of international reporting standards and reserve classification in the extractive industry has its backbone on the Australian mining industry. Australia was the pioneer in realising that the mining industry needs a set of principles, as a guideline to the public reporting of mineral assets and mineral reserve classification. Interested parties responded to the challenge as an opportunity to develop the guidelines that will be used to regulate the industry. JORC was formed in 1971 and released the first edition of the JORC Code in 1989. The code was well accepted in Australia and in ten years of use it got an international recognition and acceptance. Hence this code became the template that SA used in the process of developing our country's specific reporting document that was enacted in March 2000. The history and the development of the reporting code in the Australasian context is the basis of the SAMREC Code hence a review of the history of JORC Code was considered to be of paramount importance to give the background on the development of the reporting codes. In this chapter the historical developments in the mineral reserve classification systems and resource and reserves definitions development will be reviewed. The general reporting principles and attributes that should be complied with, for information that is issued onto public domain to be valuable will also are discussed. Finally the lessons that can be drawn from the discussions will be highlighted and recommendations made.

4.2 Mineral Discovery and Ownership in SA (1800 – 1930)

In South Africa the discovery of diamonds in 1867 and gold in 1886 formed the foundation of the mining industry. Alluvial diamonds were discovered on the Vaal River in the late 1860s. The subsequent discovery of dry deposits at, what became the city of Kimberly drew tens of thousands of people, black and white, to the first industrial hub in Africa, around the largest diamond deposit in the world. Although the mines were worked initially by small-scale claim-holders, the economics of diamond production and the marketing soon led to the consolidation of diamond claims that led to the creation of the huge one monopolistic company De Beers Consolidated Mines under the control of Cecil Rhodes.

The discovery of the Witwatersrand (literally," Ridge of White Waters" in Afrikaans) goldfield in 1886 was a turning point in the history of SA. Once the extent of the reefs had been established and deep-level mining had proved to be a viable investment, it was only a matter of time before Britain and its local representatives again found a pretext for war against the Boer republics of Transvaal and the Orange Free State.

After the discovery of these minerals, the industry was dominated by small scale, high grade surface mines and then developed shallow underground mines. Mineral resources and mineral reserves if ever they were estimated were based on hand sampling and geological inference, and the reporting of reserves was non-existent. This was because there was no need to communicate these results to any outsider but the interested parties where the ones that where mining the orebody. Literally there was no transfer of knowledge and/or information in the industry since these where small operations. These were operated presumably as one man business (sole traders) hence the

information was regarded as confidential and was kept as a secret to the miner or the owner. This goes back to the era of the slave trade and the missionaries when they exchanged these minerals for other goods from the European countries.

The increasing interest in the mining of these minerals over the years lured the interests of bigger companies and the formation of bigger companies. In order to fully and efficiently exploit large discoveries, the problems caused by disjointed tenement ownership of these deposits had to be dealt with first. To a greater or lesser extent, almost every major mine dating from this era underwent a period of consolidation before one company emerged with secure title and with the necessary technical and financial resources to develop the deposit.

4.3 Mineral Resource and Mineral Reserve Definitions Development

Gold mines in the late 1800s and early 1900s were predominantly underground operations. Although the diamond drill had been in use as an exploration tool since gold rush days, the method was slow and expensive. Companies during those days used to undertake horizontal and vertical development in order to prove up mineral reserves. Terms such as "*Ore developed*", "*Ore Blocked Out*" and "*Ore in Sight*" came into common use at the time and confidence in reserves was related to the number of sides which were exposed. This clearly shows that there was need for some geological confidence in the classification of mineral resources and ore reserves.

So the greatest confidence would only be attached to a block when all the four sides of the block have been exposed and the ore body or the reef has been identified on the expected elevation on both sides. This would then give the geologist the comfort to make the assumption that there is geological continuity from one end to the next, hence such areas would be classified as positive ore or ore developed. These blocks had to be of a certain size that would enable the geologists to make a reasonable assumption that geological continuity exists.

Herbert Hoover in 1909 wrote his classic book titled "*Principles of Mining*" where a number of the present-day concepts governing ore reserve definition and classification had been established. Reserves were classified according to the degree of confidence with which they were known and subdivisons in common use at the time were:-

Table 6: Hoover's Definitions of Reserves

TERM	DEFINITION
Positive ore or ore developed	Ore exposed on four sides in blocks of a size variously prescribed
Ore blocked out	Ore exposed on three sides within reasonable distance of each other
Probable ore or ore developing	Ore exposed on two sides.
Possible ore or ore expectant	The whole or pan of ore below the lowest level or beyond the range of the vision.

Hoover felt that the above classification was too restrictive and recommended a three-fold subdivision with broader definitions:-

Table 7: Hoover's Revised Definitions of Reserves

TERM	DEFINITION
Proved ore	Ore where there is practically no risk of failure of continuity.
Probable ore	Ore where there is some risk, yet warrantable justification for assumption of continuity
Prospective ore	Ore which cannot be included in the above classes, nor definitely known or stated in any terms of tonnage.

These definitions are in essence the same as those that are international accepted according to the Denver Accord agreed upon on a CRIRSCO conference and are still in use today. Hoover also stated that the term “Prospective” or “Possible” ore should never be used in conjunction with “positive ore” tonnages, a principle that remains true today even though the current codes has discarded use of the term “Possible Ore”.

Ore reserve was defined by the Institute of Mine Surveyors in 1981, as “*an estimate of the tonnage and specific mineral content of payable ore adequately exposed by mining operations at the date of computation”* (Storrar,1981. p172). Although it must be adequately exposed for sampling and blocking, it need not necessarily be fully developed and ready for stoping but it must be capable of being mined at a profit. Storrar (1981) wrote that “*a consensus of the Institution of Mining and Metallurgy favoured the following three classes: proved reserve, probable reserve and possible reserve*”. These classes where defined as:-

- ***Proved reserve*** *- ore reserve is the payable portion of the proved reserve. The ore has been fully exposed by development and by stoping, sampled and blocked out. The proved reserve in base mineral mines is further classified according to their availability as fully developed, partly developed and under developed.*
- ***Probable reserve*** *– is a zone of mineralisation to which sampling values of the proved reserve are believed to apply but with less certainty: and*
- ***Possible reserve*** *or prospective ore is taken to refer to ore that is an extension of the orebody, or it is new orebody which is beyond the zones of the probable and the proved reserves and its estimated tonnage and value is less certain as sampling information is meagre.*

4.3.1 Background to the Resource Classification in Australia

History tells us that metalliferous mining industry was initiated by the discovery of copper in South Australia in 1842 and was consolidated by alluvial gold rushes in Eastern Australia between 1850 and 1870. “*It was during the 1880s and 1890s that a number of Australia’s world class gold and base metal deposits were discovered and developed; Mt Morgan in 1882, Broken hill in 1883, Mt Lyell in 1886 and Kalgoorlie in 1893.*” (Stephenson et el, 1992).

There were two discoveries of major significance in the period between 1930 and 1950 in Australia. The first one was in 1930 where the recognition of gold associated with haematite/magnetite at Tennant Creek paved the way for development of a new mining field which became a major producer of gold, copper and bismuth; and in 1949, a uranium find at Rum Jungle heralded a new era of exploration which led to discovery of the world class uranium deposits of northern Australia. Mining during these days was still dominated by large base metal underground operations and by gold operations in the Kalgoorlie district, however while advances were made in mining and metallurgical technology, these were not accompanied by comparable advances in the classification and definition of Ore Reserves. But within time they realised the need to classify and report mineral resources in a manner that is clear and easily understood, coupled with common understanding among the mining professionals.

Each major operation tended to estimate mineral reserves using methods developed specifically for its orebodies. This productive experimentation with estimation methods coincided with increasing recognition of the importance of mine geologists' role, and helped to establish most of the principles and practices which still govern mineral resource estimation. At the same time however, companies also tended to classify and report ore reserves according to local terminology, and this led to a confusing multiplicity of terms which made a complete understanding of companies' reports and comparison of these results a nightmare. While there was little co-ordinated activity in Australia during this period, directed toward addressing the situation, an important development did take place at a governmental level in the US. During the Second World War, concern about ore reserves on a national scale led to the adoption in 1943 by the US Bureau of Mines of a three fold classification based on the terms "measured", "indicated" and "inferred". It is worth restating the definitions in full (Stephenson et al 1992):-

*"**Measured ore** is ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling and measurements are so closely spaced and the geologic character is defined so well that the size, shape and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to differ from the computed tonnage or grade by more than 20 per cent."*

*"**Indicated ore** is ore for which tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout."*

*"**Inferred ore** is ore for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred ore should include a statement of the spatial limits within which the inferred ore may lie."*

This system of classification was a landmark development in the field of mineral reserves and mineral resources classification and reporting, and has influenced almost all subsequent classification systems. Shortly after its release it was adopted in full by the Australian Commonwealth Bureau of Mineral Resources, Geology end Geophysics, and although intended for use on a regional or national scale, was adopted by some mining companies for local application. In the early 1960’s saw an arousing of interest in ore reserve nomenclature and definition and this was the same time that the AusIMM first become involved in the field.

“While in economic terms, the new discoveries had a major impact on the mining industry and on the nation, it was another much smaller discovery in the Kalgoorlie region of Western

Australia which was to have a far greater impact on public confidence in the industry, and which was to lead for the first time to intense official interest in reporting procedures and company practices in the field of Ore Reserves" (Stephenson et el, 1992). In 1969 a major new discovery of the Windarra nickel deposit by Poseidon NL sparked a huge share speculation. This discovery saw fortunes made and lost on the merest whisper of a new find, and brought all the stakeholders involved and companies they represent under the public and media spotlight. This close attention brought to light some of the shadier activities being perpetrated at the time, and, less fairly, cast aspersions on the integrity of the mining industry as a whole. While confidence in the industry suffered as a result, concern both within the industry itself and within official circles provided the spur necessary to bring about the badly needed reforms in nomenclature, classifications and public reporting of ore reserves and mineralisation which were introduced in the decades following.

Before the nickel boom, the AusIMM began an initiative in standardisation of ore reserve terminology, and in 1953 set up a committee to consider and report on the matter. In December 1953 the committee submitted the first report where they found out that there was a clear need for standardisation of nomenclature and classification of ore reserves and recommended a four fold system:-

- Proved
- Measured (or Developed)
- Indicated (or Partly-Developed)
- Inferred

The definitions of the latter three categories were identical with the US Bureau of Mines' definitions, while the first category was introduced to meet the need of mining companies which had substantial tonnages of ore fully developed with tonnages and grade known with high level of geological confidence. In 1956 the SEG as an international organisation that was considering the sponsoring of the developing a universal system of nomenclature for ore reserves presented its findings in a report written by F Blondel and S G Lasky. It recommended that the term "resources" be applied only at a regional or national scale where short term economic potential is not a prime consideration, with subdivisions and definitions as adopted by the US Bureau of Mines, and that the term "reserves" be applied at a deposit scale where current economic potential is the main concern with subdivisions into Proved, Probable and Possible and with definitions as proposed by C K Leith in 1938 (Stephenson et el 1992).

Leith's definitions were:-

- "**Proved or assured ore**. *Ore blocked out in three dimensions by actual underground mining operations or by drilling, but it includes in addition minor extensions beyond actual openings and drill holes, where the geological factors that limit the ore body are definitely known and where the chance of failure of the ore to reach these limits is so remote as not to be a factor in the practical planning of mine operations";*
- "**Probable or semiproven ore** *covers extensions near at hand, where the conditions are such that ore will probably be found but where the extent*

and limiting conditions cannot be so precisely defined as for proved ore. Semiproven may also mean ore that has been cut by scattered drill holes, but too widely spaced to assure continuity"; and

- "**Possible Ore**. *Ore is classed as possible or prospective where the relations of the land to adjacent ore bodies and to geologic structures warrant some presumption that ore will be found but where the lack of exploration and development data precludes anything like certainty of its actual location or extent. Often it is not desirable to assign figures to "possible" tonnages, but they may be designated by terms like "small" or "large".*

During the 1980's the industry and regulatory bodies finally began to produce Australian standards and guidelines for classification, definition and public reporting of mineral resources and ore reserves which finally leading to the adoption of the JORC code in 1989. Any documentation or reports issued prior to the code had a status of guidelines and recommendations only, however incorporation of the code in its entirety into the listing rules of the ASX in July 1989 has since made it mandatory for mining companies listed on the stock exchanges in Australia to report according to the code. At the same time different regulatory bodies and companies also accepted the code as a standard for public reporting of mineralisation, mineral resources and ore reserves. It is imperative that the mineral resource classification that had to be developed must have some degree of flexibility in the application of the rules or guidelines; this is because each mineral deposit has its own unique characteristics.

4.3.2 Codes used in SA before the SAMREC Code

Prior to the promulgation of the SAMREC Code in 2000, the SA mining industry regarded Storrar's (1981) guidelines was regarded and used by the industry as a 'sort' of code for local reporting of mineral resources and reserves. After 1989 the industry had an option of either complying with the JORC Code or any another reporting code and it wasn't mandatory to report mineral reserves and mineral resources in the annual reports. The continuing emphasis on the need for corporate governance and transparency in public reporting and how companies are run as recommended in the King II report, has made it mandatory for publicly listed companies to report mineral resource and mineral reserve in their annual reports. This would enable the stakeholders to make informed decisions about the company. To ensure that the reports that are released into the public domain are not confusing, non fraudulent, easily understood, have the same meaning and interpretation there was need for a South African reporting code as a single reference point for the industry and all other stakeholders.

The history of the development of the JORC Code and the related reporting standards would put the development of the SAMREC code into the correct time perspective. The events in chronological order are shown in Table 8.

These events tabled below clearly shows that the first edition of the JORC Code gave the base foundation for the writing of country specific codes that was only possible after ten years from the date the first edition of the JORC was enacted. International

companies would have opted to report complying with this code even though this wasn't mandatory in SA.

But for the purposes of comparison between two different operations in the different parts of the world, it would be ideal to use the same reporting standards for all the operations and this will make the consolidation of the mineral resource and mineral reserve statements easier and more meaningful. This would also comply with the general accepted reporting principles as discussed at length in the next section. Even up today multinational companies like Rio Tinto and Anglo American they have established a common reporting standard that has to be adhered to by every operation for internal management use and then make the specific ore reserve statements that are mandatory in the different areas of jurisdiction that the operation is operating in or as required by law.

Table 8 : Historical developments of the JORC and related codes

DATE	PLACE	EVENT
1971 - 1985	Australia	JORC formed and documentation of JORC guidelines on classification and reporting
1980	United States	"Circular 831, Principles of a Resources or Reserves Classification of minerals" by US Bureau of Mines and US Geological Survey;
1981	South Africa	Publication of a text by the Chamber of mines of South Africa titled South African Mine Valuation
March 1989	Australia	First Edition of the JORC Code
September 1994	Sun City, South Africa	First meeting of the CMMI International Resources/Reserves Definitions Group (Now CRIRSCO)
November 1996	Geneva, Switzerland	Publication of the "United Nations International Framework Classification for Reserves/ Resources – Solid Fuels and Mineral Commodities"
March 1997	Indonesia and Canada	Bre-X Scandal
October 1997	Denver, Colorado	Second Meeting of the CMMI International Resources or Reserves Definitions Group " The Denver Accord"
October 1998	Geneva, Switzerland	Third meeting of the CMMI International Resources or Reserves Definitions Group First Meeting with the UN-ECE
January 1999	Toronto	"Setting New Standards, Recommendations for Public Mineral Exploration and Mining Companies" Published by Toronto Stock Exchange and Ontario Securities Commission
November 1999	Geneva, Switzerland	Fourth Meeting of the CMMI international Resources/ Reserves Definitions Group Second Meeting with the UN-ECE "the Geneva Accord"
March 2000	South Africa	Release of the first edition of the SAMREC code
2000 -2003	UK, USA, Canada etc	Identical reporting codes and guidelines adopted by SA, Canada, USA (SME), UK/ Western European countries, Chile and Peru, all based on 1999 JORC Code.
2004	Australia	Release of 2004 JORC code
June 2006	South Africa	Release of exposure drafts of the SAMVAL code and the new SAMREC code

Source: J. M Rendu and modified by Author

4.4 General reporting principles and attributes

These reporting principles have been developed to ensure a consistent and coherent system of reporting and to create a common language, facilitate communications and improve the quality of information being released to the stakeholders by the extractive industry, underpinned by the reporting templates and technical accounting guidance.

Where specific guidance on any issue is not provided, reporting entities should consider the reporting principles to determine the appropriate reporting treatment. In practice, there is need to balance between these qualitative characteristics taking into account the constraints of timeliness, cost/benefit and confidentiality.

These qualitative characteristics of information and these reporting principles forms the basis of public reporting and considers the “substance over form” principle, hence transparent, competent, material, relevant and reliable information is disclosed to the users. Adherence to these principles adds value to the information by making the information useful to different stakeholders. Generally public reports are meant to provide useful information to different stakeholders and for different purposes. For example lenders, needs the information to asses the ability to repay loans and service related interest charges. The reporting principles and characteristics that make the information useful includes the following:-

Accountability and Competency

Refers to individuals or a team in a company, who make decisions, take actions and exercise professional judgement on specific issues concerning the mineral resources and mineral reserves, its measurement, classification and disclosure, the need to be accountable and responsible for their decisions and actions. The nature of mineral deposits, are that the accurate quantity and quality of an orebody can only be know with certainty when the ore body has been mined out. Because of this geological uncertainty, all the reported figures are estimates based on statistics, geostatistics and professional judgement of the CP. Hence all the reporting codes in the extractive industry are not very prescriptive but they allow for professional judgement to be exercised on a case to case basis. Also there are no mineral deposits that are exactly the same; therefore there is no way a prescriptive rule can be enforced in such circumstances.

The issues of accountability, responsibility and competency have become very critical, especially with the amount of professional judgement required in the mineral resource and mineral reserve estimation process. To ensure that public reporting under such conditions is done to an acceptable professional standard, strict education and experience is required, for one to be a recognised CP.

This reporting principle requires CP to exercise reasonable care, diligence and to observe the principles of serving the public interest and maintaining the highest degree of integrity, objectivity, and independence in applying professional judgment to all aspects of their work.

Membership to a professional association provides a means to query and assess the actions, responsibility, accountability and professional discipline of members. In public reporting of mineral assets, the CP is accountable and responsible for the mineral asset to the board of directors, who are accountable to the company and finally to the shareholders. At the same time they must act responsively to and with responsibility towards all stakeholders of the company. But currently there is no legislation that transfers liability to the CP who has reported false and unreasonable results, which would potentially mislead the stakeholders. In terms of the Companies Act section 286, the annual financial statements are the responsibility of the directors and any misrepresentation could lead to personal liability.

Independence and Objectivity

The responsible person reporting the attributes of the mineral asset should be independent and objective in performing their work; especially when they have been requested to give an independent opinion on the status of the mineral asset. The independent auditor or valuator should be free from any interference in determining the scope of mineral resource and mineral reserve audit, performing the work, communicating results and hence should have a clear objective in conducting the assignment and the reporting thereof. To emphasize the importance of independency the United States General Accounting Office made a provision in section 3.04 in the government auditing standards revised in 2003 that "*Auditors and audit organisations have a responsibility to maintain independence so that opinions, conclusions, judgments, and recommendations will be impartial and will be viewed as impartial by knowledgeable third parties. Auditors should avoid situations that could lead reasonable third parties with knowledge of the relevant facts and circumstances to conclude that the auditors are not able to maintain independence and, thus, are not capable of exercising objective and impartial judgment on all issues associated with conducting and reporting on the work*" (p.34). The same concept should be applied to the extractive industry by the CP when he/she is requested to give an independent valuation or an independent review of the mineral resource and mineral reserve statement.

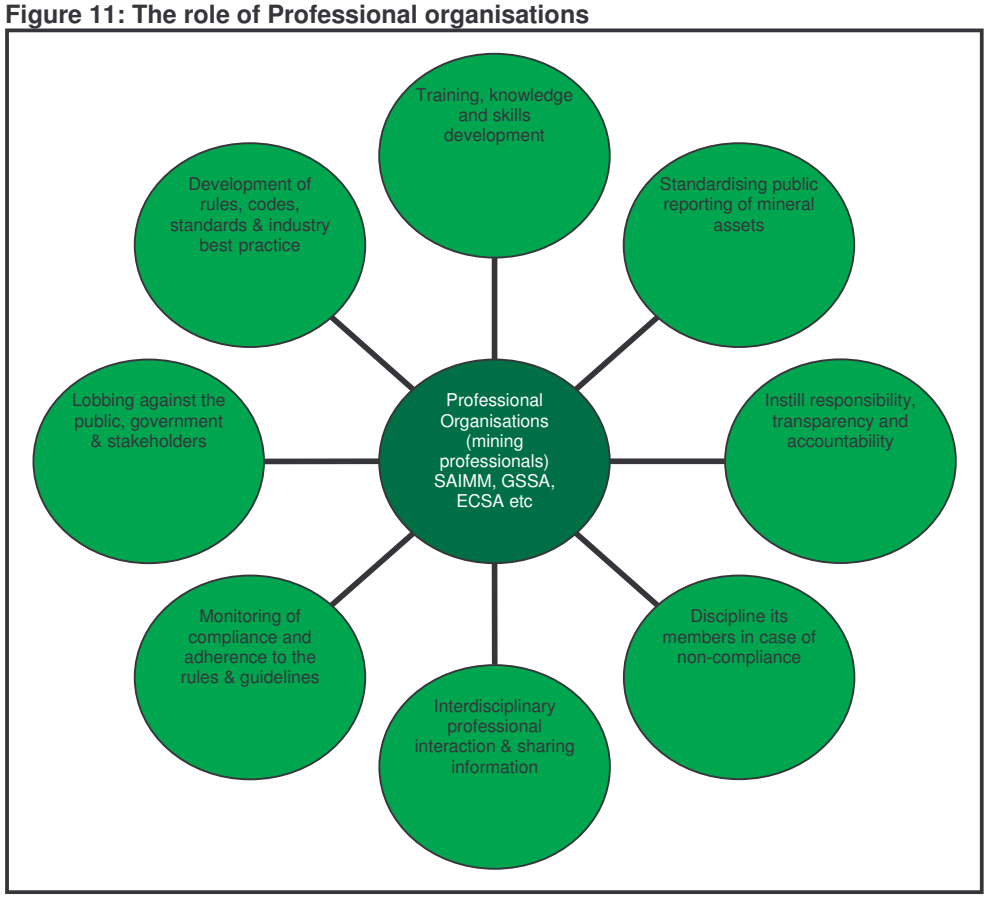
The level of independence is the extent to which systems have been incorporated to minimise and avoid potential conflicts on interest between the reporting team and the organisation. With current public reporting practices in the mining industry, the CP or competent team are employees of the company that are reporting on the mineral resources and mineral reserves of the company. In such a relationship there are potential conflicts of interest especially when bonuses are related to the mineral reserve generation. Employees might be tempted to manipulate the classification of mineral resources and mineral reserves to improve the reported results, hence the need for an independent set of eyes to check the work. Independent auditors would be required regularly to give an independent opinion on the measurement, classification and disclosure of mineral resources and mineral reserves. If independence or objectivity is impaired in fact or in appearance, the details of the impairment should be disclosed in the public report.

Role of Professional Associations

The role of professional organisations is to control and regulate the manner in which the members conduct themselves in the profession. This is important to uphold the professional conduct, ethics, professional independence and the general standard of work. Professionals in the extractive industry are guided by standards, codes, rules, guidelines, industry best practices and norms. These associations' controls, monitors and checks adherence and compliance of its members to these rules and where there is discrepancy then disciplinary action has to be taken against the members. This is aimed to bring consistency in the extractive industry by helping to achieve common understanding, interpretation and common public reporting of similar mineral assets. Development of technical standards and protocol setting leads to a general improvement in the quality of the exploration results, mineral resources and mineral reserves being reported on and the results that are compliant are given greater credibility and a greater level of confidence is assigned to such results.

Hence these associations play an important role in quality assurance and professional independence, through controls, checks and balances in the process of reserve estimation until public reporting of the asset, thereby reducing or eliminating the risk of reoccurrence of misleading public statement such as the Bre-X scandal.

Figure 11: The role of Professional organisations



Source: Complied by Author

Transparency

"*Transparency is the ease with which an outsider is able to make meaningful analysis of the company's actions, its economic fundamentals and the non-financial aspects to that business"* (IODSA, 2002). A good mineral resource and mineral reserve statement and the mineral asset valuation thereof should disclose all the relevant information, timely and accurately both within the organisation and to the public to enable them to make informed investment decisions regarding the organisation. This information should reflect a true picture of what is happening within the organisation. If there is a major impairment in the value of the mineral asset, this should be communicated timely and accurately to the stakeholders. This should not come as a surprise in the annual mineral resource and mineral reserve statement in the annual financial statements. Full disclosure of the processes, procedures and assumptions in the statement that will be issued to the public, is essential to its credibility and transparency. According to the SAMREC code (2000. p6) "*Transparency requires that the reader of a public report is provided with sufficient, clear and unambiguous information to understand the report and is not mislead".*

Understandability

Information should be presented in a simple and comprehensive format to users who have a reasonable understanding of mineral resources and mineral reserves, mining sector business, economic activities in the extractive industry and a willingness to study the information with reasonable diligence. "*It is important that technical and financial reporting should not exclude relevant information merely on the grounds that it may be too difficult for certain users to understand"* (GAAP, 2003). It should be noted that the different international reporting codes are established for general purpose reporting and to give general guidelines to be adhered to when preparing mineral assets valuation reports and mineral reserve and mineral resource statements for publication internal and in the public domain. Public reporting should therefore provide information that can be used by all users who are willing to learn and understand the information and to use it properly.

