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A FRAMEWORK TO HARMONISE MINERAL ASSET VALUATION METHODOLOGIES WITH EXISTING AND EMERGING FINANCIAL REPORTING REQUIREMENTS

Godknows Njowa

A thesis submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Doctor of Philosophy.

Johannesburg, 2017

DECLARATION

I declare that this thesis is my own, unaided work. Where use has been made of the work of others, it has been duly acknowledged. It is being submitted for the Degree of Doctor of Philosophy 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.

Signed:

_____

Godknows Njowa

This 25 of May 2017

ABSTRACT

One of the consequences of globalisation in the extractive industries is the necessity to apply uniform accounting and valuation standards that are clearly understood and consistently applied by the global stakeholder community. At the beginning of the 20th century it was realised, mainly by the major mining countries that the extractive industries is one of the biggest sectors globally. In the extractive industries the single most important asset is the Mineral Resources and Mineral Reserves, yet this is not reflected anywhere in the financial statements. The major mining countries, through their mining institutes, realised that there was a need to develop standards and guidelines to align and standardise the definitions of Exploration Results, Mineral Resources and Mineral Reserves, which was achieved through the CRIRSCO template. From the accounting fraternity, several organisations also realised the need for an accounting standard specific to the extractive industries, specifically for financial reporting. Attempts by the IVSC and IASB to develop a global accounting standard for the extractive industry attests to the global requirement to develop internationally recognised valuation guidelines or a global framework for the valuation of mineral assets. Both the mining institutions and accounting standards setting boards have been working in isolation to develop a globally acceptable standard or guideline for the extractive industries, and neither has been successful due to the inherent complexities.

The harmonisation of the national codes for reporting of Mineral Resources and Mineral Reserves through the CRIRSCO template, provides global common understanding. However, the national mineral asset valuation (MAV) codes, are needed to develop a similar international template. The CRIRSCO template provided a strong foundation on which the IMVAL template was developed. As part of this research a framework was developed to harmonise the national MAV Codes. Various authors have argued that there is no globally accepted standard or guideline for the valuation of extractive industries assets, nor is there a specific accounting standard for extractive industries. MAV is still an emerging discipline, coupled with the fact that financial reporting in the mineral industry is not yet fully developed, as IFRS 6 appears to be the only mineral specific financial reporting standard. This is supported by the fact that currently there is a lack of a comprehensive accounting standard for the extractive industries to guide the accounting, recognising and presenting these assets in the primary financial statements.

This thesis argues that there is a gap between reflecting and accounting for Mineral Resources and Mineral Reserves in the financial reporting systems, and how these mineral assets are valued and reported. These identified gaps between MAV methodologies and financial reporting requirements formed the basis of this work. Hence this thesis develops a framework to harmonise the existing and emerging financial reporting requirements and MAV methodologies. This framework is applicable to developmental projects and operating mines, and was validated by applying the framework to a real life case study.

Turquoise Hill Resources (Turquoise), which owns Oyu Tolgoi copper-gold mine in Mongolia, was selected as a good case study, due to the fact that Turquoise owns and operates this single multi-commodity mineral asset, with information available in the public domain. Hence the value of Turquoise on the stock exchange is driven by the fundamental value of the mineral asset only. The results of the proposed framework showed the highest correlation coefficient of 0.77, meaning that there is a strong correlation between proposed framework and the proxy company value selected.

It is concluded that the proposed framework to harmonise MAV methodologies and the emerging financial reporting requirements can be applied to estimate values for companies in the mineral industries.

LIST OF PUBLICATIONS

The publications listed below have emanated from this research work so far:

1. **Njowa, G**, Musingwini, C and Clay, A. N (2010), Development and implementation of a PGE mineral asset valuation curve, in *Proceedings of the 4th International Platinum Conference: Platinum in Transition 'Boom or Bust'*, Sun City, South Africa, 11th-14th October 2010, The Southern African Institute of Mining and Metallurgy, pp.353-359. An electronic copy of the paper is available on INTERNET: http://www.platinum.org.za/Pt2006/Papers/159-164_Musingwini.pdf. (invited for presentation and reprinted with SAIMM permission in VALMIN Seminar Series 2012, pp.103 – 110)

2. **Njowa, G,** Clay, A.N, Cawood, F.T and Musingwini, C (2012), Historic and Current Industry Practices in Public Reporting of Mineral Assets in Southern Africa – Platinum Case Studies, in *Proceedings of the VALMIN Seminar Series'*, Perth 18th October 2011 and Brisbane17th April 2012, Australia, The Australasian Institute of Mining and Metallurgy, pp.17-27.

3. Tholana, T**, Njowa, G,** Musingwini, C (2013), An algorithm to construct industry cost curves used in analysing cash cost performance of operations for selected minerals in South Africa, in *Journal of The Southern African Institute of Mining and Metallurgy*, Vol. 113, No. 2, pp.473-484. An electronic copy of the paper is available from the SAIMM website at INTERNET: http://www.saimm.co.za/Journal/v113n06p473.pdf

4. **Njowa, G**, Musingwini, C and Clay, A. N (2014), A perspective on global harmonisation of major national mineral asset valuation codes, in *Resources Policy,* Volume 39, March 2014, pp.1- 14, United States of America. An electronic copy of the paper is available on subscription on the Resources Policy website on INTERNET: http://www.sciencedirect.com/science/article/pii/S0301420713000858.

5. **Njowa**, G and Musingwini, C (2016), Application of the Market Approach in the valuation of Mineral Assets – a practical case study. *in Proceedings of the Samrec/Samval Companion Volume Conference*', Johannesburg, South Africa, 17th - 18th May 2016, The Southern African Institute of Mining and Metallurgy, pp 135-150.

6. **Njowa, G**, Musingwini, C and Clay, A. N (2015), Implications of IFRIC 20 in Mine Planning and Financial Reporting for Surface Mining Operations. in *Proceedings of the 23rd International Symposium on Mine Planning and Equipment Selection (MPES 2015)*, Sandton City, South Africa, 09th-11th November 2015, The Southern African Institute of Mining and Metallurgy, pp691-699.

7. Rupprecht, S. and **Njowa, G**. (2016), The valuation of an exploration project having inferred resources. *in Proceedings of the Samrec/Samval Companion Volume Conference*', Johannesburg, South Africa, 17th - 18th May 2016, The Southern African Institute of Mining and Metallurgy, pp87-94.

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Lastly, the opinions expressed in this thesis are those of the author and may not necessarily represent the policies of the organisations mentioned in this thesis.

DEDICATION

To Almighty God, who has brought me this far (Ebenezer)

To my mother, father, brothers and sisters who have been my pillar of support in life.

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1. INTRODUCTION

1.1. Chapter overview

This chapter presents an overview of the relevant historical trends in mineral asset valuation and financial reporting for mining companies, leading up to this research. Firstly, the structure of the thesis given and then the chapter provides a brief history on the development of the international standards for the reporting of exploration results, mineral resources and mineral reserves (synonymous to 'ore reserves' in the Australian context) and the various efforts in the development of an accounting standard for the extractive industries by the International Accounting Standards Board (IASB) and the International Valuation Standards Council (IVSC). These have formed the basis for the development of the different national mineral asset valuation or value (MAV) codes and guidelines in an effort to ascribe monetary values to these mineral assets. However, the failure of the accounting fraternity to develop a comprehensive accounting standard and a valuation standard for mineral assets bares testimony to the complexity of the issues surrounding the valuation of these mineral assets. This then leads to the relevance of this research. This chapter discusses the lack of a comprehensive accounting standard specific for extractive industries, and the need for global harmonisation of national mineral asset valuation codes, as noted in Njowa *et al* (2014). These developments would be the first steps towards some kind of a global guideline for the valuation of mineral assets.