The reporting organisation should remain cognisant of the diverse needs and backgrounds of its stakeholders and should make the information available in a manner that is responsive to the maximum number of users while still maintaining a suitable level of detail.

Relevance and Materiality

Relevance is the degree of importance assigned to a particular aspect, indicator or piece of information and represents the minimum threshold at which information becomes significant enough to be reported. Materiality is defined in the JORC code (2004) as "*all the relevant information which investors and their professional advisors would reasonably require, and reasonably expect to find in the report for the purpose of making a reasoned and balanced judgement regarding the exploration results, Mineral Resources or Ore Reserves being reported*". Materiality depends on the size of the item or judged in particular circumstances, on the effects of its omission or misstatement and how it could influence the decision of a user taken on the basis of the information included in the report. As a general rule all information relevant to the decision making needs of the users should be disclosed. The relevance of information is affected by its nature and materiality. Information is relevant when it is capable of making a difference to a decision.

The key driver of value and business in the extractive industry is the mineral asset, which is not shown on the balance sheet. Therefore, the mineral asset has to be disclosed elsewhere in the annual report, because this is a relevant component of a mining business. The mineral reserve is the blood of a mining company, without blood then there is no life or future for the company. *"A company must disclose any relevant information concerning a mineral deposit that could materially influence the economic value of the deposit to the company. A company must promptly report any material changes in its Mineral Resources or Ore reserves*." (JORC, 2004 p6). AC 000.30 states that "*information is material if its omission or misstatements could influence the economic decisions of users taken on the basis of mineral resources and mineral reserve statements. Material items require separate disclosure*" (GAAP,2003). A material change in any aspect of mineral resource or mineral reserve such as grade, production, dilution and commodity price, will affect the value of the shareholder's investment decision hence these factors should be reported to the stakeholders.

According to the Canadian National Instrument 43-101, any aspect that is more than 10% of the total is material and should be disclosed as such in the report.

Corporate Discipline

Is the commitment by the company's top management to adhere and comply with the standards, rules, protocols and principles that are universally recognised and accepted to be correct and proper in the field of mineral resources and mineral reserves classification, mineral property valuations and public reporting.

Reliability

Information has the quality of reliability when it is free from material error, bias and can be depended upon by users to represent faithfully that which it either purports to represent or could reasonably be expected to represent. Reporting entities are requested to exercise due care to ensure that information reported on has the precision needed for its intended use and provides reasonable assurance on the integrity of the reported information. The reporting principle of reliability is supported by the following sub-principles:-

- **Substance over form** – information has to be faithfully represented and reported in accordance with their substance and economic reality and not merely their legal form;
- **Completeness** – for the information to be reliable it must be materially complete within the reporting boundaries set since an omission can cause the information to be false or misleading and therefore, unreliable.

Comparability

Refers to consistency in the way mineral resources and mineral reserves are classified in compliance to the SAMREC code i.e. consistent in the interpretation of the code. Information about a company's mineral reserves is useful if it can be compared with similar information from other companies or with similar information from past periods from the same company. The information should be comparable in terms of content, quality and presentation. The measurement, classification and presentation of the mineral reserves of similar geologic confidence and economic parameters should be carried out in a consistent way throughout the enterprise into the foreseeable future, until the standard or the code changes. This is usually ensured through the development of internal protocols and standard work procedures in the measurement, classification and disclosure of mineral resources and mineral reserves.

Constraints

In an effort to comply with all the above mentioned reporting principles, there are some constraints that will render the information useless, if a balance between the principles is not exercised. These constraints revolve around relevant and reliability of information and are explained in the following circumstances:-

- **Timeliness** – if there is significant delay in reporting after the close of the reporting period the information may lose its relevance. In order to provide information on a timely basis, it may often be necessary to report before all aspects of a transaction are known, thereby impairing reliability. On the other hand, if reporting is delayed

until all aspects are known, the information may be highly reliable but of little relevance to users who have had to make decisions in the interim. A balance between reliability and relevance has to be achieved. Even though in the extractive industry, reliability takes more precedence since the results will be estimates, therefore these estimates have to be verified before they can be published into the public domain. Otherwise the information could be misleading and culminates into a mineral scandal like the Bre-X.

- **Cost/Benefit** – the benefits derived from the information should always exceed the cost of providing it. Even when the information is both relevant and reliable it should not always be reported. Useful information should only be reported when the benefits to be derived from the information exceed the cost of providing it, even though evaluating the cost and benefits of information is very subjective. It is difficult to apply the cost/benefit testing to any particular case especially in the extractive industry where there is a wide spread of stakeholders involved, therefore the code writers should be aware of this constraint;
- **Confidentiality** - has been defined by the ISO as "*ensuring that information is accessible only to those authorised to have access.*" Useful reporting ensures that the objectives of the reporting principles are achieved, whilst ensuring companies do not breach commercial confidentiality agreements nor are placed at a competitive disadvantage.

4.5 Lessons for the Extractive Industry

One important aspect to note is the slowness of the extractive industry to pass and adapt change in areas where change is required, for example passing decision such as the promulgation of the Royalty Bill in SA. It seems as if that history will repeat itself, the same happened in the development of mineral resource and mineral reserves classification system and definitions. To a larger extent this was illustrated by the time taken to develop and adapt the JORC code from 1971 up to 1989 which was approximately 20 years. Maybe this was as a result of individuals in the industry that are very risks averse and they are not prepared to face the consequences of their decisions or there is a large number of interested parties, therefore coming to a consensus and reaching an agreements is a difficult task and hence the process takes an abnormally long period of time for a conclusion to be agreed upon.

But once it has been tried and tested they can easily follow the bandwagon as evidenced by several countries writing their specific codes soon after the promulgation of the JORC code in 1989. In less than 10 years all the major mineral producing countries had adapted the JORC code and modified it to suit their own local requirements. The industry is perpetrated by people who are not prepared to embrace new changes as they come. Maybe the fear that it might not be generally accepted, hence they take their time to make decisions. Another typical example in the SA perspective is the time it has taken to produce the draft SAMVAL Code for comments.

It is in the opinion of the author that, this is the reason why it is very difficult to raise money on the JSE than to raise money for any project on the ASX or AIM. Investors on the ASX, AIM have over time gained trust and confidence in the reporting standards and the corporate

governance thereof. They are prepared to fund any project that has an upside potential. Even though there is always a high level of risk in mining projects, but the upside potential is very high. According to research, investing in mining projects is very risk to an extend that approximately on every 10 projects that you invest in only one might be successful but the returns thereof will be high enough to cover for all the other investments lost by investing in the other nine failed projects and still make some profit.

4.6 Recommendation to Establish Mineral Resource Committee

Mineral resource and mineral reserve issues particularly relating to the public reporting of mineral assets that has the potential to change the investment decision should be dealt with at board of director's level through the mineral resources committee. It is suggested that mining companies should establish mineral resource committee similar to the audit committee that should be composed of knowledgeable members and possibly headed by a non executive director, to help, advise the board of directors with interpretation and making recommendations on the operational and strategic decisions.

This committee should be appointed to assist the board in discharging its duties relating to the safeguarding of assets, value addition from a finite non-renewable resource, checks and independent internal audit on the work of the CP's, the optimum extraction and evaluation of the mineral deposits and implementation of adequate systems and internal controls necessary for the preparation of the compliant technical statements. The purpose is to provide additional focus on the mineral asset, since it's the mainstay of the business. Critical issues concerning the mineral asset that are vital to the operation of the company but which often cannot be fully examined by the main board because of shortage of time, lack of technical knowledge and skill. A separate committee composed of board members with the relevant mining, financial and geological skills should be established, it will be in a position to deal with issues pertaining to mineral resources. This would include the classification of resources and reserves and the valuation of these mineral assets in a greater detail than the main board. Because of lack of specialised skills and the development of mineral resource practitioners, firms cannot afford to have CP at every location and since mineral deposits are unique the protocols, control and operational systems will be different and difficult to implement these protocols. Therefore overseeing this type of work need well trained, educated and experienced individuals to seat on these committees and advise the board. At this level segregation of duties, technical expertise and experience, independence and objectivity will be called upon in executing the function as a mineral resource committee. The recent Enron collapse and the Bre-X scandal provides ample evidence of the need for mineral resource committee to independently examine the company's mineral assets estimation protocols and policies thoroughly to ensure they are appropriate to the business and results in a compliant mineral resource statement.

"*Although mineral reserves are arguably the most valuable asset for mining company, they do not appear as an asset on the balance sheet except to the extent they where purchased. Even then, the cost of mineral reserves is often not disclosed separately from other mining-related fixed assets*" (Deloitte Touche Tohmatsu, 2003). Therefore strong support both financial and technical and buy in from the top executives is required if the mineral asset is to be disclosed in compliance to the reporting principles highlighted earlier in this chapter and applicable legislation.

This will go long way in helping the directors to meet their fiduciary duties to the organisation since they can rely on the committee for a well thought advise.

4.7 Conclusion

In the recent years there has been a remarkable degree of international cooperation between the national resource/reserve reporting committee of the major mining countries to develop international recognised classification and reporting standards. The resulting uniformity of major resource/reserve reporting standards has greatly improved the understanding of what is meant by the terms mineral resource and mineral reserves. The historical development of the mineral resources and mineral reserves definitions and classification systems was discussed in this chapter. The general reporting principles was then reviewed and the forms the basis of the next chapter which is going to discuss the current reporting codes and rules, industrial best practice and norms that are currently being applied in the SA extractive industry.

CHAPTER FIVE

5 CURRENT VALUATION AND REPORTING RULES

5.1 Introduction

The current public reporting of exploration results, mineral resources and mineral reserves and mineral assets in compliance to the regulatory requirements is discussed in detail in this chapter. The first section details the interlinkages between the different rules, legislation and guidelines that have to be complied with in the extractive industry in SA. Then the major regulatory framework will then be discussed, these include the SAMREC code and the JSE listing requirements.

5.2 Compliance puzzle

The mystery of compliance and public reporting in the mineral industry appears to be an absolute maze of interlinked rules and codes regulating the administration and public reporting of mineral assets in the extractive industry. We will have a brief look at each of the various components of compliance and their interlinkages are represented in the form of the compliance puzzle. The compliance puzzle (Figure 12) was developed by Venmyn Rand (Pty) Limited, it shows the linkages that exist between the different regulatory codes, legislation and policies, standards and principles that govern the public reporting of mineral property in the extractive industry in SA.

Different stakeholders have different interests in the mineral asset, therefore the puzzle consists of a number of components to make sure that all the fundamental interests and risk areas are disclosed to enable the investors and their advisors to make sound, reasonable judgement and conclusions from the public reports.

The compliance puzzle, the interconnected framework of good governance, is centred on the various aspect of public reporting in the minerals industry. The blue block in the top left corner is the competent persons, and this is where reporting regulations start from. The upper half of the puzzle deals primarily with technical issues. Public reporting in the extractive industry commences with the competent persons. A competent person will be defined in the later section of this chapter under the SAMREC Code

The brick red blocks represent the official regulatory documents that have to be used as guidelines and standards in the preparation and reporting of mineral assets and exploration results in the public domain. While the beige blocks represent the fundamental technical issues relating to the SAMREC Code that forms the basis of an asset to be recognised as a mineral asset.

The competent person will implement the SAMREC Code which was first issued in March 2000, currently undergoing a re-write and the exposure draft was issued on the 15th June 2006. The SAMREC Code provides the standards and guidelines for the classification and public reporting of Exploration results, Mineral Resources and Mineral Reserves. It deals firstly with the technical issues regarding the orebody and thereafter the valuation aspects. For example if the gold price goes up then the pay limit goes down which effects the cut-off grade applied to the orebody model and as a result the reserves tonnages would increase.

The JSE Listing Requirements have embodied in them the SAMREC Code, so all public reports for listed companies are required to comply to the Code's guidelines. The Listing

Requirements go on to specify the minimum contents of a CPR with specific requirements for Exploration Companies and for Mining Companies. It also covers the required ongoing obligations to which listed companies must report and comply to.

The financial aspects of the puzzle will be covered in the “soon to be released” SAMVAL Code and the local and international accounting rules. There is a myriad of different methods of calculating value for an asset and more specifically a mineral asset. SAMVAL deals with which valuation methods should be used at the various stages of a mineral project. The implementation of the Capital Gains Tax legislation as of October 2001 looks at the capital gains that can be made when an asset is sold. How should these values be calculated? This is dealt with in the SAMVAL Code. Companies have to compile Asset Registers to identify all their various mineral assets and then go about valuing them. Companies are aiming to balance out their capital gains with their capital losses.

The final piece in the compliance puzzles is the MPRDA which was drafted to formulate a regulatory framework for SA’s mining and minerals industry. The aim of the legislation is to correct historical imbalances in the industry caused by the legacy of apartheid, without threatening its attractiveness to domestic and international investors. Some of the provisions of the Act are highlighted below:-

- All minerals belong to the State. South Africa has been unique in the fact that minerals were able to be held by private individuals and companies;
- “Use is or lose it principal” to mineral rights which had been previously “locked up”;
- Deals with the tradability of rights, all of which requires the Minister’s approval;
- The intention of the Act was to ensure increased access to mining activity for historically disadvantaged people and prevent the hoarding of mineral rights;
- Looks at the BEE requirements which are specified in the Mining Charter;
- Any company applying for rights will be measured using a Score Card; and
- Lastly the controversial Royalty Bill, which proposes an additional “tax” upon revenue depending on minerals. It release has been postponed to 2009.

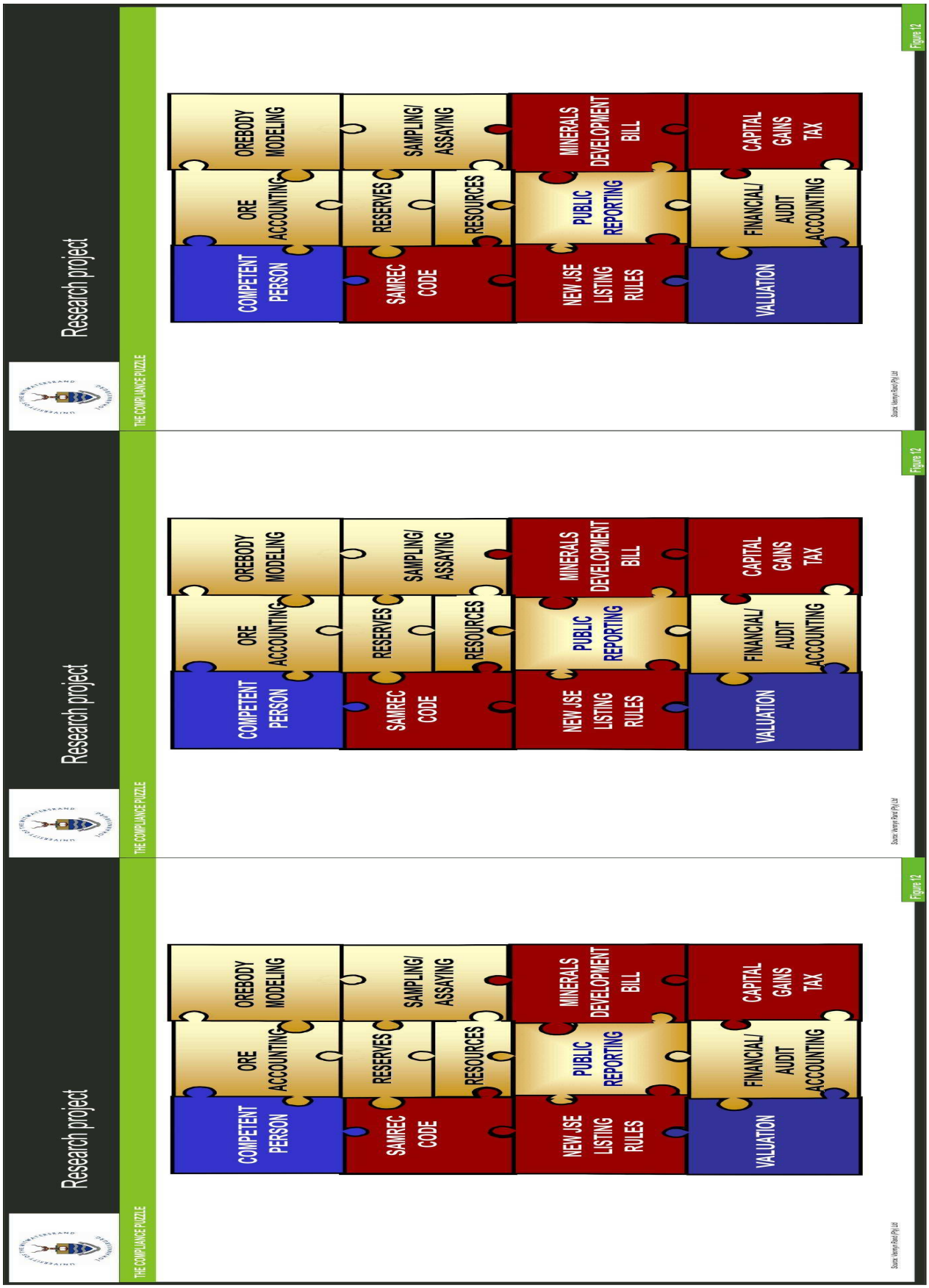
5.3 SAMREC CODE

The South African Code for Reporting of Mineral Resources and Mineral Reserves (the 'SAMREC Code') sets out the internationally recognised procedures and a required minimum standard for public reporting on exploration results mineral resources or mineral reserves in SA. This code was developed by the SAMREC under the auspices of the SAIMM and is the recommended guideline for mineral reserve and mineral resource reporting for companies listed on the JSE Limited. The code was prepared for the purpose of:-

- Informing investors or potential investors and their advisers
- Satisfying regulatory requirements on reporting exploration results, mineral resources and mineral reserves

The SAMREC Committee consists of various stakeholders such as SACNASP, representatives of the SAIMM, GSSA, PLATO, Association of Law Societies of South Africa, the DME, the Chamber of Mines of South Africa and the JSE. SAMREC was established in 1998 and modelled its code on the JORC Code.

Figure 12: The "Compliance puzzle"



The code is applicable to all minerals, as defined in the Minerals Act No 50 of 1991, for which public reporting of exploration results is required by the JSE. Minerals are defined in the Act as: "*any substance whether in solid, liquid or gaseous form, occurring naturally in or on the earth, in or underwater, or in tailings or dumps, and having been formed or subjected to a geological process excluding water but including sand, stone, rock, gravel and clay as well as soil and other than top soil*" (SAMREC, 2000).

The main principles governing the operation and application of the SAMREC Code are transparency, materiality and competence. The code was built on these three corner stones and it seeks to ensure that these principles are achieved or are seemed to be achieved in all public reports. The general reporting principles were discussed in greater detail in the previous chapter. Public reports include all reports that are published to providing information to the stakeholders and the public at large and are not limited to company annual reports, quarterly reports, technical papers and expert reports.

The bottom line is that a company must disclose all relevant information concerning the status and characteristics of a mineral deposit which could materially influence the economic value of that deposit, and promptly report any material changes in its exploration results, mineral resources and mineral reserves.

5.3.1 Scope

Paragraph 3.1 of the code provides the guideline of what the code intends to achieve, which is "to provide a minimum standard for public reporting, also to ensure that such reporting contains all information that investors and their professional advisors would require, and expect to find in the report for the purpose of making a recent and balanced judgment regarding the mineralisation being reported."(SAMREC Code, 2000. p 7). The public reports must provide all relevant and material information that is required by investors and their advisors to make informed investment decisions. Appendix 1 of the code details the checklist of assessment and the reporting criteria. The checklist is not prescriptive and relevance and materiality are overriding principles that determine what information should be publicly reported. The authors of reports should both identify and evaluate these important factors within their reports. However for a decision to determine whether the information is relevant and material remains a matter of professional judgment.

The need remains for the exploration and mining professionals to make difficult decision that is the classification of material as mineral resources or mineral reserve. Because of this difficulty, the professional has to be knowledgeable about the industry's practices, have relevant experience in the evaluation of the type and mineralisation of the deposit under consideration. The decision remains a matter of professional judgment based on knowledge, experience, industry practices and accepted international professional standards and ethics.

It should be recognised that all these reported values about the mineral asset are estimates derived from exploration results and these are predictions of what will occur in the future, based on imperfect knowledge of the present. Such results are inherently subject to some level of confidence and inaccuracy.

5.3.2 Competence and Responsibility

"A public report concerning a company's exploration results, mineral resources and/or mineral reserves is the responsibility of the company acting through its board of directors" (SAMREC, 2000).The code requires that the mineral resources and mineral reserves estimates which are included or to be included in a public report, must be prepared by or under the direction of, and signed by a CP. The code makes it clear that a public report should disclose the following information about the CP reporting on the results:-

- the name of the competent person;
- his qualifications;
- professional affiliations; and
- relevant experience.

The CP have been defined in the SAMREC code (2000, p8) as "a person who is a registered member of the SACNASP, or ECSA, or PLATO or any other statutory South African or international body that is recognised by SAMREC. A CP should have a minimum of five years experience relevant to the style of mineralisation and type of deposit under consideration and to the activity which that person is undertaking. If the Competent Person is estimating, or supervising the estimation of Mineral Resources, the relevant experience must be in the estimation, assessment and evaluation of Mineral Resources. If the CP is estimating, or supervising the estimation of Mineral Reserves, the relevant experience must be in the estimation, assessment, evaluation and economic extraction of Mineral Reserves". Besides the relevant experience in the style of the mineralisation, a competent person reporting mineral resources must have sufficient knowledge of sampling and assaying techniques relevant to the deposit under consideration to be aware of problems which could affect the reliability of the data.

The CP who signs off the statement should be clearly satisfied in their own minds that they could face their peers and demonstrate competence in the commodity, type of deposit and situation under consideration. Even though the estimation of mineral resources maybe team effort, the CP who signs the report is responsible and accountable for the whole of the report under the code, unless where there is a clear division of responsibilities within the team, then each person must be responsible for his contribution.

5.3.3 Reporting Terminology

The classification of mineral resources and mineral reserves for reporting under the SAMREC code should use the terminology shown in Figure 13. The SAMREC code provides definitions for mineral resources and mineral reserves and the sub-categories thereof. The diagram shows the relationship and the linkages between the different categories of the mineral resources and mineral reserves and hence provides a framework for the classification of the tonnage and grade estimates so as to reflect different levels of geoscientific confidence and different degrees of technical and economic evaluation. This classification system is based on an increasing degree of confidence in the geologic

delineation of the deposit for classification as a mineral resource, and allows for the application of economic limitations to assess the economic viability to allow for the classification as a mineral reserve. The code also provides guidelines on matters related to estimation and classification of mineral resources and mineral reserves, but deliberately non-prescriptive in the process and the reporting thereof leaving them to professional judgment of the CP.

As shown in the diagram, the indicated mineral resource would be converted to a probable mineral reserve after the application of the modifying factors and measured resources can be converted to proven reserve respectively. Figure 14 graphically illustrates the comparison of the SAMREC classification system and the UNFC. It also shows the amount of exploration and the technical and economic evaluation (pre-feasibility or feasibility studies) that is required for classifying of material into their respective sub-category in the CRIRSCO based classification system. For example you can only classify material in the proved reserve category when a detailed exploration programme and a feasibility study have been carried out.

There are certain situations where the measured mineral resources could be converted to probable because of uncertainties associated with modifying factors which are taken into account in the conversion from resources to reserves. This relationship is shown by a broken arrow in Figure 13, even though the arrow has a vertical component, this does not mean that there was a reduction in the level of geologic confidence or knowledge. In such a situation the modifying factors that have introduced some degree of uncertainty in the estimates should be fully explained and disclosed in the public report

5.3.4 SAMREC Definitions

The choice of the appropriate category of the SAMREC classification system depends upon the quality, distribution and quality of data available and the level of confidence attached to the data and one of the classification methodologies that are widely used is based on the borehole density and is shown graphically on Figure 15. As shown in the diagram, the geological confidence is achieved by the borehole density in the area; this would confirm the geological continuity. This would enable the classification of material in the different categories of mineral resources and then the economic viability would convert them into mineral reserves. The appropriate mineral resource or mineral reserve category must be determined by a CP; hence mineral resource classification is a matter of professional judgment. The classification of mineral resources and mineral reserves is primarily based on the level of geologic confidence and economic viability of the different portions of the deposit. Mineral resources and mineral reserves maybe classified according to the method used to prove them, such as by borehole drilling or by development, but a more practical division is according to the variation in extent to which proof has been carried. "*Drill indicated ore is used in base mineral valuation to refer to indicated by a sufficient number of boreholes drilled through the orebody to estimate tonnage and grade, which is later confirmed by development advanced primarily to make it accessible for mining*" (Truscott, 1962)

Figure 13: Relationship between Mineral Resources and Mineral Reserves

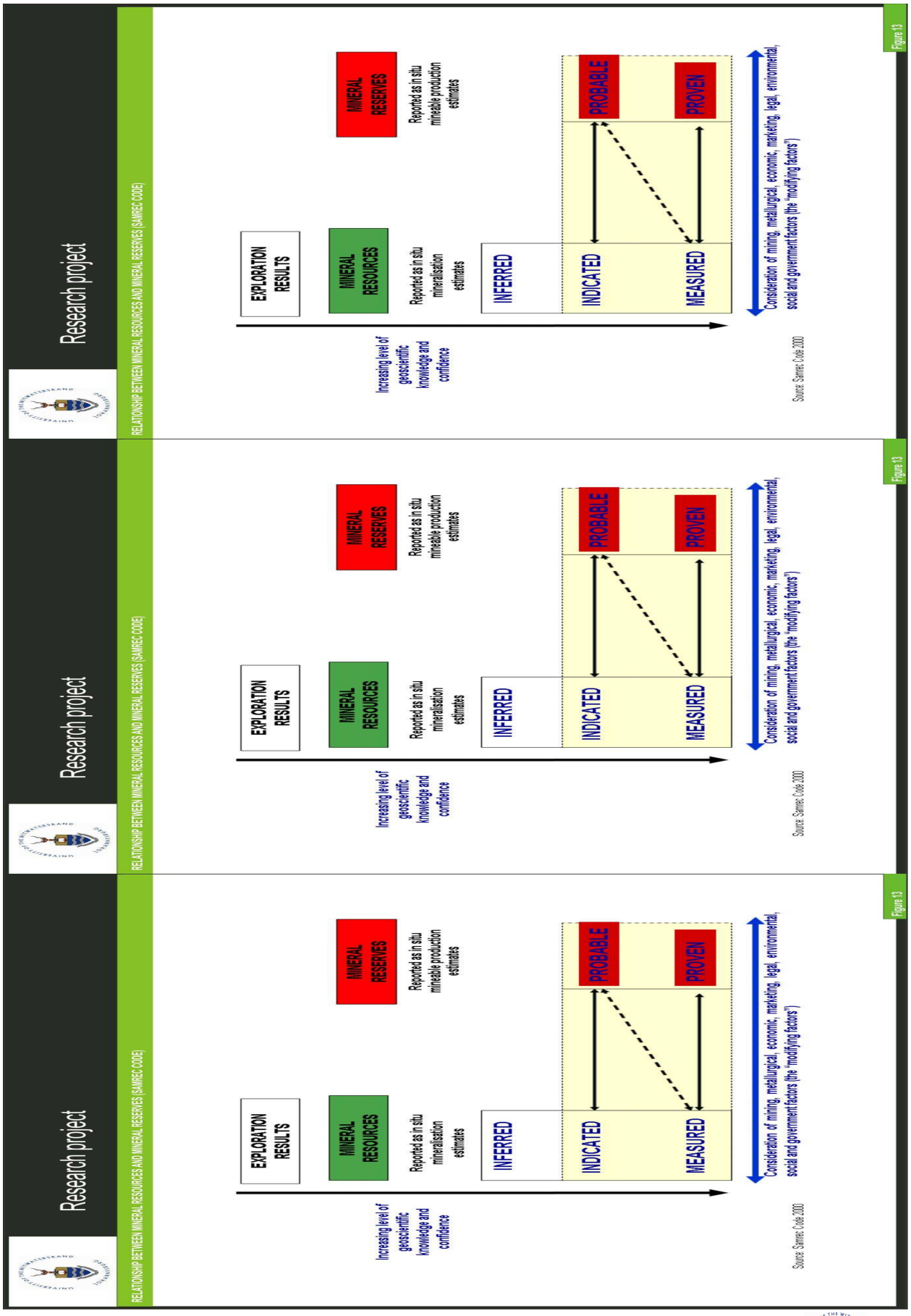


Figure 14: SAMREC Code Comparison with the UNFC



A certain school of thought says that surface drilling permits measurement of the ore reserves from only two dimensions. Hence according to this theory, none of the underground mineral deposit can be officially classified as "proven" since the third dimensional measurement may be only undertaken from underground to confirm continuity of ore outlines between drill holes. Raymond in 1985 had this to say concerning the mineral classification: "*when it comes to measuring ore reserves accurately, the key is a proper mix of sampling theory (statistics) and geology. Geostatistical methods depend heavily on large sample numbers and extensive close-spaced sampling, including heavily drilling local areas to estimate mining selectivity. Extensive drilling may not be economical in a small orebody. Even in a large orebody, going underground may ultimately be the only way to determine how well the ore can be followed*." The SAMREC code does not follow this school of thought, when the CP has drilled enough boreholes to confirm continuity of the orebody. Then he is in a position to classify the material as a mineral reserve if it is economically mineable under reasonable technical and financial assumptions.

Mineral Resource "is a concentration [or occurrence] of material of economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction. The location, quantity, grade, continuity and other geological characteristics of a Mineral Resource are known, estimated from specific geological evidence and knowledge, or interpreted from a well constrained and portrayed geological model"(SAMREC, 2000 p.12). Mineral resources are subdivided into inferred, indicated and measured categories, in order of increasing confidence in respect of geoscientific knowledge (SAMREC, 2000):-

An '**Inferred Mineral Resource'** is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that may be limited or of uncertain quality and reliability.(p.13)

An '**Indicated Mineral Resource**' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed.(p.14).

A '**Measured Mineral Resource'** is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm

geological and grade continuity.(p.14)

Mineral Reserve: A reserve is that part of the resource that meets minimum physical and chemical criteria related to the specific mining and production practices, including those for grade, quality, thickness, and depth; and can be reasonably assumed to be economically and legally extracted or produced at the time of determination. The feasibility of the specified mining and production practices must have been demonstrated or can be reasonably assumed on the basis of tests and measurements.

According to the code a mineral reserve was defined as an “economically mineable material derived from a Measured and/or Indicated Mineral Resource. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified” (SAMREC, 2000 p.16).

The term “reserves” need not signify that extraction facilities are in place and operative. The term “economic” implies that profitable extraction or production under defined investment assumptions (technical and financial) has been established or demonstrated. The assumptions made must be reasonable, including assumptions concerning the prices and costs that will prevail during the life of the project. The term “legally” does not imply that all permits needed for mining and processing have been obtained or that other legal issues have been completely resolved but that there are reasonable expectations of such approvals. However, for a reserve to exist there should not be any significant uncertainty concerning issuance of permits or resolution of legal issues. Mineral reserves can be subdivided with increasing economic certainty into probable and proven categories as defined by the code.

Figure 15: Classification Methodology of Mineral Resources to Mineral Reserves



1. *A '**Probable Mineral Reserve**' is the economically mineable material derived from a Measured and/or Indicated Mineral Resource. It is estimated with a lower level of confidence than a Proved Mineral Reserve. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified (p.17).*
2. *A '**Proved Mineral Reserve**' is the economically mineable material derived from a Measured Mineral Resource. It is estimated with a high level of confidence. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified.*(p.17).

5.3.5 Conversion of Mineral Resources to Mineral Reserves

Figure 13 shows the direct relationship between the criteria applied to indicated mineral resources and probable mineral reserves and between the criteria applied to measured mineral resources and proved mineral reserves. In other words, the level of geoscientific confidence for probable mineral reserves is similar to that required for the determination of indicated mineral resources. The level of geoscientific confidence for proved mineral reserves is similar to that required for the determination of measured mineral resources. Inferred mineral resources are always additional to mineral reserves. The Code also provides for a two-way relationship between measured mineral resources and probable mineral reserves. This is to cover the situation where uncertainties associated with any of the modifying factors considered when converting mineral resources to mineral reserves that may result in a lower degree of confidence in the mineral reserves than in the corresponding mineral resources. Such a conversion would not imply a reduction in the level of geological knowledge or confidence. A measured mineral resource may be converted to a proved mineral reserve if the uncertainties in the modifying factors are removed. No amount of confidence in the modifying factors for conversion of a mineral resource into a mineral reserve can override the upper level of confidence that exists in the mineral resource. Under no circumstances can an indicated mineral resource be converted directly to a proved mineral reserve.

Only part of a mineral resource that has been classified as measured and/or indicated can be considered for conversion to a mineral reserve if the satisfy the economic viability. Under no circumstance can an inferred mineral resource be converted to a mineral reserve unless it is first converted to an indicated or measured mineral resource. It should be noted that, even

though inferred mineral resources cannot be considered in the estimation of mineral reserves for public reporting, such resources have value which should be recognised in other situations. Economic value is given to inferred resources in the public valuation of mineral properties, during mergers and acquisitions, when developing operating plans, and for impairment testing.

5.3.6 Highlights of the Public Reporting Principles based on SAMREC Code

The important aspects of public reporting when it comes to mineral resources and mineral reserves as highlighted in the code these includes the following:-

- Mineral resources are tonnages and grades of the in-situ ore estimated over a realistic stoping width while mineral reserves are estimates of tonnages and grades of the material reporting to the plant after considering all the mine recoveries (Run-of-mine). For public reporting all the relevant factors and modifying factors must be stated in the report i.e. most importantly the commodity price used in the evaluation, the estimated metallurgical recovery factors and mine or mill call factors;
- Economic viability becomes the fundamental parameter, in the classification of mineral resources and mineral reserves. Mining decisions are made based on the economically mine able portions of the resource. Mineral reserves are economically mineable portions of a deposit for which extraction can be justified at the time the valuation was done. Mineral resources must have reasonable and realistic prospects of eventual economic extraction with the available and known technology. Portions of the deposit that do not have reasonable and realistic prospects of eventual economic extraction must be excluded from mineral resources; hence a realistic minimum cut-off grade must be applied when estimating a mineral resource;
- Modifying factors, these are considerations of mining, metallurgical, economic, marketing, legal, environmental, and social and government factors, which have to be taken into consideration and be fully satisfied when converting mineral resources to mineral reserves;
- Public reports must be based on and fairly reflect the report of the CP and shall require his written approval for the relevant parts of his report that will be published to the public domain. In the CPR, the CP's qualifications, professional affiliations and relevant experience should be disclosed;
- The code is not prescriptive on how the mineral resources can be reported either inclusive of mineral reserves or exclusive of mineral reserve. However, in the case where mineral resources are reported inclusive of mineral reserves, the relevant details (i.e. cut-off grades) of the mineral resources which have been used to modify the mineral resources to produce mineral reserves must be included in the report;
- The rewrite of the code is also designed to improve the code and eliminate any contradictory reporting practices and to ensure that the reporting of exploration results, mineral reserves and mineral resources are consistent and reliable.
- *"A company must disclose relevant information concerning the status and*

characteristics of a mineral deposit which could materially influence the economic value of that deposit, and promptly report any material changes in its exploration results, mineral resources or mineral reserves". (SAMREC, 2000).

- If a company is reporting on exploration results in relation to mineralisation that cannot be classified as mineral resources or mineral reserve, then estimates of tonnage and associated average grade must not be reported but all relevant prospecting information should be disclosed.
- The code is non-prescriptive, this gives the freedom for the competent person to make experienced-based decisions, and exercise professional judgment and comes with it responsibility and accountability in various guises:-
    1. statutory accountability through the JSE requirements to abide by the SAMREC code in public reports;
    2. ethical accountability through answerability to the recognised professional bodies; and
    3. moral responsibility, since competent persons are representatives of the mining industry with a duty to properly inform and not mislead potential investors.
- Mineral reserves derived from inferred mineral resources can be included in the mine cashflow or in valuation models only in exceptional circumstances when deemed appropriate by the CP. When this is done extreme caution should be exercised and a comparison of the two scenarios should be disclosed and explained fully in the public report;
- Mineral reserve reports must specify the different categories in which the material has been classified and the metal content figures should be presented only when the corresponding tonnage and grade figures are also given in the report;
- When both the mineral resources and mineral reserves are reported, the report should clearly indicates whether the mineral resources where reported inclusive of those mineral resources modified to produce the mineral reserves. Eventhough the mineral resources can be reported exclusive to the mineral reserves, when this is done it should be disclosed. It is imperative to note that the reported mineral reserve figures cannot be added to the reported mineral resources;
- The code also allows the reporting of all potentially economic mineralised material which is potentially mineable such as remnants, pillars, dumps and tailings where there are reasonable and realistic prospects for eventual economic extraction. Portions of a deposit that do not have reasonable and realistic prospects for eventual economic extraction under assumed and justifiable technical and economic conditions, must not be included in a mineral resource or reported on.
- Any adjustment made to the data for the purpose of making the mineral resource estimate, for example elimination of very high grades or any other relevant assumptions, should be clearly stated and described in the public report.

- In the public reports all the sub-categories of the mineral resources or mineral reserves should be specified. The reports must not contain figures that combine two or more of the categories unless figures form the individual categories are also provided;
- It should be noted that it is not implied by the code that an economic mining operation must have proved mineral reserves since its operating, however situations may arise where probable mineral reserves alone may be sufficient to justify extraction, but this is a matter for judgement by the CP.

5.3.7 Update on the SAMREC Code (Exposure Draft)

The long awaited new exposure draft of the SAMREC Code was released for comments last Thursday 15th June 2006. These have been prepared by the SAMREC working group under the joint auspices of the SAIMM and the GSSA and the code remain based on principles rather than prescriptions.

The SAMREC Code was introduced in March 2000, the industry has had time to use and apply the code and to experience the practical realities of problems and solutions to the interpretation of the code. After the completion of the on-going reporting requirements for listed companies on the JSE, the SAMREC/SAMVAL committee decided that an update of the code. "*The update mandate was to:-*

- *To review, improve and develop the Code and eliminate possible contradictions and inconsistencies;*
- *To align SAMREC with recent changes to other international codes;*
- *To ensure that, in keeping with international best practice, reporting of exploration results, mineral resources and mineral reserves are consistent and reliable;*
- *To remain within the internationally approved (CRIRSCO) definitions: and*
- *To develop best practice guidelines".(Mullins, 2006)*

There are a few changes that have been made to the SAMREC Code 2000 edition. Potentially the Code will require that companies may have to report more information than they have done in the past regarding their mineral assets and more comprehensive studies have to be done before mineral reserves can be declared. However, this does not have to be an onerous task, as it is expected that specific comment will have to be made on each of the subjects to be addressed but not necessarily long drawn out discussions as we have seen in some recent South African CPRs.

The summary of the changes that have been included in the exposure draft includes the following:-

- an additional guiding principle has been added which is impartiality. "*The author of the public report is satisfied that his work has not been unduly influenced by the organisation, company or person commissioning a public report…..that all assumptions*

are documented, and that adequate disclosure is made of all material aspects that the informed reader may require, to make a reasonable and balanced judgment thereof" (SAMREC 2006. p. 4) This partially emphasizes the need for independence in the manner the mineral assets are publicly reported by the CP;

- During the year the SAMREC committee was reorganised as a joint committee of the GSSA and of the SAIMM and identical resolutions were passed by both councils that membership of SAIMM and GSSA now qualifies their members to be recognised as a professional qualification for a CP as defined by the SAMREC code. These professional organisations where previously not specifically mentioned in the Code that their members are recognised as CP, have the powers to sign off public reports and have to comply with the provisions of the relevant facts. In a further move towards the international reciprocity of CP's the GSSA were accepted by the ASX as members of the ROPO. The members of the ROPO may thus sign off as a CP on the ASX, under the JORC Code, without having to join one of the sponsoring entities of the JORC Code itself ;

- the use of the inferred mineral resources in public reporting was tightened up. As much as it is accepted that a portion of the inferred mineral resources may be included in the mine design and planning. If this category is however included in the mine design, planning and /or economic studies full disclosure and the results of the studies with and without these mineral resources should be disclosed. In the 2006 exposure draft of the updated SAMREC code, "*Inferred Mineral Resources may only be included in mine design, mine planning and/or economic studies provided that:-*

  1. *there exists a mine plan and a statement of mineral reserves;*
  2. *the mineral reserve statement states that inferred mineral resources have been used to define ultimate mining limits;*
  3. *Inferred resources cannot be converted and stated as part of the mineral reserve;*
  4. *a comparison of the results with and without these inferred mineral resources must be shown;*
  5. *where a material amount of mining in the life of mine on an annual basis includes Inferred mineral resources, the proportion must be shown;*
  6. *the rationale behind the inclusion of such Inferred Mineral Resources must be explained; and*
  7. *Modifying factors and assumptions that were applied to the Indicated and measured mineral resources to determine the mineral reserves have been at least equally applied to the Inferred Mineral Resources"* (SAMREC, 2006 p.9).

- *"Competent Persons will be required to register with the SAMREC/SAMVAL committee, in accordance with the committee's rules. Complaints made in respect of the public report of a CP will be dealt with under the disciplinary procedures of the SAMREC/SAMVAL committee, or under the relevant ROPO agreement."*

(SAMREC,2006 p.5); and

- Improved explanation of mineral reserves and the pre-qualification before a mineral reserve can be declared, it is now a requirement that a minimum of a pre-feasibility study for a project must have been carried out, including the recognition of all modifying factors. *"Mineral reserves are reported as inclusive of uneconomic material and diluting material delivered for treatment or dispatched from the mine without treatment. To avoid confusion in the reporting mineral reserves the definition of treatment is taken to include any beneficiation of the raw product that might take place prior to, or during, the metallurgical process.*" (SAMREC, 2006 p.11);

- "*when revised mineral resource and mineral reserve statements are publicly reported they must be accompanied by reconciliation with previous statements. A detailed account of differences between the figures is not essential, but sufficient comment should be made to enable significant variances to be understood by the reader*". (SAMREC, 2006 p.13); and

- Lastly the inclusion of a checklist and guideline in Table 1 to be use as reference by those preparing reports on Exploration Results, Mineral Resources and Mineral Reserves. This is represented in table format that is easy to understand, read and cross referencing with the report. *"The checklist is prescriptive and, as always, relevance and materiality are overriding principles that determine what information should be publicly reported. It is, however, important to report any matters that might materially affect a reader's understanding or interpretation of the results or estimates being reported.*" (SAMREC, 2006 p.20).

The evaluation and reporting of mineral projects or assets is an expression of professional judgment predicated on knowledge and experience, not merely arbitrary determinations but seek to facilitate valuations as a consequence of method. Hence the methods employed must be scientifically valid, tested, using accepted scientific definitions of terms and procedures, and best suited to the making of reliable estimates for the project in question. In conclusion "*when information is publicly reported, it must be sufficient to enable an intelligent layman to make a reasonable and balanced assessment of the significance of this information. It is, however, important to report any matters that might materially affect a reader's understanding or interpretation of the results or estimates being reported.*" (SAMREC, 2006 p.20).

5.3.8 Comments on Competent Person

It has become apparent that the high level of professional judgment, competence, responsibility and the level of experience required for one to act as CP. This area requires that the person have a deeper understanding of the overlaps that exists between his profession with other professionals or skills involved in the mineral resources estimation. These professions include geology, metallurgy, mining, finance and other specific skills that will be called for, if the person is going to execute his function to the required level of competency. Hence the need for specialised training for the mineral resources practitioners,

to give them a well balanced skills over and above their background professions. This will go a long way in ensuring compliance to the codes and standards and effective public reporting.

A CP "*mineral resources manager*" is a person who is a member of a professional body that is recognised by SAMREC and should have a minimum of five years relevant experience to the style of mineralisation and type of deposit under consideration and to the activity which that person is undertaking. As a general rule the CP should be satisfied with the information he would sign off, that he is sufficiently confident of the mineral resource estimation process and the results thereof. To an extend that he should be able to defend his assumptions, to a group of knowledgeable, experienced and competent peers who are assumed to give well informed and balanced critics. This is the test of reasonableness, which every CP should use in making assumptions and professional judgment.

5.3.9 Summary on the SAMREC Code

SAMREC requires reporting on the following:-

Is the sampling representative of the orebody;

What security precautions were undertaken to ensure no "salting" of the samples occurred;

What methods of assays did the assay laboratory use? This is particularly pertinent as to what occurred at Bre-X;

How has the database created from the sampling results been validated? What was done to ensure that no typing errors occurred during the entering of results onto a computer, etc.

SAMREC wants to know that once you have a clean and verified database, how you use it to ensure compliant reporting of the mineral assets.

SAMREC requires statements on the following during the orebody modelling process:-

Data compositing methods;

Geological interpretations and assumptions made in development of the model;

Distribution of the mineralisation and the level of confidence on geological continuity between samples used in the geological modelling;

Estimation methods. This is extremely important due to the vast range of geostatistical technique that can be applied to a data set and the different results which they produce. SAMREC requires a statement on the appropriateness of the techniques used.

Taking the geological model the following technical and economic modifying factors are applied to mineral resource to convert them to mineral reserves. This is particularly relevant to operating mines. Factors requiring reporting are:-

Mining and production factors such as the Mine Call Factor, Extraction Ratio;

Metallurgical or plant recovery factors or yields;

All this is required to be pulled together into a mass balance which shows what tonnage and at what grade a mine will be required to produce at to provide the final commodity outputs on

which the revenue stream is based upon;

Finally the code requires the mineral reserves be quoted as “Fully diluted, delivered to the front of the mill”.

When quoting mineral resources and mineral reserves the Code requires that specific information or data be reported in the public reports, these include:-

The estimation confidences and definitions and whether the sampling was sufficient for the estimation of the resources;

Not only are the technical modifying factors applied, but also the economic modifying factors;

This leads to the setting of the pay limit and cut off grades; and

Whether the mineral resources have been reported inclusive or exclusive of the mineral reserves.

CHAPTER SIX

6 JOHANNESBURG STOCK EXCHANGE LISTING REQUIREMENTS

The SAMREC code was adopted in totality including the guidelines as section 12 by the JSE as listing requirements and as additional disclosure requirement by exploration and mining companies. This was done to increase transparency in the public reporting of the mining companies, and aims to promote optimum and responsible disclosure of information to investors and potential investors since the mineral asset is the principle or most important asset for a mining company.

The JSE instituted a committee with the aim of drafting a new version of the listing rules for mineral companies (section 12), after the finalisation of the SAMREC code of 2000. The committee has a wide membership which includes all major stakeholders in the public and private sector and the SAMREC committee was fully represented in this committee. "*Section 12 of the JSE's Listing Rules deals with the reporting of geological information and the section is based on the SAMREC code".(*Burke,2005). This was done "*for the purpose of ensuring that the process of reporting for mineral companies is consistent with internationally accepted principles*" (JSE, 2003).

6.1 Guiding Principles

The CP reporting on mineral reserves and mineral resources in terms of section 12 of the listing requirements must comply with the SAMREC code first for him to comply with section 12. The persons should ensure that the information conform to the required standard of competence and be fully satisfied that they can defend their assumptions before his knowledgeable peers and demonstrate competence in the commodity, type of deposit and situation under consideration. According to section 13.2(b) the "*competent person should also be satisfied that their reporting has ensured full disclosure by the entity commissioning its work of all material information that might prejudice the integrity and accuracy of the information that is being reported upon. No information should be disclosed which could misled the readers of the report with respect to the commercial prospects of the projects being reported.* (p 12-7)"

Companies and individuals that prepare and report under section 12 and the SAMREC code should be aware the , the JSE listing division will review all CPR's using an independent technical reader's panel for assessment and comment as part of the JSE approval process. Any material unresolved complaints with the CP will be referred by the JSE listing divisions to SAMREC who will ensure disciplinary action is taken by the body under which they are registered as professionals. This was done in an effort to instil and foster the importance of competency, transparency and relevance when it comes to public reporting of mineral assets. In the case where the CP relies on information provided by the third party and or include or uses such information in a CPR's in whole or part must perform all necessary validation and verification procedures that they might deem appropriate in order to satisfy themselves that they are able to place reliance on such information. Reference to such reliance and the details of the information relied upon must be disclosed in the CPR.

Section 12.5 states that "*if information required to be disclosed under this section is confidential for legal and or other reasons and the directors of the company can prove to the satisfaction of the committee that the mineral company's legitimate interests might be prejudiced if the information was to be disclosed"*.

The committee may grant a dispensation from the requirements to make the information public. Therefore all material information should be communicated to the public except when a dispensation is granted.

Under section 12, the listing requirements apply to mineral companies and are grouped into two groups that are exploration and mining companies. Separate set of requirements needs to be fulfilled by the different companies. In the case where the company is involved in both exploration and mining, it has to comply with all the provisions of the two sub-categories. The same section goes on to give a detailed account of the minimum requirements and items that should be covered in a fully compliant CPR under this section and the SAMREC code.

In conclusion the section 12 of the listing requirements was developed in order to enforce and reinforce the principles and the guidelines in the SAMREC code and making these provisions mandatory as law. Good public reporting practices has been greatly enhanced because of the establishment of the independent readers as checks and balances on the work of the CP. This is an effective way of monitoring compliance of the code and ensures that the provisions are adhered to all the times. "*From a JSE perspective, the SAMREC code levels the playing field and allows for consistent disclosure by resources companies regarding reserves and resources as well as the reporting of other geological information,"* (Burke ,2005).

General issues of the JSE

The JSE listing requirements for exploration and mining companies as provided for in section 12 of the JSE listing requirements will be discussed in the following section of this report and the focus will be on public reporting of the mineral asset. The detailed discussion will emphasize on the above mentioned issues, with regard to the information that is published on to the public domain and how it might possibly influence or mislead investors and their professional advisor in decision making. The discussion in this section is not exhaustive for the companies listed on the JSE in the extractive industry.

6.2 Exploration Companies

These are companies that are involved in the process of searching, discovering and confirming mineral occurrences in the ground. Mostly these companies are not the ones that will be involved in the actual mining activities. For a company to be admitted to be listed on the mineral resource-mining-exploration sector on the main board, it has to demonstrate that:-

the company's manager have satisfactory experience in the exploration activities that the company purports to do;

they are entitled to explore for the relevant minerals; and

they would disclose any information and details of any direct or indirect interest, beneficial or non-beneficial, which each director, CP and related party as within two years of the date of prelisting on the concerned mineral asset or any right to explore for minerals.

Section 12.8 subsection (d) emphasizes the need for independence in mind and indeed of the CP when carrying out and reporting the exploration results. "*If the CP is not independent of the issuer*

(company reporting results), clearly disclose the nature of the relationship or interest "(JSE, 2003).