1.2. Historical overview

In recent decades globalisation has been a dominant feature in financial services, trade and the minerals industry. This has driven the accounting fraternity to recognise the need for global harmonisation of accounting standards. In 1973 the International Accounting Standards Committee (IASC), the predecessor of the IASB, was created (Basoglu and Goma, 2003). The IASB develops and issues the International Financial Reporting Standards (IFRS) which are "*a set of international accounting standards stating how particular types of transactions and other events should be reported in financial statements*" (IFRS Website, 2012). These reporting standards allow companies worldwide to provide financial reports that are essentially prepared using the same framework, standards and guidelines. Such financial reports require little or no modification across countries for ease of comparison by investors, indicating that globally harmonised standards facilitate common understanding and interpretation in different regulatory jurisdictions. During the harmonisation process of accounting standards, the need for an accounting standard for extractive industries was realised. This resulted in the issuing of comprehensive discussion documents, and the subsequent development of the IFRS 6 standard as an interim measure to enable the first implementation of IFRS in the minerals industry. IFRS 6 was issued in December 2004 and applied from 1 January 2006.

The standard was written with a view to allowing companies to carry over to IFRS their previous generally accepted accounting principles (GAAP) practices to a large extent. IFRS 6 is titled "*Exploration for and Evaluation of Mineral Resources*" (IFRS 6). These initiatives enabled the generation of comparable, insightful and reliable accounting information to guide financial reporting in the minerals industry and facilitate decision making by investors, creditors, regulatory agencies and their respective advisors.

Globalisation has meant that most companies engaged in the minerals industry have had to expand their exposure across diverse geographical locations and now operate, have shareholders and engage consultants from more than one country. This development necessitated the standardisation of the way that exploration results, mineral resources and mineral reserves are reported in the public domain in order to provide a common understanding, irrespective of geographical location or regulatory jurisdiction. International standards have long been recognised as a necessity to create common language, definitions, understanding and interpretation to facilitate effective communication between stakeholders. Rendu and Miskelly (2008) reported that in the ten to fifteen years prior to 2008, substantial progress had been made to achieve this goal.

A global committee or organisation known as the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) was formed to align national reporting codes, by developing international standards for the reporting of exploration results, mineral resources and mineral reserves. CRIRSCO developed a guidance template that now fosters common understanding by harmonising the definitions, classification, estimation processes and the public reporting of exploration results, mineral resources and mineral reserves. At the time of writing this thesis, CRIRSCO supported the idea that the Australasian Institute of Mining and Metallurgy (AusIMM), the Southern African Institute of Mining and Metallurgy (SAIMM) and the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) should align their mineral asset valuation codes, although it elected not to be involved in this process.

A consistent and reliable international approach to the public reporting of a mining company's main assets, its mineral resources and mineral reserves, has become progressively important in recent years with the rapid globalisation of the mining industry. Uberman (2014) noted that although the value of mineral resources and mineral reserves emanates from the global consent that the mineral deposit is the single most valuable asset for a mining company, there is little agreement about how this value should be calculated and disclosed. Uberman (2014, p496) concluded that "*the relatively slow progress in the development of regulations related to recognition and valuation of mineral resources and mineral reserves as a class of assets results from a low number of countries where mining has become an important part of their economy and even a smaller number amongst them have developed mature financial markets creating a need for a large number of valuations*". In major mining countries, such as Australia, Canada and South Africa, professional organisations were founded (AusIMM, SAIMM &CIM) and these have been at the forefront of efforts undertaken to codify rules and methodologies for mineral asset valuation.

Similarly, the accounting professionals have been faced with the same challenge of different accounting treatment and disclosure in various accounting standards, leading to slow development of universally recognised rules or standards (or code) under the IFRS, for example the interim IFRS 6 for the minerals industry.

In addition, previous financial collapses on a global scale caused reporting on publically listed securities to be revisited in order to protect shareholders as an overriding securities exchange principle. The need to protect investors on the stock exchanges was a major factor which influenced the leading mining countries to develop national valuation codes for mineral and petroleum assets. The national mineral and/or petroleum asset valuation codes developed by the major mining countries are:

- In Australasia, the Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities for Independent Expert Reports ("The VALMIN Code, 2015") originally developed in 1995 by a joint committee of the AusIMM and Australian Institute of Geoscientists (AIG), with the participation of the Minerals Council of Australia (MCA) and other key stakeholder representatives. The code was developed in consultation with the Australian Securities and Investment Commission (ASIC), the Australian Stock Exchange Limited (ASX), the Petroleum Exploration Society of Australia, the Securities Association of Australia and representatives from the Australian finance sector;
- In Canada, the Standards and Guidelines for Valuation of Mineral Properties ("The CIMVAL Code, 2003") developed by CIM through a Special Committee of the Canadian Institute of Mining, Metallurgy and Petroleum on Valuation of Mineral Properties;
- In South Africa, the South African Code for the Reporting of Mineral Asset Valuation ("The SAMVAL Code, 2016") developed by the South African Mineral Asset Valuation (SAMVAL) Working Group under the joint auspices of the Southern African Institute of Mining and Metallurgy (SAIMM) and the Geological Society of South Africa (GSSA);
- In Poland, the Polish Code for the Valuation of Mineral Asset ("The POLVAL Code, 2008") developed by a special committee of the Polish Association of Mineral Asset Valuators; and
- In the United States of America the SEC Industry Guide 7 which was first published in 1990.

The above four mineral asset valuation codes predominantly focus on solid minerals, and were largely developed from the VALMIN Code of 1998. The main purpose for the development of these valuation codes was to give investors and their professional advisors a certain level of comfort regarding the quality and correct methodologies applied in the valuation of mineral assets. The national mineral asset valuation codes therefore have some commonality in terms of valuation principles, but differ significantly in the areas of definitions, methodologies, structure and application.

These countries have between 2010 and 2015 been reviewing their national mineral asset valuation codes and the reviews can provide a platform for the standardisation of mineral asset valuation principles, definitions and other valuation issues. This thesis therefore, focuses mainly on the minerals industry with little reference to the petroleum industry since it principally compares the VALMIN, CIMVAL, POLVAL and SAMVAL Codes. It should be noted that in the United States the valuation of mineral properties can essentially be viewed as a patchwork of state regulations and these will be discussed in later chapters. Furthermore, in the United States the term 'valuation' has been used synonymously to mean 'appraisal' hence this thesis refers to the term valuation only in order to maintain consistency. In Canada and South Africa the term 'valuator' is also used synonymously for the term 'valuer', and as a matter of preference this thesis will use 'valuer' in this report .

In April 2012, a CRIRSCO equivalent committee for mineral asset valuation named the International Mineral Valuation Committee (IMVAL) was created in Brisbane, Australia, soon after the VALMIN Seminar Series. The agreement to create IMVAL is therefore loosely referred to as the 'Brisbane Accord'. The creation of IMVAL was premised on a model that IMVAL members would be representatives of their National Reporting Organisations (NROs). NROs are responsible for developing mineral asset valuation codes, standards and guidelines in Australia (VALMIN), Canada (CIMVAL), South Africa (SAMVAL), the United States (AIMA and SME) and the United Kingdom (RICS). The acronyms AIMA, SME and RICS respectively, stand for the former American Institute of Minerals Appraisers which has recently been renamed to the International Institute of Mineral Appraisers (IIMA); the Society for Mining, Metallurgy and Exploration; and the Royal Institution of Chartered Surveyors. Currently the POLVAL is not represented at the IMVAL. IMVAL aims to provide a platform for the harmonisation of the national mineral asset valuation codes and promote best practice in the international reporting of mineral asset valuation results. IMVAL is envisaged as an international advisory body without legal authority, relying on its constituent members to ensure regulatory and disciplinary oversight at a national level. Its creation and existence recognises the global nature of the minerals industry and the agreed need for international consensus on reporting standards in mineral asset valuation.