This will enable mineral analysts, investors and their professional advisors to make an informed decision on what extend the interests or relationship can influence the reporting of the exploration results. Nowhere in the SAMREC has code required the need for independence of the CP, but it requires that any related party to disclose the nature of the relationship. However, it is the duty of the directors and the CP to consider whether any conflict of interests exists either as a consequence of pressure of the on-going relationship.

The essence and principle of the SAMREC code is that public reports must contain sufficient information to enable the "intelligence layman" to make a balanced judgment of the significance of the information. Further, exploration results must not be presented in such a manner that might unreasonably imply that potentially economic mineralisation has been discovered.

The issue that have raised intense debate around the world is whether an exploration company can present details of a potential mining operation to exploit the mineral reserves and mineral resources and can they be valued at this point. The essence of mineral reserve definition is that it has realistically reasonable prospects of eventual economically extraction in the current economic, social and political climate. An appropriate cut-off has been calculated and a split between payable and unpayable resources established. According to the SAMREC code 2006 exposure draft promulgated on the 15th of June 2006, it requires that at least a pre-feasibility study be carried out before any mineral resource can be converted and as reported as mineral reserves. "*Appropriate assessments to a minimum of a minimum of a pre feasibility study of a project , or a life of a mine plan for an operation, must be carried out, in the consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors"* (SAMREC, 2006 exposure draft p.11)

The London and Australian stock exchange expressly exclude inferred resources to valued or to included in a valuation model but for deposits which are characterised by high degrees of geological grade continuity an inferred resource can be valued. The SAMREC 2006 guideline says, "*caution should be exercised if this category is considered in economic studies, and if included, full disclosure and the effect on the results of the economic studies must be stated. A comparison between the two scenarios , the one with inclusion and the one without inclusion and the one without inclusion must be fully explained in the public report in such a way as not to mislead the investors*".(SAMREC, 2000 p.13). More importantly, is the uncertainty and insufficient data to allow the geological and/ or grade continuity to be confidently be interpreted. It would be unreasonable to assume that all or part of an inferred mineral resource will be upgraded to an indicated or measured resource as a result of continued exploration.

In conclusion the confidence in the estimate for an inferred mineral resource is usually not sufficient to allow the appropriate application of technical and economic parameters as to enable an evaluation of economic viability. Another important issue that hasn't been given the attention it deserves is the graphical presentation of each mineral property being reported on. The diagrams, maps and plans should be included in the detailed mineral resource statement to graphically show the location, the nature and extent of workings thereon and all principal geological features. Clarity and transparent disclosure are the guiding principles that are at the heart of SAMREC code. These

diagrams should also be used to illustrate the location of the mineral project, its legal boundaries, infrastructure and contained mineral resources, the location of the boreholes in to the geological model. Any visual material that assists in understanding the magnitude of the project and if possible, adjacent workings and properties of a similar nature should be indicated especially if they sense to demonstrate prospectively and potential for future development.

6.3 Mining Companies

The listing committee may only admit a company on the main board when all other listing requirements have been fulfilled and that the company undertakes or proposes to undertake mining operations. According to provisions of the JSE listing requirements, paragraphs 12.8 and 12.9, mutatis mutandis apply in respect of the content of a CPR for mining companies but in full compliance to the SAMREC code. The issues that are pertinent to the mining companies when it comes to the mineral assets public reporting and valuation thereof will be discussed in this section.

The mining factors or assumptions and the method used to convert the mineral resource to mineral reserves should be disclosed. This includes the choice of, the nature, the appropriateness of the selected mining method and other mining parameters including associated design issues such as pre-strip, underground development and access. The assumption made regarding geotechnical parameters (e.g. pit slopes, slope size), grade control and pre-production drilling. The mining dilution factors, mining recovery factors and minimum mining width used and the infrastructure requirements of the selected mining methods and a certain degree of historic reliability of the performance parameters. All this should be disclosed in a public report since this makes the inputs into the process of converting mineral resources into mineral reserves and the pre-feasibility study as required by the up-dated SAMREC code, exposure draft. To compliment the efforts in the process, diagrams should clearly indicate the spatial relationship of the mining infrastructure, mineral reserves and mineral resources together with planned mining production capabilities.

The metallurgical process proposed and appropriateness of that process to the style of mineralisation, and whether the metallurgical process is well-tested and tried technology. The nature, amount and representativeness of metallurgical test work undertaken and the metallurgical recovery factors used in the evaluation. It is important to ascertain whether the recoveries are reasonably and realistically achievable given the nature, comparison and presence of deleterious elements in the ore to be processed. The existence of any bulk sample or pilot scale test work and the degree to which such samples or pilot test work are representative of the ore body as a whole and or the full-scale metallurgical process as envisaged for mining.

Other factors that might affect the feasibility of the mining operation, and requires disclosure in the public report to enable investors and their professional advisors to make informed business decision include the following:-

Assumptions made on the cost, revenue and funding. The assumptions made regarding revenue including head grade, metal commodity prices, exchange rates, transportation and treatment charges, penalties, etc. The allowances made for taxies, royalties payable, both governmental and private.

The market assessments which includes a detailed study of the demand, supply and stock

situation for the particular commodity, consumption trends and the factors likely to affect supply and demand into the future;

In conclusion the effect of any other modifying factors, if any, of natural risk, infrastructure, environmental, legal, marketing, social or governmental factors on the likely viability of a project and or on the estimation and classification of the mineral reserves. Hence at all times, the valuation reports should not present an unrealistic expectation as to the operations profit potential; and

The status of titles and approvals are very critical to the viability of the project, such as mining leases, discharge permits, government and statutory approvals.

In addition to the disclosure in the public report highlighted above, terms of paragraph 12.14(b) requires that " *the CPR must include annualised forecast free cash flow mining valuation numbers and all key criteria and assumptions made in arriving at such valuation, which shall include in tabular form, without limiting the generality thereof, that portion of the life of the mine, stated in years, as determined by the CP for valuation purposes (for which they are reasonable prospects that the mined reserves and mineral resources can sustain the relevant life of mine cash flows).* (JSE, 2003 p. 12-17).The public reporting and the valuation of mineral assets will be governed by the SAMVAL code once it is enacted and the exposure draft was issued on the 15th June 2005 requesting for comments from the interested stakeholders in the industry. This code was prepared by South African Assets Valuation working group under the joint auspices of the SAIMM and the GSSA.

Another important issue when reporting mineral properties is the reporting of mineral reserves, tonnages and as grades as fully diluted delivered to mill. The essence of this issue is that all measurable mining and ore accounting inefficiencies should be taken into account so that delivered to mill grade and tonnage should represent a mineral reserve that can be discounted by the plant recovery factor to give product yields and saleable product. Previously industrial practice was that reserves were quoted in-situ and analysts had to take into account MCF, Block factors and Mining Recovery Factors in order to determine what product could be derived to calculate revenue of the project. This new process of quoting should enable all reserves around the world to be comparable.

During this study, one major weakness of the SAMREC code when it comes to quoting mineral reserves of base metals was identified. The code is not very clear on which grade should be reported. For example in the reporting of vanadium mineral properties, recently two CPR dually signed of by different CP but for two adjacent mineral properties separated by a boundary fence. The first report quoted the percentage of V_2O_5 as an in-situ grade and the second one reported the grade after the magnetic separation. These two reports were very confusing, since these properties are just separated by the boundary fence, hence presumably the ore body characteristics are the same or at least very similar. This wasn't the case, after a careful investigation it was found that the other was an in-situ grade and the other was after magnetic separation. It is in author's opinion that the new SAMREC code should give a guideline on the public reporting in such circumstances to avoid confusing the investors and analysts.

CHAPTER SEVEN

7 CASE STUDY ON PUBLIC REPORTING (HARMONY VS GOLDFIELDS)

In this section the proposed merger follows a process initiated by Harmony Gold Mining Company Limited ("Harmony") on the 18th October 2004 to merge with Goldfields Limited ("Goldfields"). The proposed transaction between the two major gold mining companies will be analysed to form the basis of whether these companies' public reporting practices was fair and reasonable according to the requirements of the extractive industry's norms and in compliance with standards and codes that regulate the public reporting of mineral resources and mineral reserves in the industry. Harmony's stated reasons for the proposed acquisition include the need to create significant value, to revitalise Goldfields South African asset portfolio, to create a new international major with a compelling equity story and enhanced investor appeal and also to access the value of Goldfields' exploration portfolio. Goldfields objected to the proposed merger by launching a strong publicity campaign, which highlighted the present strengths and potential, including promised improvements, operational in efficiency. This also involved the revaluation of the company's mineral assets by engaging independent expert valuers to do a new mineral asset valuation in an effort to increase the asset backing and encourage upward movement in the share price. Information and data that was available on the public domain on this potential transaction was used to evaluate an independent opinion of the author on the compliance, fair and reasonableness in the reporting of mineral assets to the investors and the public at large.

On 18th October 2004, the Company announced a proposal to merge with Goldfields. The proposal comprised an offer of 1.275 new Harmony shares for each Goldfields share and 1.275 new Harmony ADS for each Goldfields ADS. The conditions precedent stated in the offer document include, inter alia, fulfilling certain obligations in respect of compliance with various sections of the listing requirements of the JSE and the Securities Regulation Code on Takeovers and Mergers.

7.1 Mergers and Acquisitions principle

A merger or amalgamation is a transaction that will result in the combination of two separate companies into a single entity. An acquisition is defined as the purchasing of the controlling interest by one company in another company. The key principle behind buying a company is to create shareholder value over and above that of the sum of the two individual companies.

For this to be achieved a clear strategy and vision should be clearly identified so that the company will commits its resources in furtherance of its objectives

There are several reasons why mergers and acquisitions may be worthwhile in the furtherance of the objectives. The possible reasons for an organisation in the extractive industry to consider growing the company through a merger or an acquisition includes the following:-

- To reduce competition (though in SA the Monopolies Commission exist to prevent this and in the extractive industry there is no gold mining company that can influence the price of gold);
- Benefits of synergy. Synergy is defined as the magic force that allows for enhanced cost efficiencies of the new business. Synergy takes the form of revenue enhancement and cost savings. By merging, the companies hope to benefit from the following:-

a) Staff reductions - As every employee knows, mergers tend to mean job losses. Consider all the money saved from reducing the number of staff members from accounting, marketing and other departments (Head Office staff). Job cuts will also include the former CEO, who typically leaves with a compensation package.

b) Economies of Scale - Yes, size matters. Whether it's purchasing mining consumables or general supplies, a bigger company placing the orders can save more on costs. Mergers also translate into improved purchasing power to buy equipment or office supplies - when placing larger orders, companies have a greater ability to negotiate prices with their suppliers. The globalisation of operations can offer opportunities to achieve operating economies in the extractive industry

c) Acquiring new technology and specialised skills- To stay competitive, companies need to stay on top of technological developments and their business applications. By buying a smaller company with unique technologies, a large company can maintain or develop a competitive edge in the mining operation.

d) Improve their mineral reserves, and the quality of these mineral assets and industry visibility - Companies in the extractive industry buy other companies in the same industry to improve their quantity and quality of their mineral assets in their portfolio and increase the general profitability of the company. A merger can also improve a company's standing in the investment community i.e. larger organisation with reduced risk could borrow money at lower interest rates and it's easier to raise capital than smaller ones.

- Obtain tax advantages when the acquiring company acquirers a loss-making company, whose past losses can be set against future profits of the combined entity; and
- Obtain resources more quickly or cheaply than can be possible through internal growth. These could include: assets that are undervalued or can be sold off (asset stripping); cash if the target company is very liquid; access to finance; expert staff; management expertise; technology; access to strategic suppliers and processing facilities. Excess finance invested at low interest rates could be utilised to acquire profitable ventures.

There are also major problems with acquisitions and mergers:-

- Many takeover bids are contested, which means that the directors of the target company may do their best to prevent the takeover;
- Shareholders of the target company may be unwilling to sell their shares or agree to the acquisition;
- There may be problems in integrating the work forces and there may be large-scale redundancies. Similarly problems in integrating different mining operations that had different operating and management culture and systems;
- Economies of scale, especially in head office functions, often do not materialise, or indeed becomes diseconomies of scale;

- There may be public relations problems with the different stakeholders boycotting the firm because they disagree with the takeover;
- There may be regulatory intervention; and
- The acquiring company may overpay for the company it acquires in an effort to lure the shareholders of the company that is being acquired. In so doing, it may stretch its financial resources and may even risk bankruptcy.

In general a company becomes vulnerable for takeover bids when it's perceived to be undervalued by the market i.e. the company will be worth more than the assets shown in the balance sheet. The directors must also review the market price of their shares constantly in relation to their earnings and assets values, to determine whether the company is undervalued or overvalued by the market. In addition, the directors should assess the company's position within its industry as regards technology, mineral reserves and mineral resources and size of operation etc to determine whether it is uncompetitive and likely to attract a takeover bid by a major player in the industry. For a takeover bid to succeed enough shareholders must be willing to sell; this will happen when they are attracted by the potential capital gain due to the high offer price, or when they are unhappy with the current share price performance.

7.1.1 Reasons for Mergers and Takeovers in the Extractive Industry

More mergers and takeovers are expected in the mining sector as firms scramble to replace mineral reserves. Taking over other firms was only a short-term solution for companies flush with cash, due to high commodity prices sparked by heavy Chinese demand, needed to step up exploration activity. "*With depleting reserve bases, companies will need to grow their reserves to remain in business. It is therefore likely that consolidation in the industry, hostile and friendly, will continue*," (Fraser, 2005)

Investments in new technology will help improve recoveries/yield as a short term solution, but eventually new reserves will need to be discovered, requiring further investment in exploration. One Mining Analyst from Pricewaterhouse Coopers was quoted by Fraser in May 2005 saying "*the ratio of exploration to acquisitions spending had generally fallen among major mining firms since buying ready-made ore deposits owned by another firm was less risky than exploring".*

7.2 Harmony Gold Mining Company Limited

Harmony was incorporated and registered as a public company in the Republic of SA on 25th August 1950. Commercial gold mining in SA evolved with the establishment of various mining houses at the beginning of the 1900's by individuals who bought and consolidated blocks of claims until sufficient critical mass could be established to sustain underground mining operations. During those days, the mining house would enter into a management agreement with the mine pursuant to which the mining house would carry out certain managerial, administrative and technical functions pursuant to long term contracts. Harmony was operated as a mining operation and the mining house Randgold and Exploration Company limited ("Randgold") retained the management agreement. In late 1994, Randgold cancelled the management agreement and entered into a service agreement with Harmony to supply executive and administrative services at market rates. Harmony

and Randgold terminated their service agreement and Harmony began operating as an independent gold mining company. However, Harmony's operations have grown significant since 1996, through mergers and acquisitions, expanding from a lease-bound mining operation into a large scale gold mining company. Since 1995 the company increased its gold sales from approximately 0.7Moz to approximately 3.0.Moz in fiscal 2005 as shown graphically on Figure 16:.

7.2.1 Operations

Harmony is currently the largest producer of gold in South Africa, producing some 30% of the country's gold, and the sixth largest gold producer in the world. As of 31 December 2004, Harmony's principal subsidiaries were Freegold, Randfontein, Avgold, Evander, ARMgold, Kalgold, and Harmony Australia. All subsidiaries are wholly-owned direct subsidiaries incorporated in South Africa, except for Harmony Australia, a direct subsidiary incorporated in Australia. In South Africa, Harmony and its subsidiaries have twenty-seven producing mines and three projects. In addition surface mining in the form of waste dump and slimes dam re-treatment operations are in production at Randfontein. Ore from the shafts, open-pits and surface sources are treated at ten metallurgical plants.

In Australia, Harmony currently operates two mining operations in Western Australia: Mt. Magnet & Cue Mine and South Kalgoorlie Mine. Underground and surface mining is conducted at each of these Australian operations, with underground access through two declines at Mt. Magnet & Cue Mine and one decline at South Kalgoorlie Mine surface access is principally through open pits. The underground operations of Big Bell ceased in fiscal 2004. Ore from the mining operations are treated at the Checker Metallurgical Plant and the Jubilee Metallurgical Plant.

7.2.2 Mineral Resources and Mineral Reserves Statement

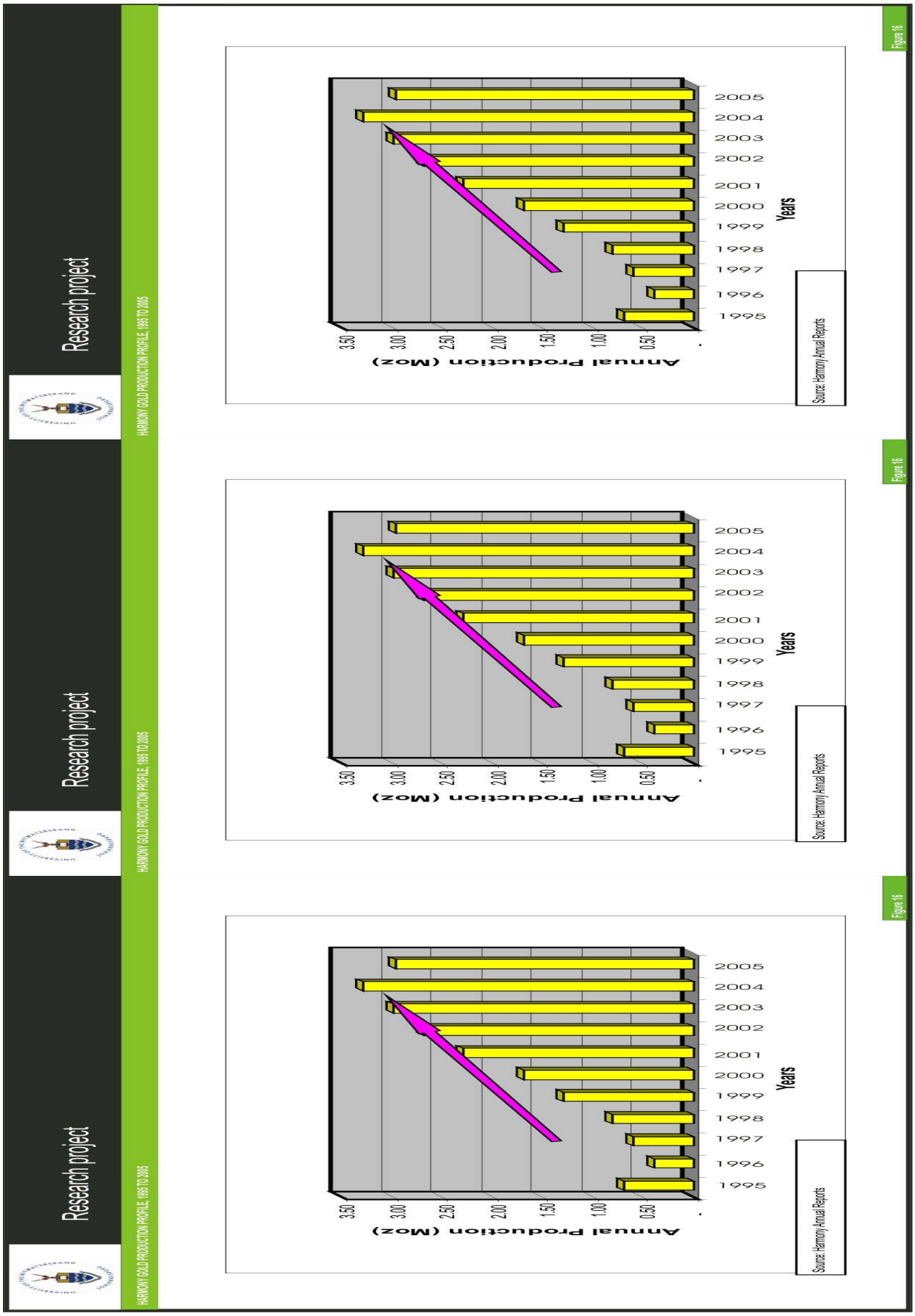
The Harmony way was a break with tradition and enabled a more immediate recognition of the profitability and cost structure issues on the mines and in the individual mine sections. Importantly, this led the industry to introduce grade control at a time when bulk mining and the economy-of-scale concept of cost per tonne mined was still a core driver of the industry.

Whilst Harmony continuously evaluates the working costs per tonne of ore, it is also concerned with the cost per ounce imperative which is an international benchmark. This was implicit to the managing of the lower grade mineral resources that inevitably formed part of the Harmony acquisitions and the commercial management was founded on the control of the mine pay limits. Since gold mines are "price takers" the Harmony way could only influence cost and efficiency controls as the pay limit formula is expressed as follows:-

Pay Limit = Working Cost ÷ Revenue

The effect of lowering the pay limit is to potentially increase the mine mineral reserve and to extend the life-of-mine, albeit that the magnitude of the effects is unique to each operation. This process is dependent upon the ore block distributions whereby each block has a unique tonnage and gold grade and forms part of a pay limit pay value curve.

Figure 16: Harmony Production Growth Profile Since 1995 to 2005.



Mineral resource management is a not a simple matter but the basic concept is that ore blocks that lie above the pay limit are economic and should be mined, whereas those that are below the pay limit are uneconomic and should not be mined. Regarding the classification and estimation of mineral resources and mineral reserve, SRK commented “the estimation of Mineral Resources and Mineral Reserves is not an exact science and degrees of subjectivity are inherent in the underlying processes” (SRK, 2005 p.27). This is graphically illustrated in the following grade tonnage curve shown on Figure 17. It shows the relationship between the pay grade and the corresponding mineable tonnage. If any change occurs in the economics of the operation the equilibrium point tends to shift to the right or left. For example if it moves to the left, the reduction in the pay grade would result in an increased pat tonnage (an inverse relationship).

Measured and indicated mineral resources are inclusive of those mineral resources modified to produce mineral reserves. Mineral resources are quoted at an appropriate in-situ economic cut-off grade with tonnages and grades based on the planned mining width. All mineral reserves are quoted in terms of ROM grades and tonnages as delivered to the metallurgical plant and are therefore fully diluted and account for mining extraction.

It is important to note that economic viability is critically dependent upon achieving the projected cost forecasts as well as the consensus macro-economic forecasts being realised. The resulting ZAR gold price is directly linked to the projected real terms devaluation of the ZAR against the US$. The mineral reserve estimation depends on the reasonable financial assumptions, hence should the real terms gold price remain at current levels (ZAR 80,000/kg to ZAR 85,000/kg) then the Mineral Reserve statements as reported in the annual statements may be significantly reduced. As at 30th June 2004 Harmony reported total mineral reserves containing approximately 62.3Moz of gold and mineral resources containing approximately 521.4Moz of gold. This mineral reserve and mineral resources statement was published in the 2004 annual report and is shown in Figure 18. Subsequent to this publication the company made two adjustments to the 30th June declaration:-

- A negative adjustment of 3.1Moz comprising depletion and cessation of mining operations at certain of the mining operations. This reduced the mineral reserve statement declared as 21st December 2004 to 59.2Moz;
- A negative adjustment of 3.6Moz at the Rolspruit Project and 1.1Moz for the shaft closures and re-classification of mineral resources included in the 21st December 2004 declaration. This reduced the mineral reserves declared at 1st January 2005 to 55.6Moz.

“SRK has stated in the CPR that the process of arriving at the Mineral Reserve statements currently adopted by the company has deficiencies. SRK notes the company’s stated intention to redress the identified deficiencies by undertaking improvements as stipulated in section 4.9.3 of the CPR” (SRK, 2005 p.4). Based on the results of the external audit that was carried out by SRK in the compilation of the CPR which was deemed to be effective on the 1st January 2005, the mineral reserve and mineral resource statement was readjusted

from a mineral reserve of 62.3Moz to 52.2Moz as shown in Figure 19.

And to put the Harmony operations in to perspective Figure 20 shows the selected salient historical operating and financial statistics and data, that have been extracted from detailed information as reported by Harmony in its 20-F submissions to the stock exchange and the company's audited financial statements for each of the years ended 30th June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The financial and operating assumptions used in the calculation, classification and as modifying factors for the conversion of mineral resources to mineral reserves where compared with the historical salient features as shown in the figure highlighted above. Assuming that there are no other material changes that will happen to the operations and the way the mineral reserves are managed, the assumptions are found to be realistically achievable and reasonable. This is not in comparison with Goldfields, the comparison between these two companies will be considered in the later sections of this report.

Figure 17: Harmony Grade Tonnage Curve Pre and Post Merger Transaction

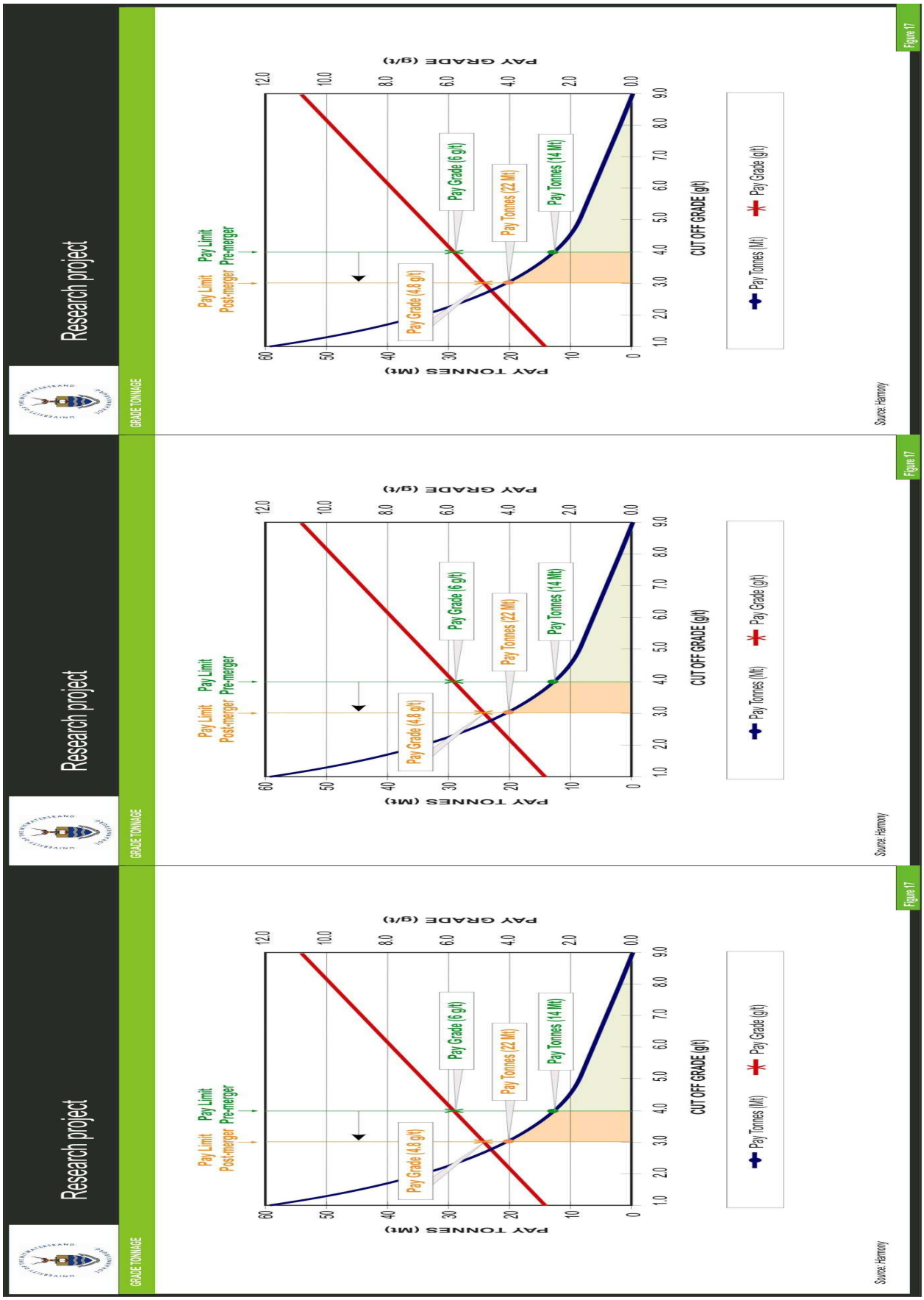


Figure 18: Harmony Mineral Reserve and Mineral Resource Statement as at 30th June 2004

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HARMONY MINERAL RESOURCE AND MINERAL RESERVE STATEMENT AS AT 30TH JUNE 2004 (UNAUDITITED BY SRK)

Mining Assets	Proven Mineral Reserves			Probable Mineral Reserves			Total Mineral Reserves		
	Tonnage (Mt)	Grade (g/t)	Gold (Moz)	Tonnage (Mt)	Grade (g/t)	Gold (Moz)	Tonnage (Mt)	Grade (g/t)	Gold (Moz)
South African Operations - u/g									
Elandskraal	11.57	8.2	3.06	21.76	8.1	5.69	33.33	8.2	8.75
Free State	25.25	4.7	3.82	19.09	4.4	2.71	44.33	4.6	6.53
Randfontein	8.99	5.6	1.61	5.57	5.5	0.99	14.56	5.6	2.6
Evander	11.1	6.8	2.42	60.63	6.9	13.39	71.73	6.9	15.81
Avgold	7.79	7.5	1.88	16.44	6.7	3.56	24.23	7	5.44
Freegold	23.76	7.6	5.78	51.82	6.9	11.47	75.58	7.1	17.25
ARMgold	3.19	8	0.82	0.55	7.3	0.13	3.75	7.9	0.95
Sub-total	**91.65**	**6.6**	**19.39**	**175.86**	**6.7**	**37.94**	**267.51**	**6.7**	**57.33**
South African Operations - s/f									
Elandskraal	0	0	0	0	0	0	0	0	0
Avgold	0	0	0	3.45	0.6	0.07	3.45	0.6	0.07
Free State	12.48	0.3	0.13	6.02	0.5	0.1	18.51	0.4	0.23
Randfontein	30.63	0.5	0.47	0.05	6.9	0.01	30.67	0.5	0.48
Evander	0	0	0	0	0	0	0	0	0
Kalgold	5.57	2.1	0.38	0	0	0	5.57	2.1	0.38
Freegold	2.53	0.5	0.04	21.45	0.6	0.38	23.98	0.5	0.42
Sub-total	**51.21**	**0.6**	**1.02**	**30.96**	**0.6**	**0.56**	**82.17**	**0.6**	**1.58**
Australian operations									
Northern Territory	0.05	11.4	0.02	0.8	3.1	0.08	0.85	3.6	0.1
Mt Magnet	2.46	1.9	0.15	5.24	4.6	0.78	7.7	3.8	0.93
South Kalgoorlie	1.5	2.7	0.13	1.16	3.8	0.14	2.66	3.2	0.27
Big Bell	0	0	0	0	0	0	0	0	0
Gidgee	0	0	0	0	0	0	0	0	0
Sub-total	**4.01**	**2.3**	**0.3**	**7.2**	**4.3**	**1**	**11.21**	**3.6**	**1.3**
PNG Operations	**2.02**	**3.1**	**0.2**	**19.44**	**2.9**	**1.84**	**21.46**	**3**	**2.04**
Total	**148.9**	**4.4**	**20.91**	**233.46**	**5.5**	**41.34**	**382.36**	**5.1**	**62.25**

Mineral Resources	Total Underground			Total Surface			Total Gold Mineral Resources		
	Tonnage (Mt)	Grade (g/t)	Gold (Moz)	Tonnage (Mt)	Grade (g/t)	Gold (Moz)	Tonnage (Mt)	Grade (g/t)	Gold (Moz)
Measured	379.54	5.29	64.34	51.57	0.31	0.68	431.11	4.69	65.02
Indicated	896.18	4.67	133.96	428.77	0.31	4.92	1,324.95	3.26	138.88
Inferred	2,836.29	3.42	309.98	968.89	0.31	7.55	3,805.18	2.69	317.53
	4,112.01	**3.73**	**508.28**	**1,449.23**	**0.31**	**13.15**	**5,561.24**	**3.52**	**521.43**

Source: Harmony Gold Mining Co Website

Figure 18

Research project

HARMONY MINERAL RESOURCE AND MINERAL RESERVE STATEMENT AS AT 30TH JUNE 2004 (UNAUDITITED BY SRK)

Mining Assets | Proven Mineral Reserves | | | Probable Mineral Reserves | | | Total Mineral Reserves
Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz)
South African Operations - u/g
Elandskraal | 11.57 | 8.2 | 3.06 | 21.76 | 8.1 | 5.69 | 33.33 | 8.2 | 8.75
Free State | 25.25 | 4.7 | 3.82 | 19.09 | 4.4 | 2.71 | 44.33 | 4.6 | 6.53
Randfontein | 8.99 | 5.6 | 1.61 | 5.57 | 5.5 | 0.99 | 14.56 | 5.6 | 2.6
Evander | 11.1 | 6.8 | 2.42 | 60.63 | 6.9 | 13.39 | 71.73 | 6.9 | 15.81
Avgold | 7.79 | 7.5 | 1.88 | 16.44 | 6.7 | 3.56 | 24.23 | 7 | 5.44
Freegold | 23.76 | 7.6 | 5.78 | 51.82 | 6.9 | 11.47 | 75.58 | 7.1 | 17.25
ARMgold | 3.19 | 8 | 0.82 | 0.55 | 7.3 | 0.13 | 3.75 | 7.9 | 0.95
Sub-total | 91.65 | 6.6 | 19.39 | 175.86 | 6.7 | 37.94 | 267.51 | 6.7 | 57.33
South African Operations - s/f
Elandskraal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Avgold | 0 | 0 | 0 | 3.45 | 0.6 | 0.07 | 3.45 | 0.6 | 0.07
Free State | 12.48 | 0.3 | 0.13 | 6.02 | 0.5 | 0.1 | 18.51 | 0.4 | 0.23
Randfontein | 30.63 | 0.5 | 0.47 | 0.05 | 6.9 | 0.01 | 30.67 | 0.5 | 0.48
Evander | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Kalgold | 5.57 | 2.1 | 0.38 | 0 | 0 | 0 | 5.57 | 2.1 | 0.38
Freegold | 2.53 | 0.5 | 0.04 | 21.45 | 0.6 | 0.38 | 23.98 | 0.5 | 0.42
Sub-total | 51.21 | 0.6 | 1.02 | 30.96 | 0.6 | 0.56 | 82.17 | 0.6 | 1.58
Australian operations
Northern Territory | 0.05 | 11.4 | 0.02 | 0.8 | 3.1 | 0.08 | 0.85 | 3.6 | 0.1
Mt Magnet | 2.46 | 1.9 | 0.15 | 5.24 | 4.6 | 0.78 | 7.7 | 3.8 | 0.93
South Kalgoorlie | 1.5 | 2.7 | 0.13 | 1.16 | 3.8 | 0.14 | 2.66 | 3.2 | 0.27
Big Bell | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Gidgee | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Sub-total | 4.01 | 2.3 | 0.3 | 7.2 | 4.3 | 1 | 11.21 | 3.6 | 1.3
PNG Operations | 2.02 | 3.1 | 0.2 | 19.44 | 2.9 | 1.84 | 21.46 | 3 | 2.04
Total | 148.9 | 4.4 | 20.91 | 233.46 | 5.5 | 41.34 | 382.36 | 5.1 | 62.25

Mineral Resources | Total Underground | | | Total Surface | | | Total Gold Mineral Resources
Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz)
Measured | 379.54 | 5.29 | 64.34 | 51.57 | 0.31 | 0.68 | 431.11 | 4.69 | 65.02
Indicated | 896.18 | 4.67 | 133.96 | 428.77 | 0.31 | 4.92 | 1,324.95 | 3.26 | 138.88
Inferred | 2,836.29 | 3.42 | 309.98 | 968.89 | 0.31 | 7.55 | 3,805.18 | 2.69 | 317.53
| 4,112.01 | 3.73 | 508.28 | 1,449.23 | 0.31 | 13.15 | 5,561.24 | 3.52 | 521.43

Source: Harmony Gold Mining Co Website

Figure 18

Research project

HARMONY MINERAL RESOURCE AND MINERAL RESERVE STATEMENT AS AT 30TH JUNE 2004 (UNAUDITITED BY SRK)

Mining Assets | Proven Mineral Reserves | | | Probable Mineral Reserves | | | Total Mineral Reserves
Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz)
South African Operations - u/g
Elandskraal | 11.57 | 8.2 | 3.06 | 21.76 | 8.1 | 5.69 | 33.33 | 8.2 | 8.75
Free State | 25.25 | 4.7 | 3.82 | 19.09 | 4.4 | 2.71 | 44.33 | 4.6 | 6.53
Randfontein | 8.99 | 5.6 | 1.61 | 5.57 | 5.5 | 0.99 | 14.56 | 5.6 | 2.6
Evander | 11.1 | 6.8 | 2.42 | 60.63 | 6.9 | 13.39 | 71.73 | 6.9 | 15.81
Avgold | 7.79 | 7.5 | 1.88 | 16.44 | 6.7 | 3.56 | 24.23 | 7 | 5.44
Freegold | 23.76 | 7.6 | 5.78 | 51.82 | 6.9 | 11.47 | 75.58 | 7.1 | 17.25
ARMgold | 3.19 | 8 | 0.82 | 0.55 | 7.3 | 0.13 | 3.75 | 7.9 | 0.95
Sub-total | 91.65 | 6.6 | 19.39 | 175.86 | 6.7 | 37.94 | 267.51 | 6.7 | 57.33
South African Operations - s/f
Elandskraal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Avgold | 0 | 0 | 0 | 3.45 | 0.6 | 0.07 | 3.45 | 0.6 | 0.07
Free State | 12.48 | 0.3 | 0.13 | 6.02 | 0.5 | 0.1 | 18.51 | 0.4 | 0.23
Randfontein | 30.63 | 0.5 | 0.47 | 0.05 | 6.9 | 0.01 | 30.67 | 0.5 | 0.48
Evander | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Kalgold | 5.57 | 2.1 | 0.38 | 0 | 0 | 0 | 5.57 | 2.1 | 0.38
Freegold | 2.53 | 0.5 | 0.04 | 21.45 | 0.6 | 0.38 | 23.98 | 0.5 | 0.42
Sub-total | 51.21 | 0.6 | 1.02 | 30.96 | 0.6 | 0.56 | 82.17 | 0.6 | 1.58
Australian operations
Northern Territory | 0.05 | 11.4 | 0.02 | 0.8 | 3.1 | 0.08 | 0.85 | 3.6 | 0.1
Mt Magnet | 2.46 | 1.9 | 0.15 | 5.24 | 4.6 | 0.78 | 7.7 | 3.8 | 0.93
South Kalgoorlie | 1.5 | 2.7 | 0.13 | 1.16 | 3.8 | 0.14 | 2.66 | 3.2 | 0.27
Big Bell | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Gidgee | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Sub-total | 4.01 | 2.3 | 0.3 | 7.2 | 4.3 | 1 | 11.21 | 3.6 | 1.3
PNG Operations | 2.02 | 3.1 | 0.2 | 19.44 | 2.9 | 1.84 | 21.46 | 3 | 2.04
Total | 148.9 | 4.4 | 20.91 | 233.46 | 5.5 | 41.34 | 382.36 | 5.1 | 62.25

Mineral Resources | Total Underground | | | Total Surface | | | Total Gold Mineral Resources
Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz) | Tonnage (Mt) | Grade (g/t) | Gold (Moz)
Measured | 379.54 | 5.29 | 64.34 | 51.57 | 0.31 | 0.68 | 431.11 | 4.69 | 65.02
Indicated | 896.18 | 4.67 | 133.96 | 428.77 | 0.31 | 4.92 | 1,324.95 | 3.26 | 138.88
Inferred | 2,836.29 | 3.42 | 309.98 | 968.89 | 0.31 | 7.55 | 3,805.18 | 2.69 | 317.53
| 4,112.01 | 3.73 | 508.28 | 1,449.23 | 0.31 | 13.15 | 5,561.24 | 3.52 | 521.43

Source: Harmony Gold Mining Co Website

Figure 18

Figure 19: Harmony Mineral Reserve and Mineral Resource Statement as adjusted by SRK

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HARMONY: MINERAL RESOURCE AND MINERAL RESERVE STATEMENT ADJUSTED BY SRK

Mineral Reserve Category				Mineral Resource Category				
	Tonnage (kt)	Grade (g/t)	Gold koz)		Tonnage (kt)	Grade (g/t)	Gold koz)	Conversion rate
Proved				**Measured**				
Underground	63,454	6.60	13,475	Underground	78,537	9.70	24,535	81%
Underground	-	-	-	Underground	31,842	10.20	10,432	
Surface	4,702	0.70	113	Surface	6,993	0.80	170	67%
Surface	-	-	-	Surface	13,533	0.40	166	
Open Pit	6,167	2.60	517	Open Pit	16,518	2.40	1,271	37%
Open Pit	-	-	-	Open Pit	12,154	1.20	466	
Sub Total	**74,323**	**5.90**	**14,106**	**Sub Total**	**159,577**	**7.20**	**37,040**	**47%**
Probable				**Indicated**				
Underground	163,257	6.80	35,617		187,850	10.00	60,448	87%
Underground	-	-	-		92,190	7.60	22,552	
Surface	30,328	0.50	536		50,678	0.50	868	60%
Surface	-	-	-		411,074	0.40	4,868	
Open Pit	20,328	2.90	1,927		50,773	2.30	3,795	40%
Open Pit	-	-	-		161,939	1.50	7,872	
Sub Total	**214,013**	**5.50**	**38,081**		**954,504**	**3.30**	**100,443**	**22%**
Total Reserves	**288,336**	**5.60**	**52,187**	**Total Resources**	**1,114,081**	**3.80**	**137,483**	**26%**
Inferred in LOM				**Inferred**				
Underground	43,479	6	8		138,957	8	34,003	**31%**
Underground	-	-	-		326,269	7	75,934	
Surface	-	-	-		176	1	4	
Surface	-	-	-		163,439	0	1,747	
Open Pit	4,019	3	334		46,823	2	2,185	**9%**
Open Pit	-	-	-		74,820	2	4,315	
Sub-Total	**47,498**	**5**	**8,297**	**Sub-Total**	**750,484**	**5**	**100,403**	**6%**
Total in LOM	**335,834**	**6**	**60,484**		**1,864,565**	**4**	**237,886**	**18%**

Source: SRK CPR

Figure 19

Research project

HARMONY: MINERAL RESOURCE AND MINERAL RESERVE STATEMENT ADJUSTED BY SRK

Mineral Reserve Category				Mineral Resource Category				
	Tonnage (kt)	Grade (g/t)	Gold koz)		Tonnage (kt)	Grade (g/t)	Gold koz)	Conversion rate
Proved				**Measured**				
Underground	63,454	6.60	13,475	Underground	78,537	9.70	24,535	81%
Underground	-	-	-	Underground	31,842	10.20	10,432	
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Open Pit	-	-	-	Open Pit	12,154	1.20	466	
Sub Total	**74,323**	**5.90**	**14,106**	**Sub Total**	**159,577**	**7.20**	**37,040**	**47%**
Probable				**Indicated**				
Underground	163,257	6.80	35,617		187,850	10.00	60,448	87%
Underground	-	-	-		92,190	7.60	22,552	
Surface	30,328	0.50	536		50,678	0.50	868	60%
Surface	-	-	-		411,074	0.40	4,868	
Open Pit	20,328	2.90	1,927		50,773	2.30	3,795	40%
Open Pit	-	-	-		161,939	1.50	7,872	
Sub Total	**214,013**	**5.50**	**38,081**		**954,504**	**3.30**	**100,443**	**22%**
Total Reserves	**288,336**	**5.60**	**52,187**	**Total Resources**	**1,114,081**	**3.80**	**137,483**	**26%**
Inferred in LOM				**Inferred**				
Underground	43,479	6	8		138,957	8	34,003	**31%**
Underground	-	-	-		326,269	7	75,934	
Surface	-	-	-		176	1	4	
Surface	-	-	-		163,439	0	1,747	
Open Pit	4,019	3	334		46,823	2	2,185	**9%**
Open Pit	-	-	-		74,820	2	4,315	
Sub-Total	**47,498**	**5**	**8,297**	**Sub-Total**	**750,484**	**5**	**100,403**	**6%**
Total in LOM	**335,834**	**6**	**60,484**		**1,864,565**	**4**	**237,886**	**18%**

Source: SRK CPR

Figure 19

Research project

HARMONY: MINERAL RESOURCE AND MINERAL RESERVE STATEMENT ADJUSTED BY SRK

Mineral Reserve Category				Mineral Resource Category				
	Tonnage (kt)	Grade (g/t)	Gold koz)		Tonnage (kt)	Grade (g/t)	Gold koz)	Conversion rate
Proved				**Measured**				
Underground	63,454	6.60	13,475	Underground	78,537	9.70	24,535	81%
Underground	-	-	-	Underground	31,842	10.20	10,432	
Surface	4,702	0.70	113	Surface	6,993	0.80	170	67%
Surface	-	-	-	Surface	13,533	0.40	166	
Open Pit	6,167	2.60	517	Open Pit	16,518	2.40	1,271	37%
Open Pit	-	-	-	Open Pit	12,154	1.20	466	
Sub Total	**74,323**	**5.90**	**14,106**	**Sub Total**	**159,577**	**7.20**	**37,040**	**47%**
Probable				**Indicated**				
Underground	163,257	6.80	35,617		187,850	10.00	60,448	87%
Underground	-	-	-		92,190	7.60	22,552	
Surface	30,328	0.50	536		50,678	0.50	868	60%
Surface	-	-	-		411,074	0.40	4,868	
Open Pit	20,328	2.90	1,927		50,773	2.30	3,795	40%
Open Pit	-	-	-		161,939	1.50	7,872	
Sub Total	**214,013**	**5.50**	**38,081**		**954,504**	**3.30**	**100,443**	**22%**
Total Reserves	**288,336**	**5.60**	**52,187**	**Total Resources**	**1,114,081**	**3.80**	**137,483**	**26%**
Inferred in LOM				**Inferred**				
Underground	43,479	6	8		138,957	8	34,003	**31%**
Underground	-	-	-		326,269	7	75,934	
Surface	-	-	-		176	1	4	
Surface	-	-	-		163,439	0	1,747	
Open Pit	4,019	3	334		46,823	2	2,185	**9%**
Open Pit	-	-	-		74,820	2	4,315	
Sub-Total	**47,498**	**5**	**8,297**	**Sub-Total**	**750,484**	**5**	**100,403**	**6%**
Total in LOM	**335,834**	**6**	**60,484**		**1,864,565**	**4**	**237,886**	**18%**

Source: SRK CPR

Figure 19

Figure 20: Harmony Salient Historical Operating and Financial Statistics

Research project

HARMONY: SALIENT HISTORICAL OPERATING AND FINANCIAL STATISTICS

Harmony: Salient Historical Operating and Financial Statistics

Statistics	Units	1999	2000	2001	2002	2003	2004	2005
Production								
Tonnage	**(kt)**	**7795**	**11881**	**17543**	**20719**	**23565**	**29622**	**12480**
South African Underground Operations	(kt)	7520	9366	14286	12127	11153	15978	7624
South African Surface Operations	(kt)	275	2516	3257	3808	5261	8902	2925
Australian Operations	(kt)	0	0	0	4784	7151	4742	1931
Yield	**(g/t)**	**5.1**	**4.3**	**3.8**	**3.6**	**3.1**	**3.4**	**4**
South African Underground Operations	(g/t)	5.3	5.1	4.4	5.1	4.7	5.3	5.6
South African Surface Operations	(g/t)	1.3	1.2	1.3	1.1	0.9	0.6	0.9
Australian Operations	(g/t)	0	0	0	1.6	2.2	2.2	2.6
Sales	**(koz)**	**1286**	**1626**	**2140**	**2380**	**2366**	**3225**	**1621**
South African Underground Operations	(koz)	1275	1530	2008	1988	1701	2702	1374
South African Surface Operations	(koz)	11	96	132	139	155	185	88
Australian Operations	(koz)	0	0	0	253	510	338	158
Expenditures								
Cash Operating Costs	(ZARm)	1859	2535	3822	4774	5476	8049	3907
South African Underground Operations	(ZARm)	1848	2394	3578	3921	3883	6844	3370
South African Surface Operations	(ZARm)	11	140	244	245	325	444	225
Australian Operations	(ZARm)	0	0	0	607	1267	761	311
Capital Expenditure	**(ZARm)**	**313**	**191**	**400**	**602**	**1908**	**872**	**468**
Cash Costs	**(ZAR/kg)**	**46486**	**50118**	**57417**	**64481**	**74403**	**80233**	**77475**
South African Underground Operations	(ZAR/kg)	46618	50306	57290	63405	73381	81431	78843
South African Surface Operations	(ZAR/kg)	31332	47124	59339	56758	67406	77166	81884
Australian Operations	(ZAR/kg)	0	0	0	77174	79947	72342	63147
Cash Costs	**(ZAR/t)**	**239**	**213**	**218**	**230**	**232**	**272**	**313**
South African Underground Operations	(ZAR/t)	246	256	250	323	348	428	442
South African Surface Operations	(ZAR/t)	40	56	75	64	62	50	77
Australian Operations	(ZAR/t)	0	0	0	127	177	161	161
US$/ZAR Ave Exchange Rate		6.04	6.35	7.61	10.2	9.13	6.89	6.35

Source : SRK CPR

Figure 20

Research project

HARMONY: SALIENT HISTORICAL OPERATING AND FINANCIAL STATISTICS

Harmony: Salient Historical Operating and Financial Statistics

Source : SRK CPR

Figure 20

Research project

HARMONY: SALIENT HISTORICAL OPERATING AND FINANCIAL STATISTICS

Harmony: Salient Historical Operating and Financial Statistics

Source : SRK CPR

Figure 20

7.3 Goldfields Limited

Goldfields Limited ("Goldfields") is one of the world's largest unhedged producers of gold, providing investors with maximum leverage to the gold price. The company was formed in 1998 with the amalgamation of the gold assets of Goldfields of South Africa Limited and Gencor Limited

Goldfields has attributable production of 4.2 million ounces per annum, mineral reserves of 64.8 million ounces and mineral resources of 174.5 million ounces and ranked fourth in terms of the world's gold mining companies. The company employs some 43,942 people including contractors across its operations and is listed in the JSE Securities Exchange South Africa (primary listing) (code: GFI), New York Stock Exchange, London Stock Exchange, Euronext in Paris and Brussels as well as the SWX Swiss Exchange. Gold Fields has producing mines in South Africa, Australia and Ghana in addition to various exploration properties situated in Europe, North and South America, Indonesia and China. As at 1st January 2005 Goldfields had 492,025,801 ordinary shares in issue, valued at ZAR69.50/share giving a market capitalization of ZAR34.2bn. Total gold production for Gold Fields for fiscal 2005(H1) was 2.2Moz of gold at a total cash cost of US$327/oz and capital expenditure of US$195.7m.

7.3.1 Operations

The South African operations comprise the wholly owned Driefontein, Kloof and Beatrix mines. The international operations comprise the Ghanaian and Australian mines as well as development projects in Peru and in Finland. Goldfields Ghana Limited is owned by Goldfields Limited (71.1%) and IAMGold a Canadian company listed on the Toronto Stock Exchange (18.9%). The Ghanaian government holds the remaining 10% as a 'free carry' interest. The Ghanaian mines comprise the Tarkwa mine as well as the Damang mine which was acquired in January 2002. The Australian operations comprise the wholly–owned St Ives and Agnew gold mining operations in Western Australia, acquired in December 2001.