The word harmonisation was defined by Basoglu and Goma (2003), as the process of reducing the degree of variation in international accounting practices. In the context of this thesis, this definition implies reducing variation in international mineral asset valuation practices. The United Nations has also previously explored harmonisation of mineral policies in Southern Africa. In their definition, harmonisation was perceived as the development of high level common standards to which national policies, laws and regulations are subsequently aligned in order to reduce as much as possible, differences in operating environments among countries (United Nations, 2004). Since the common thread in these definitions is the reduction of variations at a high level, this thesis assumes harmonisation to imply reducing at a high level, the degree of variation in the international mineral asset valuation practices in terms of how mineral assets are valued and reported in the public domain.

A key characteristic of the minerals industry that sets it aside from other industries is the depletion of natural resources that cannot be replaced through natural processes into their original state following extraction.

The single most important asset or agent of production is extraction of the natural resource from the earth, which requires huge capital expenditure and takes several years to develop the ore body for commercial extraction. The ultimate quantity and quality of material of economic interest that might be extracted from a property is often not known with absolute certainty at the 'Effective Date of Valuation', until the natural resource has been exhausted because the process is based on estimations, with some level of uncertainty associated with it. The MAV codes described earlier were developed to address the uniqueness of the mineral industry's assets and value ascribed to them as discussed in Sections 1.3.1 to 1.3.5.

1.2.1. Structure of thesis

This thesis is divided into eight chapters, followed by references and appendices.

Chapter 1 introduces the subject matter on MAV and financial reporting in the mineral industry and identifies the gaps between the two current frameworks that are not linked and the lack of a comprehensive accounting standard for the extractive industries. This chapter further describes the definitions, purposes and uses of MAVs and the purposes and uses of financial reports. Lastly, it highlights the importance of interfacing MAV and financial reporting as an extension to integrated reporting.

Chapter 2 defines the general framework and further explores literature on the recent developments in the MAV and financial reporting frameworks. It also explores the institutional frameworks on the development of the national MAV codes with the major mining countries such as Australia, Canada and South Africa. Lastly, this chapter concludes by describing the perceived development in MAV and financial reporting.

Chapter 3 is dedicated to the comparison of major MAV codes globally and developments towards harmonisation of the national codes through the proposed IMVAL template. In this section the VALMIN, CIMVAL, SAMVAL and GN 14 are discussed to establish differences and similarities, as this would form the basis of the harmonisation of these codes. It further explores the different organisations efforts that are considered relevant precursors to the harmonisation of the mineral asset valuation codes. These were efforts by the IASB and IVSC to develop a global accounting or a valuation standard for the extractive industries. On the technical side, the chapter explores the lessons learnt through the development and implementation of the CRIRSCO template regarding the reporting of exploration results, mineral resources and mineral reserves. Lastly, the chapter concludes by proposing a structure for the IMVAL template.

Chapter 4 explains the concepts applied in financial reporting in the mineral industry as the basis for the historical cost accounting for the financial disclosure. The section also explores the uses and difference between the IFRS and GAAP applied to the mineral industry and notes that IFRS based financial statements are widely used globally and would be used for any analysis in this research work. The chapter also explores how the equity valuation of mineral companies is estimated using financial ratios and what factors affect or influence the value of a mining shares. Lastly, it explores the use of historical financial statements in an investment banking methodology to estimate the value of a mining company. In Chapter 7, this methodology was applied to a mining company (Turquoise Hill Resources Limited (Turquoise)) with only one mineral asset Oyu Tolgoi gold and copper mine in Mongolia as a case study.

Chapter 5 gives a detailed discussion of the current understanding between mineral project evaluation and mineral asset valuation and aims to establish the links between these two concepts and the financial reporting discussed in the previous chapter. This explores the general fundamental factors that drive the value of a mineral asset at different stages of development and only explore further the factors that affect value in the developmental and operating mines stage. On reviewing details in the fundamental factors, the mineral project evaluation process and the mineral asset valuation it was established that there are strong links or relationships (framework) that affect the value of a mineral asset or mineral company. This framework or links are summarised in Chapter 6 and in Chapter 7 the framework is tested using a real life case study.

In Chapter 7 a detailed analysis of the Oyu Tolgoi case study is analysed and dissected, in an effort to test whether the framework established in Chapter 5 and 6 are considered valid and that the relationships are statistically valid. This would then validate the potential framework to link financial reporting and MAV. Observations, conclusions and recommendations are made in Chapter 8.

1.3. Definition, purpose and uses of Mineral Asset Valuation (MAV)

1.3.1. Definition of value

Value can be defined as a dimension of measurement on the worthiness or performance of an entity as determined by an individual's or organisation's preferences, and the trade-offs they choose to make in an open market given their limited resources. In general, entities invest in the expectation that when they sell, the value of each investment will have grown by a sufficient amount above its costs to compensate them for the risk they took (Koller, *et al*., 2010).

In simple terms, economic value can be represented by the maximum amount a consumer is willing to pay for an item in a free market economy. The value ascribed to any item or business is highly dependent on the perception of value that the individual or company has within the current and future market conditions. Therefore, the monetary value of any asset is considered to be subjective to the capability and potential uses that the owners of the asset would envisage. The monetary value of an asset can be perceived differently by individuals and companies depending on several factors that are at the disposal of that specific entity.

From an accounting point of view, "*the guiding principle of value creation is that companies create value by investing capital they raise from investors to generate future cash flows at rates of return exceeding the cost of capital (the rate investors require to be paid for the use of their capital). The faster companies can increase their revenues and deploy more capital at attractive rates of return, the more value they create. The combination of growth and return on invested capital (ROIC) relative to its cost is what drives value"*, (Koller, *et al*., 2010, p4).

1.3.2. Definition of Mineral Asset

Mineral assets or mineral properties are defined in the VALMIN Code (2015, p38) as "*all property including but not limited to real property, intellectual property, mining and exploration tenements held or acquired in connection with the exploration of, the development of and the production from those tenements together with all plant, equipment and infrastructure owned or acquired for the development, extraction and processing of minerals in connection with those tenements*". Almost all the mineral assets can be classified as 'Exploration Areas', 'Advanced Exploration Areas', 'Pre-Development Projects', 'Development Projects', 'Operating Mines' or 'Defunct Mines', depending on the level of development and the amount of work that has been conducted on the tenements or properties.

During the mining development cycle, the building blocks for the mineral asset would be the declared mineral resources and mineral reserves. Mineral resources are those materials that are potentially valuable, and for which reasonable prospects exist for eventual economic extraction in the near future. Mineral reserves are those materials that can be legally, economically and technically extracted within the immediate future in order to provide earnings to the company. However, whether those earnings exceed costs to generate profit depends on many factors especially commodity price and exchange rate, but some mines are operated for strategic purposes where "economic" and "value" are not necessarily met.

An asset is defined, according to the IFRS, as "*a resource controlled by the enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise"* (Oppermann *et al*, 2001, p5).

Macfarlane (2011, p2) defined an asset as, "*anything tangible or intangible that is capable of being owned or controlled to produce value and that is held to have positive economic benefits*". In general an asset is a resource that is used to conduct an enterprise's normal business. The primary characteristic of an asset is the future economic benefits which would eventually result in a net cash inflow to the enterprise and should be as a result of some form of legal or economic ownership arising from a past event or events.