The Artic Platinum Partnership in Finland is a wholly owned exploration venture. This project was previously held in partnership with Outokumpu Oyj of Finland, before Gold Fields exercised its pre-emptive right to acquire Outokumpu's 49% interest in September 2003.

The Cerro Corona project is located within the Hualgayoc District to the North of the Yanacocha mine in the Cajamarca Department of Northern Peru. In December of 2003, Goldfields subsidiary, Goldfields Corona (BVI) Limited, entered into an agreement to purchase an 80.7% interest in the Cerro Corona Cu-Au Project from the Gubbins Family.

Goldfields have an extensive precious metals exploration programme, with projects in Africa, Australasia, Europe and South America. Regional exploration offices are situated in Accra, Denver, Johannesburg, Oxford, Perth and Santiago.

Figure 21 shows the Goldfields total production since 1995 to 2005, which clearly shows that Goldfields' production, is very consistent over the ten year period.

7.3.2 Mineral Resources and Mineral Reserves Statement.

"Goldfields mineral resource and reserve strategy ensures consistency and integrity in reporting and to continue to pursue growth through exploration, acquisition and sustained delivery of value" (Goldfields annual report 2005).The mineral resource and reserve figures are derived from a rigorous strategic and operational planning process that is embedded at each of its operating mines. Mineral reserve estimates are based on many modifying factors including estimates of future production costs, future commodity prices, and notably in SA, the exchange rate between the ZAR and US$.

The following key assumptions and parameters, based on the SAMREC guidelines, were used as the basis for estimation and classification of this declaration (2005 mineral resources statement):-

- Mineral resource tonnages and grade are estimated in-situ over a minimum mining width, and include mineralisation below the selected cut-off grade to ensure that the Mineral Resource comprises blocks of adequate size and continuity;
- Mineral resources on open cut operations are confined to pit shells that are defined by the price used in the estimation process. The approach has required the introduction of un-engineered pit shells to constrain the mineralisation to that which is economically and practically extractable under assumed economic conditions, and departs from the disclosure of a mineral inventory, regardless of location and continuity;
- Mineral resources are reported inclusive of mineral reserves;
- Mineral reserves are that portion of the mineral resource, which technical and economic studies have demonstrated can justify extraction at the time of disclosure;
- Declared mineral reserves take cognisance of cost levels at each operation and are supported by mine plans;
- Mineral reserve tonnages and grade include allowances for mining dilution and mining factors, and consequently are reported as net tons and grade delivered to the mill or leach pad; and

All tabulated numbers represent Gold Fields' total managed Mineral Resources and Reserves unless otherwise stated as shown in Figure 22.

7.4 Discussion of Results on the Proposed Merger

When comparing two companies in the minerals industry, the following factors need to be considered by an investor when choosing which stock to invest in. A detailed fundamental analysis was performed on these two organisations to enable conclusions to be derived from the analysis, on which company would be a better investment. And also to determine whether the hostile bid by Harmony to Goldfields was fair and reasonable to the Goldfields shareholders and give an independent opinion on the merits and demerits of the proposed merger. The opinion would be based upon economic, operational, market, regulatory and other conditions as well as on the information available on the public domain.

Figure 21: Goldfields Total Production Profile since 1995 to 2005.

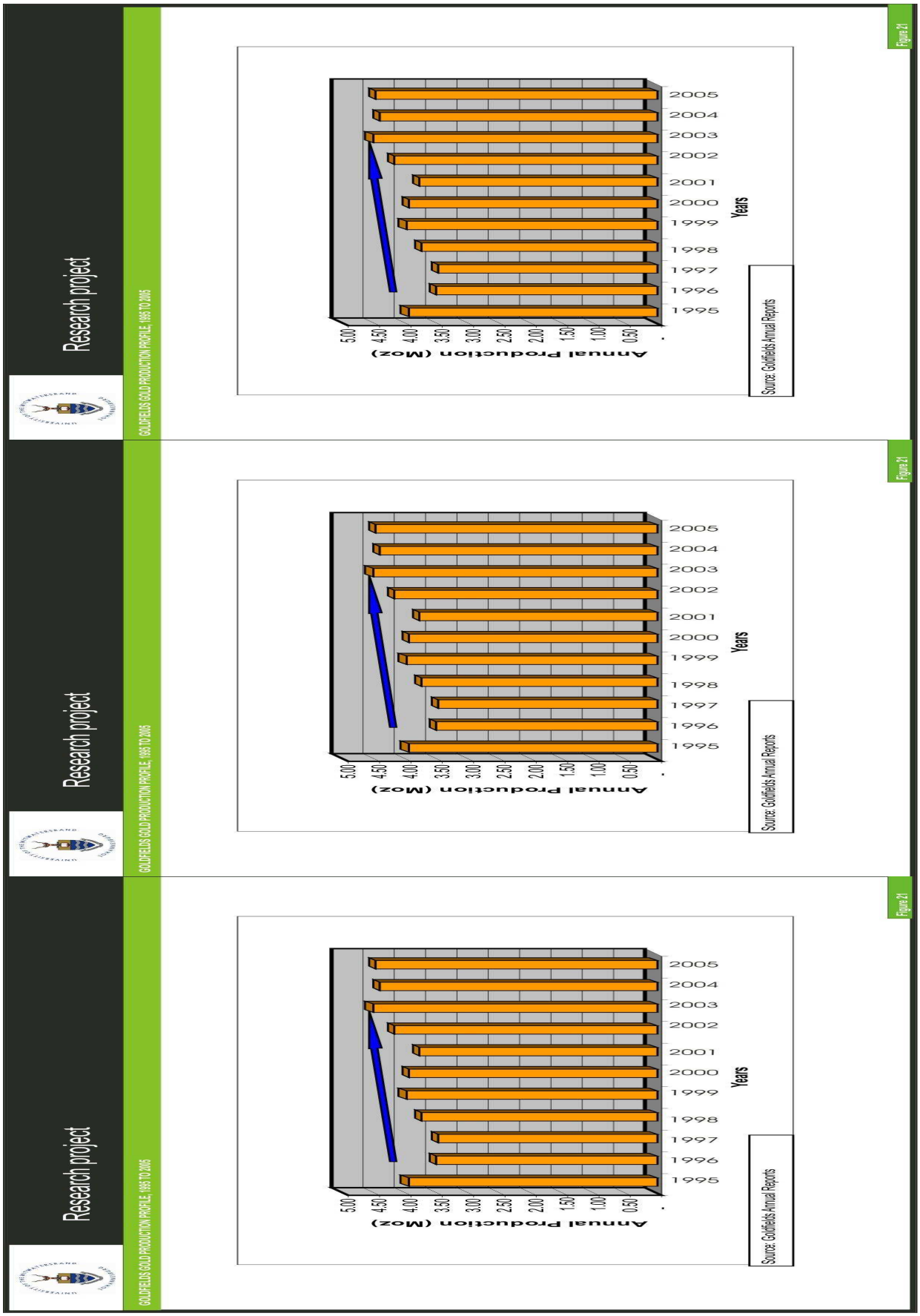
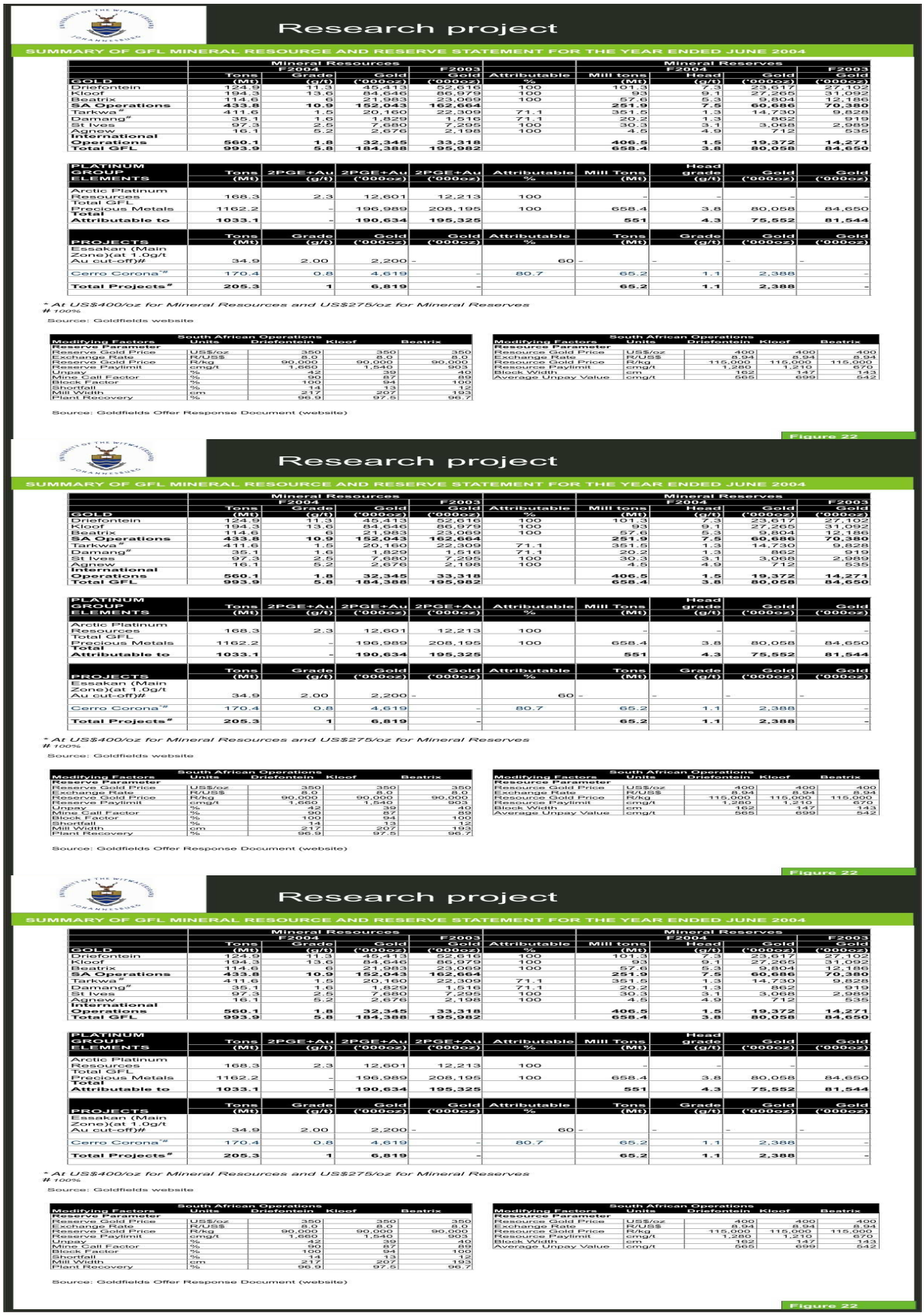


Figure 22: Goldfields Mineral Reserve and Mineral Resource Statement 30th June 2004



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SUMMARY OF GFL MINERAL RESOURCE AND RESERVE STATEMENT FOR THE YEAR ENDED JUNE 2004

	Mineral Resources F2004			F2003		Mineral Reserves F2004			F2003
	Tons	Grade	Gold	Gold		Mill tons	Head	Gold	Gold
GOLD	(Mt)	(g/t)	('000oz)	('000oz)	Attributable %	(Mt)	(g/t)	('000oz)	('000oz)
Driefontein	124.9	11.3	45,413	52,616	100	101.3	7.3	23,617	27,102
Kloof	194.3	13.6	84,646	86,979	100	93	9.1	27,265	31,092
Beatrix	114.6	6	21,983	23,069	100	57.6	5.3	5,804	12,186
SA Operations	**433.8**	**10.9**	**152,043**	**162,664**		**251.9**	**7.5**	**60,686**	**70,380**
Tarkwa#	411.6	1.5	20,160	22,309	71.1	351.5	1.3	14,730	9,828
Damang#	35.1	1.6	1,829	1,516	71.1	20.2	1.3	862	919
St Ives	97.3	2.5	7,680	7,295	100	30.3	3.1	3,068	2,989
Agnew	16.1	5.2	2,676	2,198	100	4.5	4.9	712	535
International Operations	**560.1**	**1.8**	**32,345**	**33,318**		**406.5**	**1.5**	**19,372**	**14,271**
Total GFL	**993.9**	**5.8**	**184,388**	**195,982**		**658.4**	**3.8**	**80,058**	**84,650**

PLATINUM GROUP ELEMENTS	Tons (Mt)	2PGE+Au (g/t)	2PGE+Au ('000oz)	2PGE+Au ('000oz)	Attributable %	Mill Tons (Mt)	Head grade (g/t)	Gold ('000oz)	Gold ('000oz)
Arctic Platinum Resources	168.3	2.3	12,601	12,213	100	-	-	-	-
Total GFL Precious Metals	1162.2	-	196,989	208,195	100	658.4	3.8	80,058	84,650
Total Attributable to	**1033.1**	**-**	**190,634**	**195,325**		**551**	**4.3**	**75,552**	**81,544**

PROJECTS	Tons (Mt)	Grade (g/t)	Gold ('000oz)	Gold ('000oz)	Attributable %	Tons (Mt)	Grade (g/t)	Gold ('000oz)	Gold ('000oz)
Essakan (Main Zone)(at 1.0g/t Au cut-off)#	34.9	2.00	2,200	-	60	-	-	-	-
Cerro Corona*#	170.4	0.8	4,619	-	80.7	65.2	1.1	2,388	-
Total Projects#	**205.3**	**1**	**6,819**	**-**		**65.2**	**1.1**	**2,388**	**-**

** At US$400/oz for Mineral Resources and US$275/oz for Mineral Reserves*
 # 100%

Source: Goldfields website

Modifying Factors	South African Operations Units	Driefontein	Kloof	Beatrix
Reserve Parameter				
Reserve Gold Price	US$/oz	350	350	350
Exchange Rate	R/US$	8.0	8.0	8.0
Reserve Gold Price	R/kg	90,000	90,000	90,000
Reserve Paylimit	cmg/t	1,660	1,540	903
Unpay	%	42	39	40
Mine Call Factor	%	90	87	89
Block Factor	%	94	100	100
Shortfall	%	14	13	12
Mill Width	cm	217	207	193
Plant Recovery	%	96.9	97.5	96.7

Modifying Factors	South African Operations Units	Driefontein	Kloof	Beatrix
Resource Parameter				
Resource Gold Price	US$/oz	400	400	400
Exchange Rate	R/US$	8.94	8.94	8.94
Resource Gold Price	R/kg	115,000	115,000	115,000
Resource Paylimit	cmg/t	1,280	1,210	670
Block Width	cm	162	147	143
Average Unpay Value	cmg/t	565	699	542

Source: Goldfields Offer Response Document (website)

Figure 22

Research project

SUMMARY OF GFL MINERAL RESOURCE AND RESERVE STATEMENT FOR THE YEAR ENDED JUNE 2004

Mineral Resources F2004 / Mineral Reserves F2004 — GOLD

	Tons (Mt)	Grade (g/t)	Gold ('000oz)	F2003 Gold ('000oz)	Attributable %	Mill tons (Mt)	Head (g/t)	Gold ('000oz)	F2003 Gold ('000oz)
Driefontein	124.9	11.3	45,413	52,616	100	101.3	7.3	23,617	27,102
Kloof	194.3	13.6	84,646	86,979	100	93	9.1	27,265	31,092
Beatrix	114.6	6	21,983	23,069	100	57.6	5.3	5,804	12,186
SA Operations	**433.8**	**10.9**	**152,043**	**162,664**		**251.9**	**7.5**	**60,686**	**70,380**
Tarkwa#	411.6	1.5	20,160	22,309	71.1	351.5	1.3	14,730	9,828
Damang#	35.1	1.6	1,829	1,516	71.1	20.2	1.3	862	919
St Ives	97.3	2.5	7,680	7,295	100	30.3	3.1	3,068	2,989
Agnew	16.1	5.2	2,676	2,198	100	4.5	4.9	712	535
International Operations	**560.1**	**1.8**	**32,345**	**33,318**		**406.5**	**1.5**	**19,372**	**14,271**
Total GFL	**993.9**	**5.8**	**184,388**	**195,982**		**658.4**	**3.8**	**80,058**	**84,650**

PLATINUM GROUP ELEMENTS

	Tons (Mt)	2PGE+Au (g/t)	2PGE+Au ('000oz)	2PGE+Au ('000oz)	Attributable %	Mill Tons (Mt)	Head grade (g/t)	Gold ('000oz)	Gold ('000oz)
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Total Attributable to	**1033.1**	**-**	**190,634**	**195,325**		**551**	**4.3**	**75,552**	**81,544**

PROJECTS

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Essakan (Main Zone)(at 1.0g/t Au cut-off)#	34.9	2.00	2,200	-	60	-	-	-	-
Cerro Corona*#	170.4	0.8	4,619	-	80.7	65.2	1.1	2,388	-
Total Projects#	**205.3**	**1**	**6,819**	**-**		**65.2**	**1.1**	**2,388**	**-**

** At US$400/oz for Mineral Resources and US$275/oz for Mineral Reserves*
 # 100%

Source: Goldfields website

South African Operations — Reserve Parameter

Modifying Factors	Units	Driefontein	Kloof	Beatrix
Reserve Gold Price	US$/oz	350	350	350
Exchange Rate	R/US$	8.0	8.0	8.0
Reserve Gold Price	R/kg	90,000	90,000	90,000
Reserve Paylimit	cmg/t	1,660	1,540	903
Unpay	%	42	39	40
Mine Call Factor	%	90	87	89
Block Factor	%	100	94	100
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South African Operations — Resource Parameter

Modifying Factors	Units	Driefontein	Kloof	Beatrix
Resource Gold Price	US$/oz	400	400	400
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Resource Gold Price	R/kg	115,000	115,000	115,000
Resource Paylimit	cmg/t	1,280	1,210	670
Block Width	cm	162	147	143
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Figure 22

Research project

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International Operations	**560.1**	**1.8**	**32,345**	**33,318**		**406.5**	**1.5**	**19,372**	**14,271**
Total GFL	**993.9**	**5.8**	**184,388**	**195,982**		**658.4**	**3.8**	**80,058**	**84,650**

PLATINUM GROUP ELEMENTS

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Total Attributable to	**1033.1**	**-**	**190,634**	**195,325**		**551**	**4.3**	**75,552**	**81,544**

PROJECTS

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Essakan (Main Zone)(at 1.0g/t Au cut-off)#	34.9	2.00	2,200	-	60	-	-	-	-
Cerro Corona*#	170.4	0.8	4,619	-	80.7	65.2	1.1	2,388	-
Total Projects#	**205.3**	**1**	**6,819**	**-**		**65.2**	**1.1**	**2,388**	**-**

** At US$400/oz for Mineral Resources and US$275/oz for Mineral Reserves*
 # 100%

Source: Goldfields website

South African Operations — Reserve Parameter

Modifying Factors	Units	Driefontein	Kloof	Beatrix
Reserve Gold Price	US$/oz	350	350	350
Exchange Rate	R/US$	8.0	8.0	8.0
Reserve Gold Price	R/kg	90,000	90,000	90,000
Reserve Paylimit	cmg/t	1,660	1,540	903
Unpay	%	42	39	40
Mine Call Factor	%	90	87	89
Block Factor	%	100	94	100
Shortfall	%	14	13	12
Mill Width	cm	217	207	193
Plant Recovery	%	96.9	97.5	96.7

South African Operations — Resource Parameter

Modifying Factors	Units	Driefontein	Kloof	Beatrix
Resource Gold Price	US$/oz	400	400	400
Exchange Rate	R/US$	8.94	8.94	8.94
Resource Gold Price	R/kg	115,000	115,000	115,000
Resource Paylimit	cmg/t	1,280	1,210	670
Block Width	cm	162	147	143
Average Unpay Value	cmg/t	565	699	542

Source: Goldfields Offer Response Document (website)

Figure 22

In the analysis the following information was evaluated and it includes the type and nature of mining operation, earnings generating capacity, production capacity and operational flexibility, quality and quantity of mineral resources and mineral reserves, management's expertise and reputation in the mining operation.

7.4.1 Background Analysis based on May 2002 Annual Report by Gold-eagle

On the basis of unit earnings per unit capital invested, Harmony has a commanding lead over Goldfields and to put the companies in the world perspective some selected international gold mining companies have been included for comparative purposes as graphically illustrated on Figure 23. The other companies included in the graph include the following: Barrick (ABX), GoldCorp (GG), Agnico-Eagle mines (AEM) and Durban (DROOY).

Assuming that all the companies have equal earnings, companies with more production will benefit much more in a gold bull market especially if they are production is unhedged. Production is the greatest leverage to the price of gold, which can also be complimented by the reduction in the units cost would yield even better results. Figure 23 shows that Harmony has a higher unit of production per $100,000 invested in the company compared to Goldfields. Contrary Harmony actually produced 3.2Moz and Goldfields produced 4.1Moz in 2002 but because of the difference in capital structure the scenario is represented to show the opposite.

Figure 24 shows the comparison of the two gold mining companies in terms of the reserve and resource ounces per $100,000 invested. Even though the reserve and resource ounce per $100,000 invested figures are higher for Harmony, the possible reason for this is shown in Figure 25 that shows the different capital structures of the different gold companies. According to each company's annual report, Goldfields has resources of 139Moz and Harmony has resources of 224Moz. Because Goldfields has 300m more shares issued than Harmony, the resources and reserves per unit capital invested are significantly higher with Harmony. This comparison it depicts that Harmony's mineral assets are better than Goldfields, but this is not true because of the accounting numbers that have distorted the presentation since Goldfields has more issued capital than Harmony. Hence all the comparison that uses the share or the market capitalisation have distorted the results but worked to the advantage of Harmony since creates a perception that it is performing and utilising its assets better than Goldfields.

In conclusion at this point and the facts presented, an opinion was made that Harmony's current share price suggests very strongly that it is grossly undervalued compared to Goldfields and have a large investment capital. In my opinion these results and substantial growth in production created a perception in the market that Harmony's is performing better and the management team can operate Goldfields assets in a more efficient manner. Harmony's ability to successfully manage Goldfields is uncertain since the quality of assets is different and hence different operational strategies are applicable.