In defining a mineral asset, it would be equally important to understand the definition of the word "Extractive Industries". According to the IASC (2001, p15) the extractive industries are defined as "*those industries involved in finding and removing wasting natural resources located in or near the earth's crust. Wasting natural resources are those natural resources that cannot be replaced in their original state by human beings. Examples of wasting natural resources include, but are not limited to, sand, gravel, stone, coal, sulphur, metal ores (such as copper, gold, iron, nickel, lead, zinc, silver, tin, and platinum), gemstones, oil (including natural gas liquids), natural gas, and other gaseous substances*". Despite the ASIC definition, it should be noted that some historical references use the terms "non-renewable" or "finite", especially when discussing the economics of mining. These terms further impart the concept of never being able to renew or regenerate them. Hence the need to exploit the natural resources in a responsible manner for the generations to come. In general these finite, wasting natural resources are referred to generally as minerals.

In most countries globally, including South Africa, the State (government) actually owns the minerals and not the operator. The operator merely leases the mineral asset through royalties and taxes, the right to exploit the minerals and receive the economic benefit. Mining licences are typically awarded for 25 to 30 years, renewable thereafter if all the conditions of the licence has been met. This aspect, is important in the definition of a mineral asset and the mining companies would endeavour to comply with the conditions of the mining licence to ensure its validity and the ability for it to be renewed in the future. Failure to maintain its validity, the mineral asset seizes to be an asset for the mining company.

1.3.3. Definitions of Mineral Asset Valuation and Evaluation

In a mining project context, the SAMVAL Code (2016) defines "valuation" as having the rather narrow meaning of *"placing a monetary value on the worth of the mineral asset as a whole"*. The word "valuation" can be used to refer to the estimated MAV (the Valuation conclusion) or to the preparation of the estimated MAV (the act of valuing). The monetary value can be determined in the market at any specific point in time, or may be estimated by one of the several valuation methods that are in use, depending on the stage of development of the mining project which is a function of increasing geological confidence and the different level of the engineering studies conducted on the project. Mineral exploration normally starts with a target generation phase, which is generally a desktop study used to identify suitable countries and mineral belts or target areas.

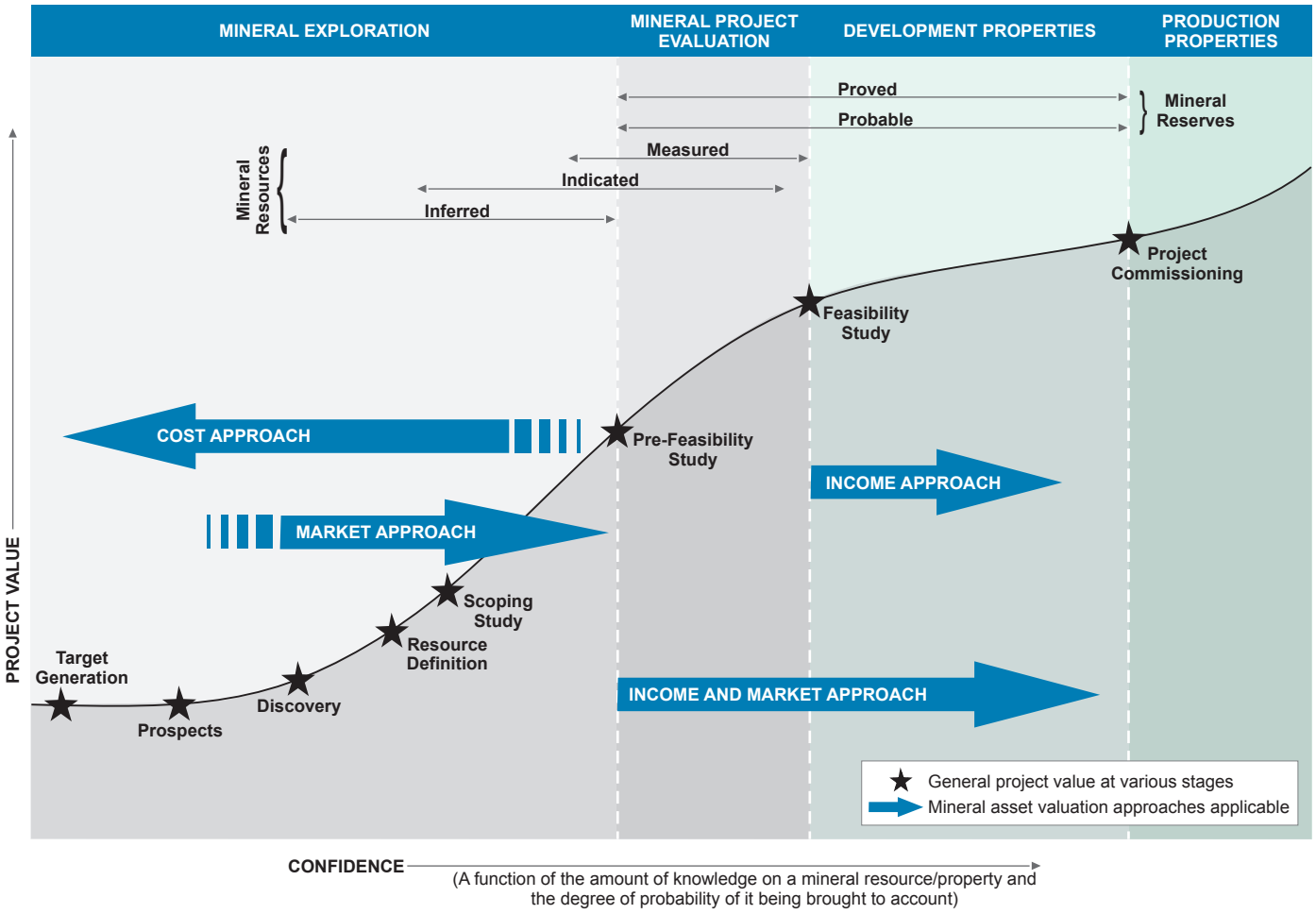
Physical exploration then follows to generate prospects, which if a mineral deposit is “discovered” then becomes a project for resource definition and Evaluation, initially through a Scoping Study, and proceeding to Pre-Feasibility and Feasibility if warranted. Figure 1.1 illustrates how monetary value tends to vary with the stage of development of a mineral project. It further illustrates the stages at which each of the commonly applied valuation approaches are applied. These are the cost, market and income approaches. The cost approach is most applicable to exploration and advanced exploration projects due to the limited amount of geological information available, whereas the market approach is applicable for the complete mining value chain from exploration to production due to the fact that mineral assets exchange hands at any level of development. Lastly the income approach is most suitable for projects where engineering studies with a minimum of pre-feasibility studies have been completed and mineral reserves have been declared (Heffernan, 2004).