Figure 23: Comparison of the Performance of Gold Mining Companies 1 and 2

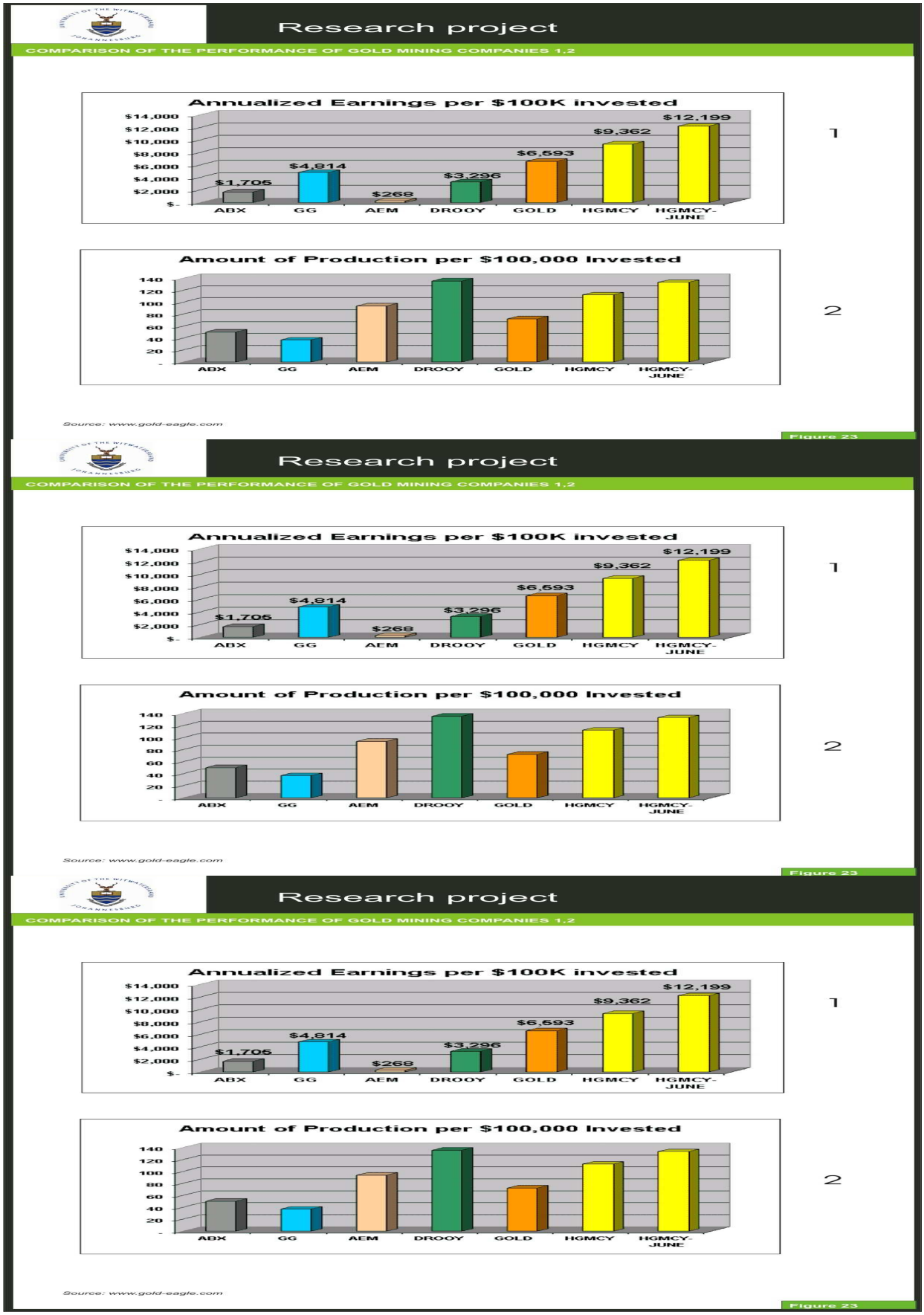


Figure 24: Comparison of the Performance of Gold Mining Companies 3 and 4

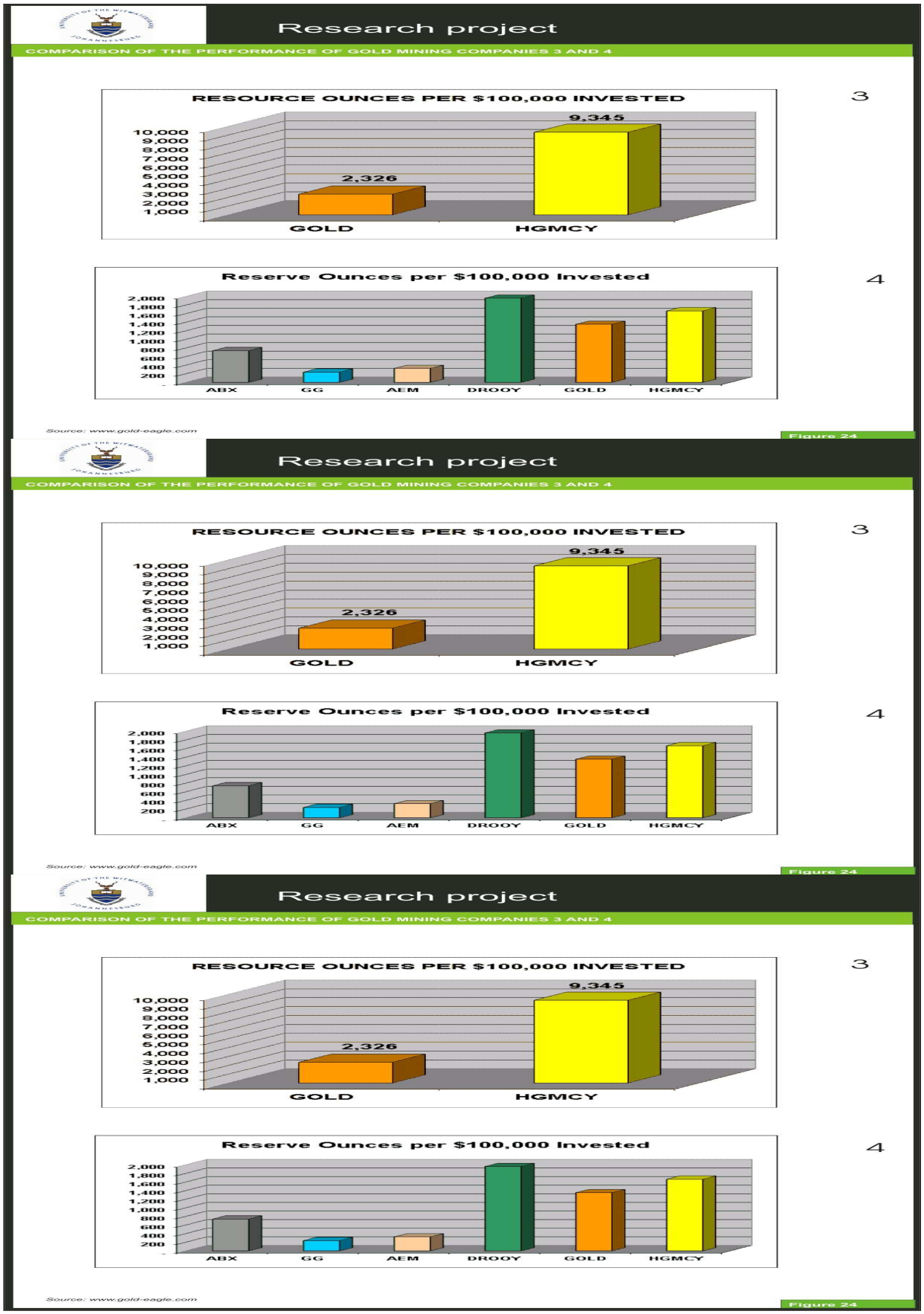
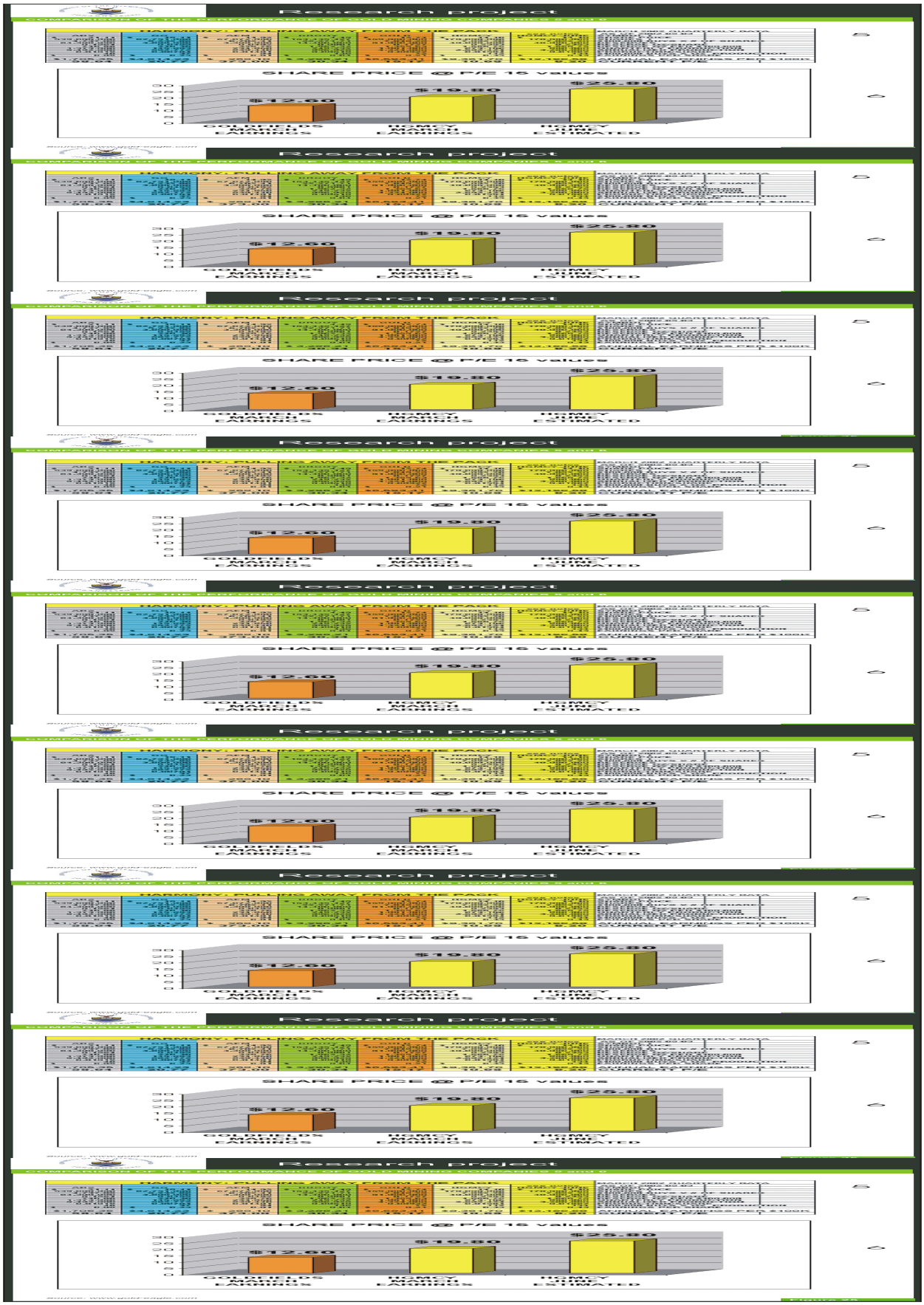


Figure 25: Comparison of the Performance of Gold Mining Companies 5 and 6



7.4.2 Earnings Generating Capacity

The most critical measurement of the company's success is its earnings or the earnings generating potential in the near future. A company with a higher net profit margin is better a firm since it can withstand adverse market conditions. This is in line with the shareholders major objective to increase their shareholder's wealth. Investors are interested in the return on capital they have invested in the business, ie increase in their wealth. The results of the financial analysis performed on the financial results for the year ending 30th June 2004, using the DuPont analysis is shown in Figure 26 and Figure 27. The analysis depicts that Harmony have a negative return on equity hence it is destroying value for the shareholders and contrary Goldfields is performing better than Harmony.

The extractive industry is unique in the sense that they are 'price takers' and the only way they can improve on the profit margins would be to improve operating efficiencies and lower input costs. A change in the production of gold does not necessarily affect its world price, as this is determined at the daily gold fix and that no gold mine can influence the price of gold. Despite spending R425 million in restructuring costs, in the previous years, Harmony's cash operating costs remain high compared to their counter party Goldfields as shown in Figure 28 this means that its profit margin is squeezed. Although Harmony's Q1 2005 performance showed some improvements, but the sustainability of this performance is uncertain and this result was heavily influenced by the recovered grades at Evander mine. The financial and operational performance on a relative basis, Harmony's performance has been pathetic as shown in the table on Figure 28. In 2004, Goldfields' SA operating profit was 4.7 times greater than Harmony's' and the group's operating profit was 11.7 times greater. Based on these results Harmony is under-performing compared to Goldfields. Harmony's asset portfolio comprises a disparate collection of mines and shaft systems sold by larger producers unable to run those mines profitably in the longer term. However, Harmony has been successful in reducing costs and extending the lives, its success has often been achieved through a short-term strategy known as "harvesting". This strategy is wholly inappropriate at Goldfields mines and would seriously damage the long-term prospects of these operations.

Figure 26: Goldfields Mining Company 2004 Financial Analysis (DuPont)

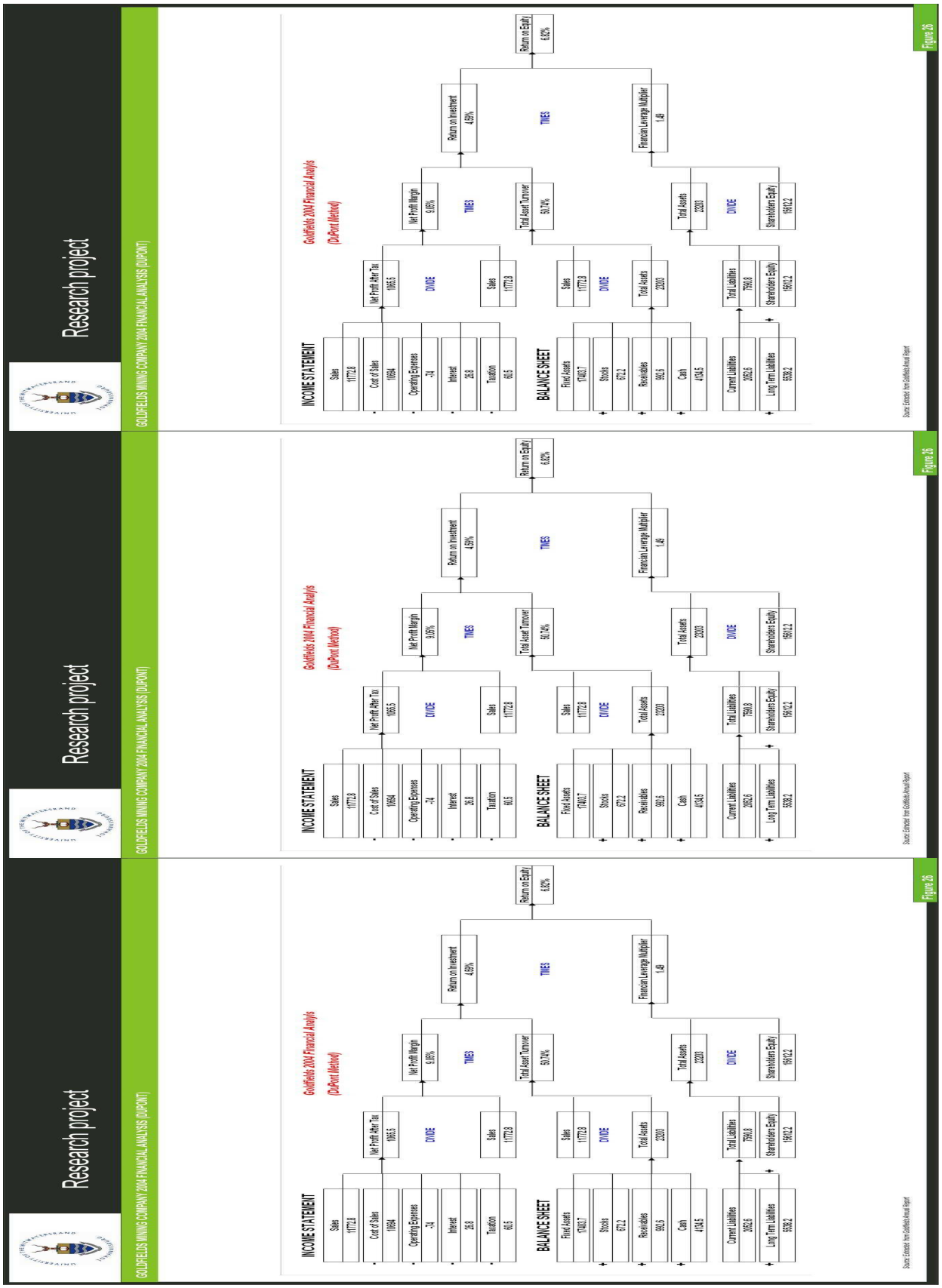


Figure 27: Harmony Gold Mining Company 2004 Financial Analysis (DuPont)

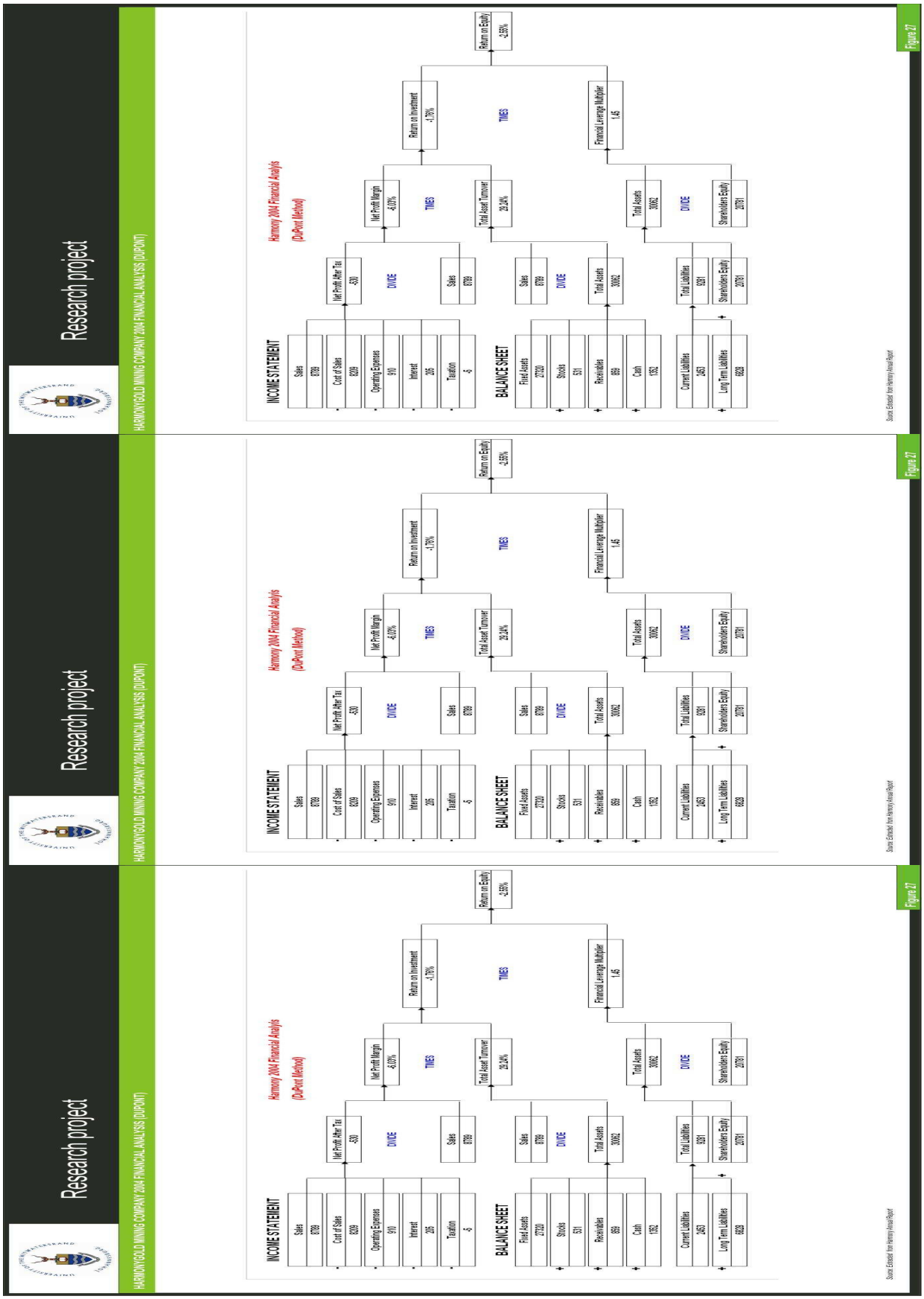


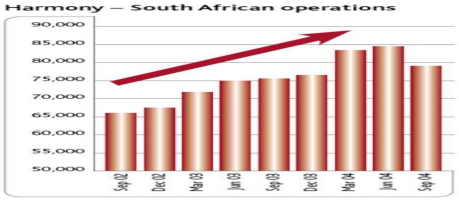
Figure 28: Comparison of Financial and Operational Performance of Harmony and Goldfields

Research project

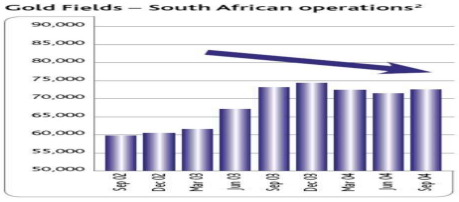
COMPARISON OF FINANCIAL AND OPERATIONAL PERFORMANCE OF HARMONY AND GOLDFIELDS

Cash operating costs for Harmony and Gold Fields (R/kg)[1]

Harmony – South African operations



Gold Fields – South African operations[2]



Comparison of Harmony and Goldfields Income Statements

South Africa		Gold Fields F2004	Harmony F2004	Gold Fields Q1 2005	Harmony Q1 2005
Gold produced	kg	87,204	100,026	21,779	23,390
Cash operating costs	R/kg	72,805	79,736	72,533	79,169
Total cash costs	R/kg	73,626	n/a	73,263	n/a
Revenue	Rm	7,471	8,527	1,784	1,946
Cash operating costs	Rm	6,349	7,976	1,580	1,852
Cash operating profit	Rm	1,122	551	204	94
Rehabilitation cost provision[1]	Rm	37	(26)	10	14
Employment termination cost[1]	Rm	72	224	16	154
Corporate marketing and new business[1]	Rm	225	184	58	38
Operating profit	Rm	788	169	120	(112)

Source: Harmony and Goldfields quarterly reports

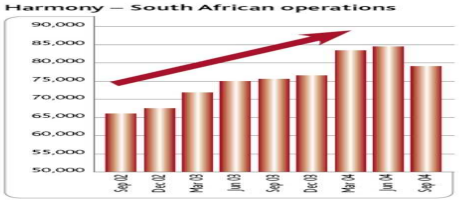
Figure 28

Research project

COMPARISON OF FINANCIAL AND OPERATIONAL PERFORMANCE OF HARMONY AND GOLDFIELDS

Cash operating costs for Harmony and Gold Fields (R/kg)[1]

Harmony – South African operations



Gold Fields – South African operations[2]

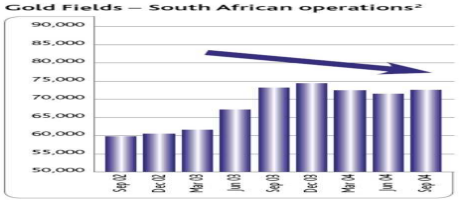


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Figure 28

Research project

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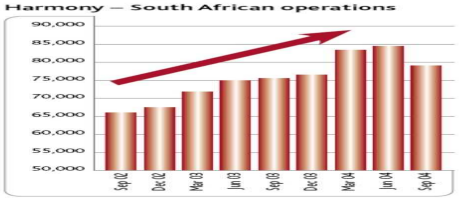
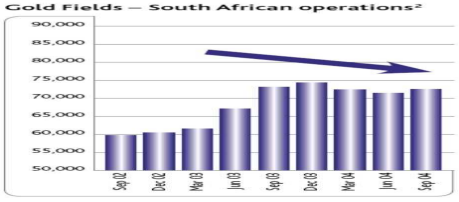
Cash operating costs for Harmony and Gold Fields (R/kg)[1]

Harmony – South African operations



Gold Fields – South African operations[2]



Comparison of Harmony and Goldfields Income Statements

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Source: Harmony and Goldfields quarterly reports

Figure 28

7.4.3 Production Capacity

Goldfields annual production profile shows a high level of consistency in the production output in the last 10 years as graphically illustrated in Figure 21. During the years the production capacity has been consistent with little or no interruption on the operations and hence consistent production output. For the last 10 years Goldfields have been producing approximately 4Moz of gold annually from the three SA operations and the four international operations (two in Ghana and two in Australia). Harmony over the same period has acquired several mineral assets both locally and internationally and their production growth profile as shown in Figure 16. Since 1996 Harmony's production output has grown significantly from about 0.4Moz in 1996 to approximately 3.1Moz in 2005. The growth was achieved through the implementation of CONOPS, mergers and acquisitions. In the last ten years Harmony has grown to be one of the largest gold producers in the world through their organic and inorganic growth strategies and the turnaround strategies that have been successfully been implemented on Harmony's loss making marginal shafts.

7.4.4 Mineral Resources and Mineral Reserves

Harmony and its subsidiaries in SA have twenty-seven producing mines, three projects and two mining operations in Australia, whereas Goldfields have only seven mines both locally and internationally. Comparing these two companies in terms of their mineral resource and mineral reserve statements published in the 2004 annual reports prior to the potential transaction involving a hostile takeover bid by Harmony to Goldfields. The summarised figures are shown in the Table 9 below:-

Table 9: Summary comparison of the Mineral Resources and Mineral Reserves

CLASSIFICATION CATEGORY	HARMONY		GOLDFIEDS	
	2004 Moz	2005 Moz	2004 Moz	2005 Moz
Total Mineral Reserves	**62.25**	**54.14**	**79.19**	**83.62**
Proven Mineral Reserves	20.91	12.56	25.95	23.55
Probable Mineral reserves	41.34	41.58	53.24	60.07
Total Mineral Resources	**521.43**	**528.65**	**182.27**	**190.34**
Measured	62.05	61.33	59.96	52.4
Indicated	138.88	145.15	116.45	105.47
Inferred	317.53	322.18	5.86	32.47

Source: Goldfields and Harmony Annual Reports

From the table above Harmony have a chunk of low quality mineral assets compared to Goldfields. It would be expected that Harmony should have much more mineral reserves and mineral resources if the assets where of equal quality. But the opposite is true; Goldfields have more mineral reserves than Harmony. In terms of mineral resources Harmony has more mineral resources, of which slightly more than 60% is in the inferred category, whereas Goldfields have 55% of its mineral resources in the indicated category. Clearly Harmony is a low quality mineral asset miner compared to Goldfields. Cockerill was quote saying "*he will also remind them that Goldfields is prepared to consider some form of friendly merger with Harmony, but only if this were to involve the latter's better assets. Goldfields*

would not want to be involved in a deal involving Harmony's marginal mines" (unknown, 2005). The commentary in the business day pointed out that "*Investors had believed in the Harmony story, and that Goldfields had high-quality mines. However, he was concerned that questions had been raised about the management of both companies and about the integrity of gold reserves statements"* (Fraser, 2005).

Market Capitalisation per ounce is a very important 'acid test' measurement of what shareholders and investors are will to pay for an ounce of gold that is in the ground held by a company. From the comparison shown in the above tables and figures Goldfield's ounces are perceived to be of better quality and hence the market are will to pay a premium for these ounces this comparison is shown in Table 10. This result confirms that Goldfield's mineral reserves and mineral resources are of better quality than Harmony's ounces

Table 10: Market Capitalisation per ounce comparison

	2004	2005	2004	2005
CLASSIFICATION CATEGORY	HARMONY		GOLDFIELDS	
	US$/oz	US$/oz	US$/oz	US$/oz
Mineral Reserves	43.90	116.7	66.91	140.47
Mineral Resources	5.17	11.95	29.07	61.71
Exchange Rate ZAR/USD	6.45	6.35	6.45	6.35

7.4.5 Public Reporting of Mineral Assets

Table 11 below shows the summary mineral reserve statement that was reported in the CPR that was prepared by SRK, and presented three broad options, each with five sub-options, from which the stakeholders are required to derive a mineral reserve number for Harmony. Surprisingly in all the options, the number of ounces presented is lower and significantly different to the 62.26Moz stated in the 2004 Annual Report and in the Harmony's offer document and the 55.65Moz that was stated in Harmony's press release issued on 10th May 2005.