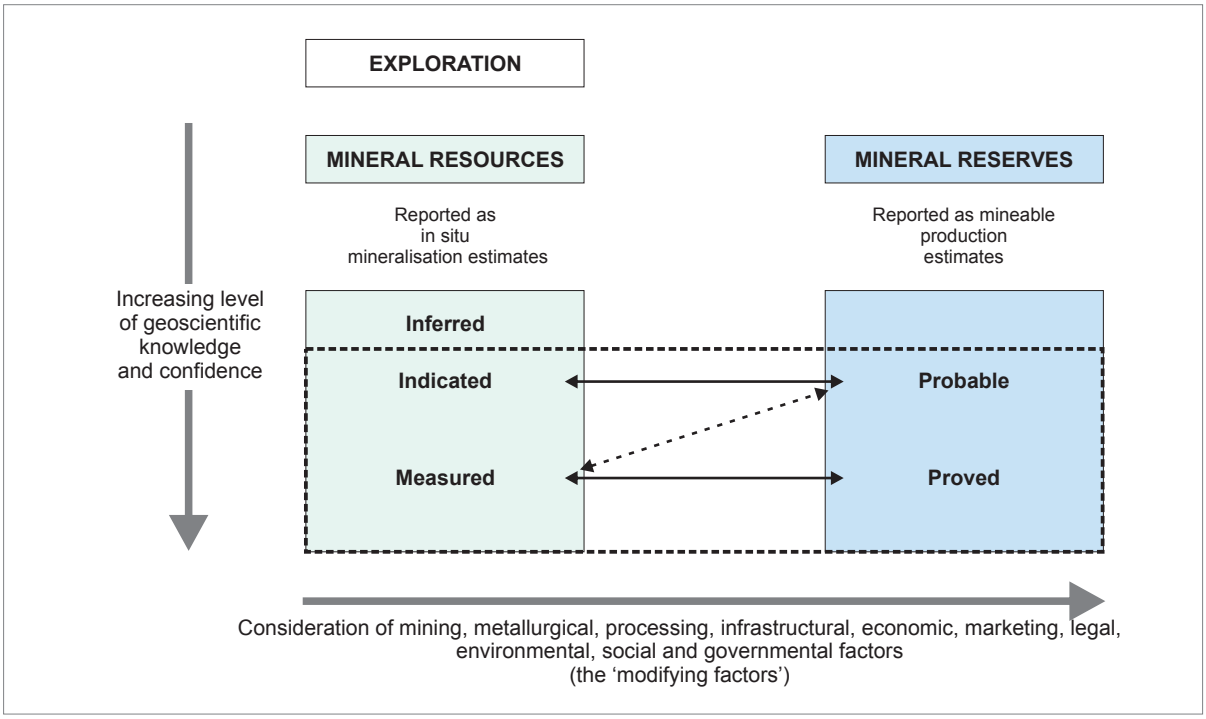
In its simplest form, valuation is the determination of the amount for which the mineral asset will transact on a particular date (Pagourtzi *et al*, 2003). The VALMIN Code (2015, p40) defines valuation *“as the process of determining the monetary value of a mineral, petroleum or security asset*”. The process of attaching a value to a mineral asset is complex given the level of uncertainties in forecasting commodity prices, unpredictability of future production and other technical and financial factors. One criticism of MAVs is that it is regarded as “difficult” and subject to too many variables and uncertainties. The purposes of MAVs was previously compiled by Frimpong (1992) and modified (added to) by Lilford (2004) to include but are not limited to, mergers and acquisitions, capital reductions, fairness and reasonableness opinions, income tax assessment, accounting and financial reporting, stamp duty valuations, compensation for compulsory acquisitions, vendor consideration in a public float, debt raising, equity financing, litigation, estate settlements, corporate valuations and investment purposes.

Lonergan (2006) also supported the fact that the valuation of mineral assets depends upon the purpose of the valuation, the outlook of the commodity price forecast, the development stage of the mineral asset, the sophistication of the investor and the materiality of the investment. Kramna (2014) also supported the argument that mineral asset valuation is a sophisticated discipline, in which it is necessary to combine knowledge from different disciplines and at the beginning of a business valuation it is always necessary to know the purposes and objectives of the value determination which, then influences the choice of methods and procedures.

The valuation of a mining business enterprise is not a precise science and the conclusions arrived at will in many cases be dependent on the conceptual hypothesis, valuation principles, methods and assumptions adopted. There is therefore no indisputable single estimate of value. There is consensus that the allocation of value has to be both reasonable and defensible based on the information provided and the information that has been obtained independently; others may place a different value on the same property.

Figure 1.1: Project lifetime value and valuation approaches for mineral resource projects at different stages of development





Source: Hope (1971), Lilford (2004), SAMREC Code (2016)

It is a commonly presented argument that mineral assets have characteristics which make them different from assets in other industries hence the methodologies used in the valuation of mineral assets are also different. One of the major unique characteristics of the extractive minerals industry that sets it apart from other industries is the depletion of the natural resources that then cannot be replaced in their original state by natural processes following extraction, and hence are considered non-renewable except in unusual and special cases. Special cases of natural replacement may occur within water-transported minerals and geothermal fluids. Macfarlane (2011, p3) summarised the special characteristics of a mineral asset as follows:-

- *"it is finite;*
- *it is a wasting asset with a finite life which, when consumed, cannot be renewed in the existing physical location in which it occurs hence it is depreciated through exploitation;*
- *capital intensive to get the mining operation started;*
- *high fixed cost and may have narrow margins;*
- *long lead times from exploration through to mine development and ultimately through to closure, so the capital remains at risk for prolonged periods;*
- *exposed to multiple risks such as technical, financial, political, geographical and economic risks;*
- *currently is not recognised as a financial asset on a company's balance sheet;*
- *it is highly sensitive to commodity price, which demands flexibility;*
- *it usually outlives price cycles and normally the companies are 'price-takers';*
- *it is based on sampling information and estimation, rather than constant exact measurement;*
- *it has a dynamic exploitation strategy, which changes as prices and costs change; and*
- *its value is a function of its future exploitation strategy, rather than its invested capital*".

Over and above the characteristics identified above, some of the largest risk issues in mining today, are social acceptance and environmental impact and the social dynamics tend to be fluid and would need continuous engagement with the communities. There are many examples of mining projects that have been granted permission to mine, but have been stalled or cancelled because of social or environmental issues. No mining company would proceeds to mining without having the necessary technical abilities or financial backing. It has been very clear in recent years that "permission to mine" is based more on socio-political and environmental factors than strictly regulatory compliance, technical "ability to mine" or economic "profitable to mine".

In order to encourage investment into mining, policies and government regulations need to recognise these characteristics of mining and help reduce the risks of investment in long term projects. In the valuation of mineral assets, mineral asset valuers integrate their knowledge and experience with other specialists in an effort to consider the knowledge and information available and the appropriate methodologies and approaches and to determine a professional opinion on the value of a mineral asset.

It should also be noted that to conduct a balanced mineral asset valuation requires extensive knowledge and experience in a number of fields particularly in geology, geostatistics, mining, mineral processing, taxation, environmental assessment and economics. The application of all these fields has to be taken into consideration in the process of determining the value of the mineral asset. A detailed examination of the technical and economic circumstances peculiar to the ore body and constraints relating to the mineral asset, factoring in and combined with realistically achievable parameters in operational economics, metal marketing and commodity pricing, form the basis for the development of sophisticated financial models to evaluate and determine the value of the mineral asset.

The value of a mineral asset is not the price at which it will transact. The actual price that may be achieved in a hypothetical transaction involving various components of a mining cash generating unit to which a mining company is entitled, may be higher or lower than the values determined by any mineral asset valuer, depending upon circumstances specific to the transaction. The specific circumstances of a transaction may include such factors as the competitive bidding environment at the time of the transaction, the prevailing general market sentiments, commodity prices and a purchaser's perception of any "special value" that may be derived from the transaction itself. The knowledge, negotiating ability and motivation of the buyers and sellers may also affect the actual price achieved in a transaction. It can therefore be argued that valuation precedes pricing as valuation is used as the basis from which to negotiate a price.

The term "evaluation" in a mining project context, denotes the broader meaning of "*determining the numerical values of all possible factors or variables that are important in establishing the technical and economic viability of a mining project*". The SAMVAL Code defines an evaluation of a Mineral Asset, "*as a broad physical, legal, economic, and other assessment, generally sought for an investment decision" (SAMVAL, 2016, p4).* In other words, evaluation in a mining project context denotes the technical and economic assessment of such factors as the relative economic potential of the mineral project. This is done by considering the mineralisation potential or mineral resources, mining rates, revenue, costs, expected returns and associated risks, primarily to demonstrate and support its crucial notion tha*t "there are reasonable and realistic prospects for eventual economic extraction*" (SAMREC, 2016, p18). In addition, it is minerals industry best practice that a mineral project evaluation is conducted as would normally be documented in a pre-feasibility study or feasibility study before a mining company can make an investment decision either to proceed with the project if it adds value to the company or to stop any work on the project. Evaluations include Feasibility Studies, Pre-feasibility Studies, and Scoping Studies. For clarity, there is a sharp distinction between evaluation and valuation. Evaluation encompasses a more comprehensive set of technical and financial data.

1.3.4. Valuation approaches and methodologies

This section explores the application of the valuation approaches and methodologies to real life case studies, as given in Njowa *et al* (2014), Njowa and Musingwini (2016). According to the definition of an asset in the preceding sections, a mineral asset is considered as an asset and it should have a value and hence must be valued. However, the value of a mineral asset depends on the stage of development of the mineral asset and the amount of information that is available at the date of the mineral asset valuation.

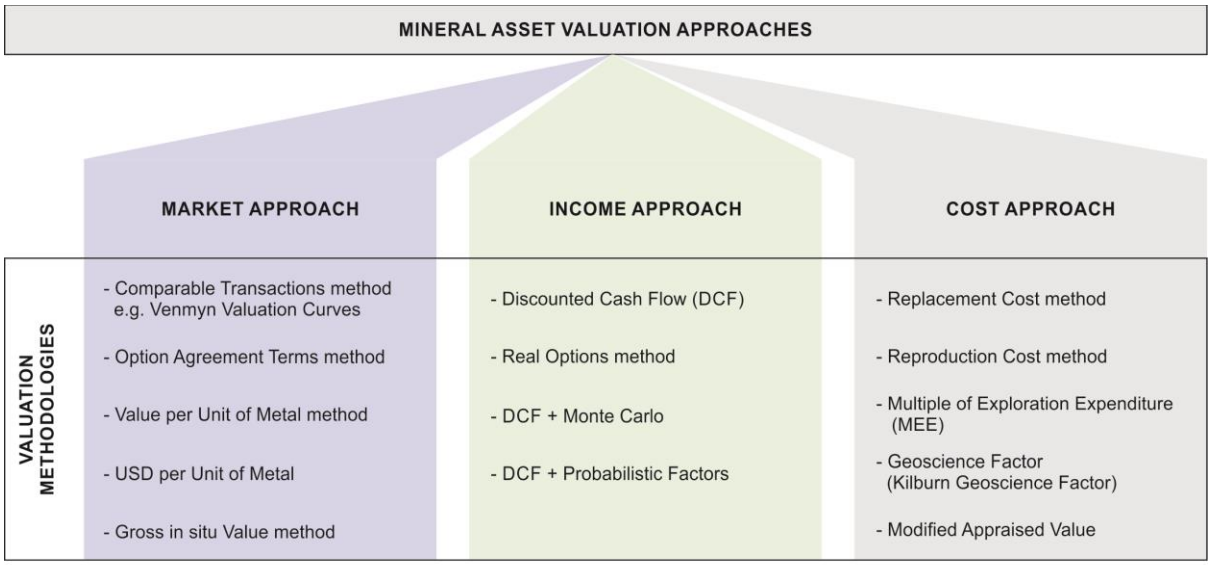
The international mineral asset valuation codes set out clear guidelines, valuation approaches and general methodologies for the valuation of mineral assets, with confidence in the mineral resource and mineral reserve estimates being the primary value lever. For example in Australia, the VALMIN Code and Guidelines govern the Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities and standards for Independent Expert Reports (VALMIN Code, 2015), the Polish Code for the valuation of mineral assets (The POLVAL Code, 2008) in Poland and similarly CIMVAL (2003) in Canada.

In the Southern African context, the South African Mineral Resource Committee (SAMREC) Code governs the estimation and classification of Mineral Resources and Mineral Reserves on the back of demonstrated confidence in the estimates achieved through exploration. The SAMVAL Code sets the framework for the valuation of mineral assets in Southern Africa depending on the primary listing of the organisation.

The valuation approaches and methodologies adopted by the minerals industry are based upon the principle of determining market-related values for the mineral asset at any given date of valuation. There are three main generally accepted approaches to MAV; the Income, Market and Cost Approaches. Within each approach are several different methods as shown in Figure 1.2, so valuation methodologies are subsets of valuation approaches. It should be noted that within these valuation approaches, the valuation methodologies are subdivided into primary and secondary methodologies depending on their applicability to the circumstances at hand. The principal valuation approaches used in mineral asset valuation advocated by the VALMIN Code (2015), the CIMVAL Code (2003), the POLVAL Code (2008) and the SAMVAL Code (2016) include the:-

- *Cost Approach* which is based primarily on the principle of contribution to value and assumes that the amount of exploration expenditure is related to its value. According to the valuation codes, the Cost Approach relies on historical and/or committed future amounts to be spent on the mineral asset. The historical and/or committed future expenditure should increase the geological understanding of the deposit, for it to be applicable;

- *Market (sales comparative) Approach* which is based primarily on the principle of substitution. According to the valuation codes, the Market Approach relies on the principle of 'willing buyer, willing seller' and requires that the amount obtainable from the sale of the mineral asset is determined as if in an arm's-length transaction. The concept of an arm's length principle is a condition or fact that the parties in a transaction are independent, approximately equal footing in the negotiation and are acting in their own self-interest and are not subject to any pressure or duress from the other party; and
- *Income (cash flow capitalisation) Approach* which is based on the principle of anticipation of benefits. According to the valuation codes, the Income Approach relies on the 'value-in-use' principle and requires determination of the present value of future cash flows over the useful life of the Mineral Asset. Once technical studies establishing the basis for future economic exploitation have been carried out, discounted cash flow (DCF) methods are applicable.



Source: Smith (2013), PWC (2014) (modified by the author)

Figure 1.2: Relationship between Mineral Asset Valuation Approaches and methodologies

Source : Smith (2013), PWC (2014), (modified by the author)

The income approach is regarded as the most reliable method for estimating the value of a mineral asset in the development and operating stage, and primarily uses DCF analysis as the primary valuation methodology. Kramna, (2014, p455) defined DCF analysis as financial models that estimate "*the intrinsic value of a company and are based on the principle that the current value of an asset is equal to the present value of all expected future cash flows"*. This methodology yields the most accurate, fair and reasonable results by capturing the pertinent technical, economic, legal and environmental aspects of the 'business' investment case. These aspects interact in a complex manner with each other and the general business environment, and these should be reproduced through robust DCF analysis to compare the different scenarios, and this will be discussed in detail in Chapter 5.

The DCF analysis is either conducted as deterministic or probabilistic/stochastic methodology. The different scenarios, and the complex manner of how each aspect interplays with the others is best examined by probability analysis. Most financial modelling uses the fixed deterministic method with additional sensitivity analysis which can be argued that this demonstrates lack of confidence in the result from the outset. However, until such a time in the future when financial analysis routinely uses probability based models, a deterministic DCF analysis is always going to be the weak link precisely because of the manner in which it handles confidence.

The Cost Approach is based on the reproduction or replacement cost of the exploration project, less any total accrued depreciation, plus the value of the land. In effect, this comparison to a "replacement" focuses on what has already been expensed on the exploration project including appropriate premiums or discounts. It relies primarily on audited or auditable historical expenditures on exploration and acquisitions, to which a prospectivity enhancement multipliers (PEMs) is applied to arrive at a MAV. This method essentially incorporates the principle of 'successful efforts' and endeavours to capture the change in MAV, mainly for exploration assets, based upon a qualitative assessment of improved or reduced prospectivity.

The market approach bases the value of an asset on prices and other relevant information on transactions involving similar or comparable mineral assets that have occurred in the market. The market approach may be considered to be problematic in the minerals industry since it is difficult to ensure complete comparison of different mineral assets because of technical idiosyncrasies that apply to almost every mineral property, since no mineral asset is exactly the same. To a certain extent this is similar to the real estate sector but, the large volume of real estate transactions helps to provide broadly comparable transactions.