Table 11: Harmony's Mineral Reserves as reported in the CPR by SRK

SCENARIO	MINERAL RESERVES (Moz)	COMMENTS
Option A	52.2	Includes Evander Rolspruit and Poplar projects, as well other entities with a negative NPV
Option B	42.3	Excludes Evander Rolspruit and Poplar projects, but includes other entities with a negative NPV
Option C	33.7	Includes only ounces that can be economically mined at a gold price of R92 000/Kg

Source: Harmony CPR by SRK

All of the sub-options presented under option A include the LOM plans of Harmony assets, irrespective of economic viability at R92 000/kg, the price at which Harmony's CPR calculates its mineral reserves. This also included entities that resulted in a negative NPV under the assumed modifying factors. Option B is exactly the same as option A, with the exception that the Evander Rolspruit and Poplar projects that are not economically viable are excluded.

However, despite the exclusion of the projects, option B still includes 8.6Moz at other entities which are not economically viable at a gold price of R92 000/kg. Both option A and B include entities and projects with negative NPV that are uneconomic. Based on the facts explained above, these mineral reserves do not conform to the definitions of mineral reserves as described in the SAMREC Code or Section 12 of the JSE listing requirements, which defines a mineral reserves as the economic mineable material derived from a measured or indicated resource.

Option C excludes all projects as well as other reserve ounces, which are not economically viable at R92 000/kg. This option is considered to be compliant with SAMREC definitions for a mineral reserve, since it comprises only those ounces that are economically viable and justifiable under reasonable economic circumstances.

This reporting format and structure was an unusual departure from the norm and was very confusing even to a knowledgeable reader. This format did not consider the general reporting principles as explained in the previous chapters since the format of presentation had 15 different scenarios, hence different mineral reserve figures. With such presentation, stakeholders would find it difficult on which figures would model a true representation of value of these mineral assets, which they can base, their investment decision. On the different cases considered, the next question that would be asked would be what the corresponding probability is associated with each case. If the probabilities where highlighted that could have simplified the interpretation of the results to a stakeholder of average intelligence and knowledgeable about the extractive industry. The numerous scenarios considered can in other sense reflect the level of uncertainty that the authors had on the information they where disclosing to the public.

7.5 Comments on the Potential Transaction

Harmony used this competitive advantage created in the market and some additional marketing strategies to launch the hostile takeover bid for Goldfields. The public reporting and presentation of information was convincing to be public and investors and made them to believe that Harmony is a better mining company than Goldfields. This perception was built from the fact that Harmony over the previous years have been able to:-

1. successful implementation of CONOPS on the most significant shafts;
2. reduce the overall production costs on the marginal shafts that where loss making and converted them to start making a margin on these operations;
3. increase the production capacity from 0.4Moz to 3.2Moz in less than 10 years;
4. implement fast turnaround strategies on the loss making operations and convert them to be profit making entities; and
5. prove to the market that they have better management expertise based on the successful implementation of the above issues.

Based on the above facts and the market perception in the industry, Harmony created a story that they can operate Goldfield's mineral assets much cheaper and more efficiently than the way they are being managed by Goldfields thereby maximising shareholders wealth of both

companies. Hence Harmony attempted to do a hostile takeover and acquire Goldfields. In the minds of sensible investors this made a lot of business sense since gold miners are price takers and the only way the mining companies can improve their margins without affecting the price would be to reduce the operating costs and increase efficiency on the operations. Harmony's management has demonstrated its competence in these actions repeatedly over the years. This is in line with investor's main objective, which is increasing their shareholders wealth.

"*In addition, a significant number of Gold Fields' shareholders have expressed to Harmony their recognition that the proposed IAMGOLD transaction, which represents the major pillar of Gold Fields' management's strategy, is value destructive and not in the best interest of Gold Fields and its shareholders*".(No author, 2005)

A risk of investment in the mining industry for any company is commodity risk especially to companies that specialise in the extraction of one commodity. These companies are very sensitive to the slight changes in the commodity prices and this is the case with Harmony since most of its shafts are marginal operations. But during boom times like these, when most of the commodities prices are on the rise such companies would enjoy abnormal profits. Another risk affecting all mining companies is production risk, whether it is environmental, geological or engineering. Mining companies with few operations are more susceptible to production risk since an interruption at one mine could impact the company's production profile. Harmony currently has interests in twenty-seven operating mines and, therefore, a disruption in any one mine will not have a large effect on the company. Eventhough Goldfields have only seven operations, over the last ten years they have proved that production risk is not an issue in their quality operations.

"Now that Gold Fields' management is reaching the end of its largely unsuccessful attempts to frustrate the proposed merger through a serious of expensive and technical legal challenges, we look forward to arguing Harmony's compelling value proposition based on fundamentals with the confidence that the various contradictory promises made by Gold Fields' management will be revealed as both value destructive and ultimately incapable of implementation in a manner that is either to the benefit of or likely to meet with the approval of Gold Fields' shareholders," Swanepoel said. (no author, 2004). This hostile bid ended up as a boardroom fight between the two companies and resulted in a very expensive potential transaction since both companies had to defend their positions through the legal system and external consultations.

7.6 Comment on the Fair and Reasonableness

After a carefully consideration of the terms and conditions, analysis of the information on the public domain on the proposed hostile merger between Harmony and Goldfields, the author's opinion on the fair and reasonableness is as follows:-

- Harmony promised to deliver its CPR, and the fact that it took seven months for the document to be produced and was only made available to Goldfields shareholder barely two weeks before the close of the offer. The true quantity of economically mineable mineral reserves was the single most important measure required to value Harmony's offer. The results contained in the CPR were presented in a way that was difficult to synthesise and make an informed decision for any average investor. Because of these factors

the offer and the dealing during this period was considered to be unfair and not transparent.

- Given the difference in quality of the mineral assets held by the two companies, and operational efficiencies displayed by Goldfields over the period under review. It is self evident that the offer was unreasonable and unfair to Goldfields shareholders. The author's opinion based on the information and the analysis of the reported results showed that the premium that was offered to Goldfields shareholders wasn't sufficient enough to make them give in to the hostile bid launched by Harmony. The conclusion based on facts described above, Harmony's shares were overvalued on the premise of its ever-changing mineral reserve declarations and a confusing CPR.

CHAPTER EIGHT

8 CONCLUSIONS AND RECOMMENDATIONS

The resulting uniformity of major mineral resource and mineral reserve reporting standards and definitions greatly improved the international understanding of what is meant by the terms mineral resources and ore (mineral reserves). But there is still along way to go, especially on the public reporting of mineral assets. Since most of the critical input to the mineral resource and mineral reserve estimation, classification hinges on the professional judgment of the competent person, which is sometimes very subjective depending on individuals. That is, it is very difficult to draw a common line to distinguish what has to be classified as measured or indicated resource. As much as the common understanding have been achieved. The next stage is the implementation and clarity in the minds of CP to use these standards and guidelines with the same meaning and interpretation of results. This common understanding has in turn facilitated the flow of investor funding to the mining companies, as some of the participating countries are also major sources of funding to the mining industry worldwide.

Complying with the new rules come with it advantages for the extractive industry, investors, stock exchanges and other concerned stakeholders. These include:-

- Because of globalisation of the mining industry uniform classification and standards would enable common understanding and interpretation of mineral resources and mineral reserves for cross-border transactions, operations, reporting and international investments;
- Standardising the classification systems and definitions would result in an easy transfer of capital from one country to the next, since the merits of a project anywhere in the world would be understood in exactly the same way by all investors world-wide;
- These rules are aimed to create a common language, facilitate communications and improve the quality of the information released in the public domain. It also makes it easier for multi-national companies to consolidate their mineral resource statements and compare operations irregardless of their location since a single classification system would be used;
- In the business community, the common understanding would facilitate the concept of global village, and makes international trade easier;
- The existence of common approaches to the mineral resources and mineral reserve classification systems and proper public reporting of exploration, development and mining results not only hastens the creation of a global mining industry but also facilitates the mobility of the technical professionals engaged in that industry and maximized employment opportunities;
- Reliable and comparable reporting aids not only the market participants, but also those responsible for surveillance and equitable operation of the market in the public interest;
- It gives the mining professionals a medium of communication, enabling them to describe what they have discovered, the value of their discovery to investors, regulators, international agencies in a way they would understand and have confidence in the information they are given; and
- It’s a sign and evidence of good corporate governance and this would improve the corporate

image, goodwill and credibility of the company

The quality of mineral resource and reserve reporting has significantly increased over the last decades. The evolving reporting process has now reached the point where most major industrial countries are working to common definitions and to nearly identical public reporting standards. More work is required before truly international standards are developed and accepted, and processes are in hand on several fronts to bring this to fruition. The following format for public reporting of mineral assets is suggested when any information about a mineral asset is sent out to the public:-

- Mineral resources should be reported exclusive of mineral reserves in all text and summary tables unless all the modifying factors used to convert the mineral resources to mineral reserves are disclosed.
- Measured and Indicated Resources should only be combined only if also reported separately;
- Inferred resources cannot be combined with measured or indicated resources, and should only be reported separately;
- Contained metal should only be reported only when accompanied by grade and tonnage estimates;
- A statement should be made that, while the estimate of mineral resources is based on the Competent Person's judgment that there are reasonable prospects for eventual economic extraction;
- Price assumptions made when estimating mineral resources should be disclosed along with mineral resource statements to the extent that this is customary and does not place the reporting entity at a competitive disadvantage;
- Reporting of mineral resources should be accompanied by public disclosure of the reasons why these mineral resources are not mineral reserves; and
- As a general rule, when reporting on a mineral asset the attributes of that asset should be disclosed. For example a company has concluded an acquisition deal on a mineral asset, the value of the transaction and the mineral resources statement of that asset should be disclosed since in the near future this inventory that have been purchased would need to be disclosed on the balance sheet.

8.1 Recommendations

After a carefully consideration of the situation and current circumstances in the public reporting of exploration results and mineral assets in SA, the following recommendations were suggested to be implemented in the extractive industry. These include:-

- More training of mining, geology and other mining related professions in the classification and public reporting in compliance to the current regulatory framework as indicated the compliance puzzle.
- A clear cut definition of who and why the guidelines and standards are being written for either securities exchanges or as guidelines to standardise the work of professionals. All stakeholders should remember that first and for most various professional

organisations have formulated codes and rules for the guidance for their membership in the pursuit of their profession and as a standard in case where professional liability could arise;

- A minimum checklist should be developed of what should be included in any report, article or press release as a minimum disclosure requirement for a mineral asset in the public domain.
- Establishment of Mineral Resource Management Committee similar to an audit committee that is composed of knowledgeable members who are impartial, to help and to advise the Board of Directors with interpretation, analysis and make recommendations at board level and this would help in decision making.
- Implement internal controls aimed at achieving consistency between Financial and Technical Reports: Financial reports take into account mineral resources and mineral reserves and are based on assumptions concerning commodity prices and other parameters used as input in the techo-economic valuation. To be clear and unambiguous, technical and financial information should be published on a comparable basis, making the same basic assumptions. Where financial reporting makes use of mineral reserve estimates, for example in depreciation, depletion and amortization calculations, it should use reserve estimates made in accordance with accepted guidelines. Where financial reporting makes use of information that is also used in reserve estimates, such as commodity prices or other particulars of life-of-mine plans, this information should be consistent with that used in the reserve estimates.
- Development of good practice guidelines: the professional organisations and regulators of stock exchanges should corroborate in the development and defining good practice guidelines which take into account the following issues:-
    - The need for consistent and reliable estimation and reporting of mineral resources and mineral reserves;
    - The increased requirement by the regulators especially the SEC for an adequate procedure and internal controls in the estimation of mineral reserves; and
    - The need to support and protect the interests of the shareholders and investors.
- For global companies, transparency can only been achieved if information is reported on a consistent basis in the extractive industry. Only then can the information supplied to all investors be identical, clear and unambiguous. International standards have long been recognized as desirable to create a common language, facilitate communications, and improve the quality of the information being released to the public by the mining industry. Such standards are required if rational decisions are to be made on the basis of well-understood information. Mining companies need uniformly accepted means to describe exploration projects, mineral deposits they discover or acquire, and mines they develop. Investors, governments, community leaders, international agencies, regulators and the public need to understand the representation made by the mining companies,

and must have reason to believe and have confidence in the information they are given. Only if meaningful international standards are available and enforced can any of the parties involved make sound decisions concerning their participation in the mineral industry.

8.2 Recommendations for Future Research Work

This research project detailed the historical developments, current practices in the public reporting of mineral assets based on the mineral resource and mineral reserve statements. As shown in Figure 5 shows the mineral asset valuation triangle developed by the author and Figure12 the compliance puzzle developed by Venmyn Rand. These two diagrams show the interaction between different rules, codes and standards that the extractive industry has to comply with. This research report dealt with the technical component of these reporting standards, whereas the financial component wasn't discussed. Hence it is recommended that the future research work could be looking at financial component. This will be of paramount importance especially in light of the SAMVal Code that is due to be enacted soon and the need for the Competent Mineral Asset Valuer to comply to these rules, codes and standards.

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10 GLOSSARY OF TERMS

Abnormal item	This is a material item possessing a high degree of abnormality which arises from events or transactions that fall within the ordinary activities of the reporting entity and which are not expected to reoccur
Assay	A chemical test performed on a sample of ores or minerals to determine the amount of valuable metals contained.
Assay map	Plan view of an area indicating assay values and locations of all samples taken on the property.
Bulk sample	A large sample of mineralized rock, frequently hundreds of tonnes, selected in such a manner as to be representative of the potential orebody being sampled. Used to determine metallurgical characteristics, Large sample which is processed through a small-scale plant, not a laboratory
By-product	A secondary metal or mineral product recovered in the milling process.
Carbon-in-leach	The recovery process in which gold is leached from gold ore pulp by cyanide and simultaneously adsorbed onto activated carbon granules in the same vessel. The loaded carbon is then separated from the pulp for subsequent gold removal by elution. The process is typically employed where there is a naturally occurring gold adsorbent in the ore.
Cut-off grade	The grade at which the ore body is mined with no profit or loss, i.e. the breakeven grade.
CONOPS	Continuous operations- this refers to the practice whereby a mine operates on all days of the year, including Sundays but excluding public holidays.
Competent person ("CP")	The SAMREC Code defines a competent person as a person who is registered with any one of SACNASP, ECSA, PLATO or any other statutory South African or international body that is recognised by SAMREC. A competent person should have a minimum of five years' experience relevant to the style of mineralisation and type of deposit under consideration and to the activity, which that person is undertaking.
Capital expenditure	Total capital expenditure on mining assets to both expand and maintain operations. This expenditure is usually very high and the useful life of the assets constructed or built is usually greater than a financial year. Hence for accounting purposes these amounts are written off over a couple of years and are allowable for tax purposes
Cash Cost Components	namely direct mining costs, direct processing costs, direct general and administration costs,by-product credits, consulting fees, management fees, transportation and realisation charges;
Carbon-in-pulp	A method of recovering gold and silver from pregnant cyanide solutions by adsorbing the precious metals to granules of activated carbon, which are typically ground up coconut shells.
Cross section	A diagram or drawing that shows features transected by a vertical plane drawn at right angles to the longer axis of a geologic feature.
Channel sample	A sample composed of pieces of vein or mineral deposit that have been cut out of a small trench or channel, usually about 10 cm wide and 2 cm deep.
Cyanidation	A method of extracting exposed gold or silver grains from crushed or ground ore by dissolving it in a weak cyanide solution. May be carried out in tanks inside a mill or in heaps of ore out of doors.
Density	Measure of the relative "heaviness" of objects with a constant volume, density = mass/volume
Deposit	Any sort of earth material that has accumulated through the action of wind, water, ice or other agents
Depletion	The decrease in quantity of ore in a deposit or property resulting from extraction or production.
Development property	A mineral property that is being prepared for mineral production and for which economic viability has been demonstrated.
Development	Underground work carried out for the purpose of opening up a mineral deposit. Includes shaft sinking, crosscutting, drifting and raising. Activities (including shaft sinking and on-reef tunnelling) required to prepare for mining activities and maintain a planned production level and those costs to enable the conversion of mineralised material to reserves.
Dilution	Waste, which is mined with ore in the mining process.

Diamond drilling	A drilling method, where the rock is cut with a diamond bit, to extract cores.
Dip	The angle that a structural surface, i.e. a bedding or fault plane, makes with the horizontal measured perpendicular to the strike of the structure.
Estimation	The quantitative judgement of a variable.
Exploration	Prospecting, sampling, mapping, diamond drilling and other work involved in the search for mineralization.
Economically Mineable	The extraction of the mineral reserve has been demonstrated to be viable and justifiable under a defined set of realistically assumed modifying factors
Exploration Property	A Mineral Asset which is being actively explored for Mineral deposits or petroleum fields, but for which economic viability has not been demonstrated
Equity	Shareholders' equity adjusted for other comprehensive income and deferred taxation. Where average equity is referred to, this is calculated by averaging the figures at the beginning and the end of the financial year
Facies	An assemblage or association of mineral, rock, or fossil features reflecting the environment and conditions of origin of the rock.
Fault	A fracture in earth materials, along which the opposite sides have been displaced parallel to then plane of the movement
Feasibility study	A comprehensive study of a mineral resource in which appropriate assessments have been made of realistically assumed geological, mining, metallurgical, economic, marketing, legal, environmental, social, governmental, engineering, operational and all other modifying factors, which are considered in sufficient detail to demonstrate at the time of reporting that extraction is reasonably justified (economically mineable) and the factors reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or finance, the development of the mineral asset.
Grade	The quantity of metal per unit mass or ore expressed as a percentage as ounces or grammes per tonne of ore.
Head grade	The grade of the ore as delivered to the metallurgical plant.
In situ	In its original place, most often used to refer to the location of the mineral resources.
Indicated Mineral Resource	That part of a mineral resource for which tonnage, densities, shape, physical characteristics, grade and average mineral content can be estimated with a reasonable level of confidence. It is based on exploration sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed and sufficient minerals have been recovered to allow a confident estimate of average mineral value.
Inferred Mineral Resource	That part of a mineral resource for which tonnage, grade and average mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified by geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that may be limited or of uncertain quality and reliability.
License, Permit, Lease or other similar entitlement	Any form of license, permit, lease or other entitlement granted by the relevant Government department in accordance with its mining legislation that confers on the holder certain rights to explore for and/or extract minerals that might be contained in the land, or ownership title that may prove ownership of the minerals
Life-of-Mine/LOM	Expected duration of time that it will take to extract accessible material
Liberation	Release of gold from the host rock through processing.
Mill/Milling	The comminution of the ore, although the terms have come to cover the broad range of machinery inside the treatment plant where the mineral is separated from the ore.
Market capitalisation	The number of ordinary shares in issue at close of business on a specified date e.g. June 30, 2003, multiplied by the closing price of the share as quoted on stock exchanges.
Mining property	A mineral asset which is in production.
Mineable	That portion of a resource for which extraction is technically and economically feasible.
Mine Call Factor ("MCF")	The ratio of the grade of material received at the mill to the grade of the ore calculated by sampling in stopes.

Mineral Asset(s)	any right to explore and / or mine which has been granted ("property"), or entity holding such property or the securities of such an entity, including but not limited to all corporeal and incorporeal property, mineral rights, mining titles, mining leases, intellectual property, personal property (including plant equipment and infrastructure), mining and exploration tenures and titles or any other right held or acquired in connection with the finding and removing of minerals and petroleum located in, on or near the earth's crust. Mineral Assets can be classified as Dormant Properties, Exploration Properties, Development Properties, Mining Properties or Defunct Properties.
Mineral Reserve	The economically mineable material derived from a Measured and/or Indicated Mineral Resource. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified. Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proved Mineral Reserve.
Mineral Resource	A concentration of material of economic interest in or on Earth's crust in such form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction. The location, quantity, grade, continuity an other geological characteristics of a Mineral Resource are known, estimated from specific geological evidence and knowledge, or interpreted from a well constrained and portrayed geological model. Mineral Resources are subdivided, in order of increasing confidence in respect of geoscientific evidence, into Inferred, Indicated and Measured categories. A deposit is a concentration of material of possible economic interest in, on or near the Earth's crust. Portions of a deposit that do not have reasonable and realistic prospects for eventual economic extraction must not be included in a Mineral resource.
Measured Mineral Resource	That part of a mineral resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill-holes. The locations are spaced closely enough to confirm geological and grade continuity.
Mineralisation	The presence of a target mineral in a mass of host rock.
Mining Property	a mineral asset which is in production.
National instrument 43-101	The Canadian Code for reporting exploration results, mineral resources and mineral reserves.
Opencast / Open pit	Surface mining in which the ore is extracted from a pit. The geometry of the pit may vary with the characteristics of the ore body.
Optimisation	Creating the best mining scenario while taking into account the economic parameters of the deposit.
Ore	A mixture of mineralised material from which at least one of the contained minerals can be mined and processed at an economic profit.
Orebody	A continuous well defined mass of material of sufficient ore content to make extraction economically feasible.
Overburden	The alluvium and rock that must be removed in order to expose an ore deposit.
Pre-Feasibility Study	A comprehensive study of a range of options for the viability of a mineral project that has advanced to a stage where the preferred mining method, in the case of underground mining, or pit configuration, in the case of an open pit, has been established, and where an effective method of mineral processing has been determined. It includes a financial analysis based on reasonable assumptions of technical, engineering, operating, economic factors and the evaluation of other relevant factors which are sufficient for a competent person, acting reasonably, to determine if all or part of the mineral resource may be classified as an mineral reserve.

Probable reserves	Is the economically mineable material derived from a Measured and/or Indicated mineral resource. It is estimated with a lower level of confidence than a Proved Reserve. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified.
Production	The day-to-day activities directed to obtaining saleable product from the mineral resource on a commercial scale. It includes extraction and other processing prior to sale.
Proved Mineral Reserve	A "Proved Mineral Reserve" is the economically mineable material derived from a Measured Mineral Reserve. It is estimated with a high level of confidence. It is inclusive of diluting materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration or and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justified.
Project capital	Capital expenditure which is associated with specific projects of a non-routine nature.
Prospect	A deposit with the potential for economic extraction
Pay-limit	The break-even grade at which the ore-body can be mined without profit or loss, calculated using forecast commodity prices, working costs and recovery factors.
Plant Recovery Factor ("PRF")	The ratio expressed as a percentage, of the mass of specific mineral product actually recovered from ore treated at the plant to its total specific mineral content before treatment.
Recovered grade/Yield	The actual grade of ore realised after the mining and treatment process.
Rehabilitation	The process of restoring mined land to a condition approximating to a greater or lesser degree its original state. Reclamation standards are determined by the Russia Federation Department of Mineral and Energy Affairs and address ground and surface water, topsoil, final slope gradients, waste handling and re-vegetation issues.
Sample	The removal of a small amount of rock pertaining to the deposit which is used to estimate the grade of the deposit and other geological parameters.
Sampling	Taking small pieces of rock at intervals along exposed mineralization for assay (to determine the mineral content)..
Shaft	A shaft provides principal access to the underground workings for transporting personnel, equipment, supplies, ore and waste. A shaft is also used for ventilation and as an auxiliary exit. It is equipped with a hoist system that lowers and raises conveyances for men, material and ore in the shaft
Stakeholder	Individuals, groups or organisations who have some kind of investment in a company, and consequently expect a return, and as a result has some kind of interest in the success of the company.
Slimes dam	A storage facility for all fine waste products from the processing plant.
Specific gravity/S.G.	Measure of quantity of mass per unit of volume, density.
Stockpile	A store of unprocessed ore or marginal grade material.
Stripping	Removal of waste overburden covering the mineral deposit.
Stripping ratio	Ratio of ore rock to waste rock.
Tailings	The waste products of the processing circuit. These may still contain very small quantities of the economic mineral.
Tailings dam	Dams or dumps created from waste material from processed ore after the economically recoverable metal or mineral has been extracted.
Total Costs	the summation of total working costs, net movement in working capital and capital expenditure

Total Cash Costs	Total cash costs include site costs for all mining, processing and administration, as well as contributions from by-products and are inclusive of royalties and production taxes. Amortisation, rehabilitation, corporate administration, retrenchment, capital and exploration costs are excluded. Total cash costs per ounce are the attributable total cash costs divided by the attributable ounces of gold produced. Royalties in this regard include the amount of 3% assumed to take effect in respect of South African gold mining operations on 1 January 2009
Total Production Costs	Total cash costs including amortisation, retrenchment, rehabilitation and other non-cash costs. Corporate administration, capital and exploration costs are excluded. Total production costs per ounce are the attributable total production costs divided by the attributable ounces of gold produced.
Total Working Costs	include the incremental components, including terminal separation liabilities, reclamation and mine closure costs (the net difference between the total environmental liability and the current trust fund provision) but excluding non-cash items such as depreciation and amortisation
Tonnage	Quantities where the tonne is an appropriate unit of measure. Typically used to measure reserves of metal-bearing material in-situ or quantities of ore and waste material mined, transported or milled.
TSX	Toronto Securities Exchange
Trenching	Making elongated open-air excavations for the purposed of mapping and sampling.
Trust Fund	A fund required by law to be set up, to which annual contributions are paid so that the remaining environmental liability of the operation is covered
Weighted average number of ordinary shares	The number of ordinary shares in issue at the beginning of the year, increased by shares issued during the year, weighted on a time basis for the period during which they have participated in the income of the group
Yield/Recovered grade	The actual grade of ore realised after the mining and treatment process.