Certain valuation methods are more widely used and may be more generally acceptable as industry practice than others, depending on the stage of development of the mineral asset as shown in Table 1.1 although these could change over time. Some methods can be considered to be primary methods for MAVs, while others are secondary methods or rules of thumb, considered suitable only to check MAVs by primary methods, but it is imperative to use at least two methods as required by the valuation codes.

Table 1.1: Relationship between stages of development and valuation approaches for mineral properties.

VALUATION APPROACH	STAGE OF DEVELOPMENT					
	EXPLORATION	DEVELOPMENT	PRODUCTION	ECONOMICALLY VIABLE	NOT VIABLE	DEFUNCT
Cash Flow	Not generally used	Widely used	Widely used	Widely used	Not generally used	Not generally used
Market	Widely used	Less widely used	Quite widely used	Quite widely used	Widely used	Widely used
Cost	Quite widely used	Not generally used	Not generally used	Not generally used	Less widely used	Quite widely used

Source: SAMVAL Code, 2009 and 2016

Various valuation approaches and methodologies which provide for the different combinations of valuation requirements, development stages of the mineral asset and investor needs, were developed and are illustrated in Table 1.1. It is the responsibility of the valuer to decide on the valuation approaches and methodologies to use. However, Lawrence (2001, p4) made an important conclusion regarding the complexity of the different purposes for which the valuations are required by noting that, *"because of the diversity of situations in which a valuation could be required, no simple standard formulas can be used in Mineral Asset Valuations. In particular, the market is not as efficient nor as open and unrestricted as many assume. The competence and judgement of the Valuer is the critical factor, since all Valuations (especially market-based ones) are time and circumstance specific and there is no best method"*.

The global industry best practice concurs that the market approach is generally widely used across the different stages of development from prospecting to defunct operations. The income approach is widely acceptable to development and production mineral assets, and the cost approach is more acceptable to early stages of mining development.

Lilford (2004) conducted research on the applications and methodologies used in the valuation of mineral properties or assets, under the three broad mineral asset valuation approaches. The research provided insight in the valuation methodologies available to a Competent Valuer when valuing mineral assets and their applicability to various stages of development. However, in this Thesis the knowledge gap identified is that the mineral asset valuation codes do not provide insight or guidelines on the mechanics of using these methodologies when conducting a mineral asset valuation and how the valuation should link to financial reporting on an annual basis.

There are a number of approaches to valuing a mining company and its underlying mineral assets, but each has its own drawbacks. These drawbacks arise because the factors involved in the valuation of a mineral asset are complex and include inherent uncertainty in the estimation of parameters used in the mineral asset valuation. Mining projects are characterised by a range of unique features that set them apart from other investments. A classic example would be the shape and attributes of an orebody cannot be defined precisely until it is mined. The manner in which it is mined is more a reflection of prevailing economics and company hurdle rates and targets, and the value that has been created or destroyed through mining cannot be changed at this point. In addition, most companies do not mine out an orebody completely because the economics simply do not justify it. Most mines close with some mineral resource or even mineral reserve still in the ground.

The value of the asset depends mainly on the amount of ore, its grade and the geological confidence attached to these estimates and the economic modifying factors. Hoover (1933) defined the value of a mineral asset as the process of estimating future profits, in a highly uncertain environment.

However, if the engineering methods are applied with care and diligence, an approximation may be made that will place the value of the mine within certain levels of accuracy, with a relatively wider range with maximum and minimum limits. Based on this theory of mine valuation, Hoover (1933) suggested that for a mineral deposit to have value, the ore in the deposit must ultimately pay for:-

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 proponents and investors.

The same theory or principle has been developed over the years and was redefined by Davis (2002) as 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 such as the cost of development and production from the total asset value to derive the value of the extractable mineral. However, 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. In other words, there is nothing inherently valuable about a drill hole, and so one cannot value it at cost especially when it adds no value to a mineral 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 at a profit. If the mineral asset is never expected to generate a profit, it has no value. Therefore, it is the responsibility of the mineral resources manager to identify portions of the resource that create value for the shareholders and develop a plan to extract the identified portions.

This conclusion suggests that harmonisation would be difficult, but this thesis notes that at a high level, creating a common widely accepted valuation framework could be considered relatively simple, although the devil is clearly in the detail. The discussion above suggests that mineral asset valuation codes do not provide insight or guidelines on the mechanics of using different methodologies when conducting a mineral asset valuation, nor do they address how the valuation would link to financial reporting on an annual basis. Although harmonisation may be difficult, this thesis posits that creating a common widely accepted valuation framework at a high level can be achieved.

1.3.5. Standard of value in the mineral industry

The standard of value that is generally used in the mineral industry is widely variable depending on the purpose of the MAV and the interpretation amongst the various stakeholders in the industry. The global acceptance of the IFRS as the widely used accounting standard requires 'Fair Value Accounting' as the basis of financial reporting.

This establishes a fair value hierarchy that prioritises the inputs to valuation techniques used to measure 'fair value'. The hierarchy gives the highest priority to observable inputs or unadjusted quoted prices in active markets for identical assets or liabilities, and the lowest priority to unobservable inputs. In the same breath, in some cases the standard requires the use of a 'Market Value' that should be based on what the market is willing to pay for the same asset in an open market, mainly using the precedent and comparable transactions as the basis.

In the mining technical fraternity, the standard of value adopted in the major mineral asset valuation codes such as the VALMIN, SAMVAL and CIMVAL is either the "Fair Market Value or Market Value" as the default standard of value. However, these codes acknowledge that other types of value may be required depending on the purpose of the valuation and prevailing circumstances. These are not limited to intrinsic value, technical value, technical and economic assessments. As principle-based standards, the codes require the Qualified or Competent Valuer to define the value that is being estimated in a particular circumstance.

In this thesis the standard of value that impacts the MAV and financial reporting is discussed in detail in Section 3.2.3, including its different applications and brief history of the standard of value as it has developed in the different major mining countries globally.

1.3.6. Purposes of MAV

Cawood (2004, p46) 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*". In addition, mineral asset valuations are conducted at various stages of the mining development cycle starting from prospecting, exploration, development, production through to decommissioning. In this research both groups will be considered, but more emphasis will be on the mining industry's and general stakeholders' perspective.

Van der Merwe and Erasmus (2006) also noted that mineral properties are valued for a diversity of reasons and purposes, and hence no simple mathematical formula or recipe can be used without critical appraisal of the specific circumstances around the mineral property. The complexity of valuing mineral assets is as a result of uncertainty associated with the mineral asset and the fact that there are no two deposits that are identical, hence market comparisons are subjective and require a significant amount of professional judgement. Due to this fact there is no way a general valuation model can be built to cater for all situations, since each project or asset is unique.

The extractive industry is therefore an inefficient market, resulting in the fact that the valuation results may be different for the same asset because of the dissimilarity in the purpose for which the valuation is being made. This could be because of the incomplete information about the mineral asset that the stakeholders have.

It has been noticed that mineral asset valuations are performed for a number of reasons as highlighted below and the results may be different, due to the complexity of factors influencing the valuation and the weighting applied by the valuer to each contributing factor. This weighting is subjective and at the discretion of the valuer's professional judgment.

According to Frimpong (1992) as cited in Lilford (2004, p 42), the four main reasons for mineral property valuations in the extractive industry are to:-

- *"highlight to potential investors the value, viability, uncertainty, and downside risk of a mineral project;*
- *provide management with economic, technical and operational guidelines for efficient exploitation of the property. The analysis suggests an operating strategy for the project, while providing the necessary outcome to help guide the design process. The design process can then be entered based on probability distributions dictated by the 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 provided by Frimpong (1992) as cited in Lilford (2004) and further restated by Njowa (2006, p26) are as follows:-

- *"allow informed investment decisions to be made on capital allocation for the purpose of project development and the most efficient use of 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, impacts of partial or complete nationalisation 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 mineral asset valuations and reporting are moving in the direction where the asset value might have to be reported in the annual reports in compliance with the IFRS, King II Report and Johannesburg Stock Exchange (JSE) listing requirements"*.

Onley (2002, p 86) reported that during an independent review of the VALMIN Code by the Board of the AusIMM, "*there was a suggestion that there should be a distinction between the type of report required for an Initial Public Offering (IPO) and a takeover, although there was no argument that independent valuations are needed in both situations:-*

- *In an IPO, more detailed information is required because the potential investor is likely to have no prior knowledge of the assets. Further, as there is no time limit on preparation of the report, there is time to provide full disclosure; and*
- *In a takeover, the Target Company should already have provided information about its assets in quarterly and annual reports and under continuous disclosure requirements of the Corporations Law. There is only a short time frame in which to prepare an Independent Report. In these circumstances, it was argued that Target Company Statements could provide a lesser level of detail comprising an Independent Review of previous information provided by the company in its public statements, appropriately updated with any subsequent information."*

This further confirms that the purpose of the mineral asset valuation will determine the amount of information that should be included in the valuation report. In both instances an independent valuation report will be required, however differences arise in the type of the report, the amount of information to be included in the report, the major assumptions to be used in the valuation and the valuation methodologies.

In conclusion Mineral Asset Valuations are required for various purposes, which can be summarised as follows Njowa (2006, p27):-

- *"Statutory filing and public reporting;*
- *Pricing of IPO of a stock on listing;*
- *Purchase / Sale of mineral property (Takeovers, Mergers and Acquisitions, Joint Ventures);*
- *General financing and project financing purposes;*
- *Insurance purposes;*
- *Economic Evaluations (Pre-feasibility and Feasibility Studies);*
- *As a measure of value created by the management team;*
- *Financial Accounting and Financial Reporting purposes, including fair value assessments for impairments;*
- *Good business practice (Corporate Governance);*
- *BEE empowerment transactions;*
- *Capital Gains Tax (CGT), Stamp Duties and other tax purposes; and*
- *Expropriation compensation purposes".*

The critical success factors in any mineral asset valuation is the competence and professional judgement of the competent valuer since all valuation exercises in the extractive industry are time and circumstance specific and there is no one best method for the valuation exercise.

1.3.7. Uses of MAV

According to the IVSC, (2011, p1), "*general valuations are widely used and relied upon in financial and other markets, whether for inclusion in financial statements, for regulatory compliance or to support secured lending and transactional activity*." These mineral asset valuations, as defined and governed by the mineral asset valuation codes seek to accomplish the following:-

- provide an estimated MAV at a specific point in time for a specific purpose, usually an acquisition or disposal, as a result of a regulatory trigger or an impairment calculation;
- the methodologies applied are governed by the mineral asset valuation codes and usually require the use any of two of the three main valuation approaches, which are the cost approach, market (or comparative) approach and income approach;
- the commodity price applied in a valuation is a specific metric, which is estimated by the valuer or in the case of the Securities and Exchange Commission (SEC), it is mandatory to use a three-year trailing average;
- the estimated MAV thus derived is a definitive metric which, can be used in financial reporting;
- provide a general guideline on how the mineral asset valuation should be conducted for the different purposes and uses by a wide variety of users of financial information; and
- the mineral asset valuation codes should attempt to or provide best practice on the specific reference to the valuation skills and experience needed for the recognition to be an expert or specialist in mineral valuation.

As opposed to the very specific requirements of the mineral asset valuation described above, most independent technical reports on mining projects include some form of economic analysis or evaluation as stipulated by the codes in respective jurisdictions. It is important to note that these economic evaluations are specific project economic viability analyses aimed at demonstration of project feasibility and by their very nature are non-specific in terms of providing an asset value.

Such economic analyses are often called 'valuations' in the mining industry reporting codes but such a term requires clarification. The economic analysis/evaluation conducted for Competent Persons Reports, Independent Technical Reports and Expert Reports required by National Instrument 43-101 (NI 43-101) in Canada, SAMREC Code in South Africa and the Joint Ore Reserves Committee (JORC Code) in Australia respectively are:-

- project specific not company specific;
- to provide a range of possible Net Present Values (NPVs) at various commodity prices and discount rates;
- an attempt to show the economic viability of the project given various possible future commodity prices, assumed mining methods, assumed mineral beneficiation method and market scenarios;
- an indication of the economic merits of the project, but cannot be used in a financial statement or any other service line that requires a specific value; and

- whilst not strictly valuations, are generally conducted and reported according to the mineral asset valuation codes (CIMVAL, SAMVAL, POLVAL and VALMIN) to the extent that these are applicable during the project evaluation.

The economic evaluation, thus performed, would not be regarded as an MAV, but would provide an opinion on the economic robustness of the project based on the assumptions used in the engineering studies performed. The mineral project evaluation process and assumptions are discussed in detail in Section 5.4.

1.4. Fundamental Factors that drive Value in Mineral assets at different stages of development

Most of the international mineral asset valuation codes provide general guidelines and principles to the valuation approaches and methodologies for the valuation of mineral assets, with confidence in the Mineral Resource and Ore Reserves estimates being the primary value lever. In the global context, the CRIRSCO family of codes govern Mineral Resource and Mineral Reserve classifications and categorisations, on the back of demonstrated confidence in the estimates achieved through the exploration process. With regard to valuation methodology, the VALMIN Code (2015, p.29) states that "*The Practitioner must make use of valuation methods that are suitable for the Mineral under consideration. Selection of an appropriate valuation method will depend on such factors as:-*

- *the nature of the valuation;*
- *the development status of the Mineral Assets; and*
- *the extent and reliability of available information."*

The first consideration in establishing which valuation approach and methodology is appropriate in valuing a mineral asset, is to assess its development status at the date of valuation. This has been discussed in detail in section 1.3.4. The stage of development will most often indicate the appropriate valuation approach and methodology (See Table 1.1) and will have a significant impact on the estimated mineral asset valuation.

Mineral projects follow a broadly predictable development path, from the identification of the mine's potential, to exploration, to technical and economic evaluation (through engineering studies), to mine planning and construction, production and, finally, to decommissioning followed by remediation at the end of the mine's life. The VALMIN Code (2005), CIMVAL Code (2003) and VALMIN code (2015) further define the various categories of Mineral Assets as follows:-

- **Exploration Areas** – properties where mineralisation may or may not have been identified, but where a Mineral Resource has not been determined. Exploration is defined as the acquisition, processing and analysis of geological and geophysical data or other related activity for the purpose of defining an exploration target to be tested by drilling, logging and testing up to and including the field appraisal stage;

- **Advanced Exploration Areas** – properties where considerable exploration has been undertaken and specific targets have been identified that warrant further detailed evaluation, usually by drill testing, trenching or some other form of detailed geological sampling. A resource estimate may or may not have been made, but sufficient work will have been undertaken on at least one prospect to provide both a good understanding of the type of mineralisation present and encouragement that further work will elevate one or more of the prospects to the Mineral Resource category;
- **Pre-Development Projects** – properties where Mineral Resources have been identified and their extent estimated but where a decision to proceed with development has not yet been made. Properties at the early assessment stage, properties for which a decision has been made not to proceed with development, properties on care and maintenance and properties held on retention titles are included in this category if Mineral Resources have been identified, even if no further valuation, technical assessment, delineation or advanced exploration is being undertaken;
- **Development Projects** – properties for which a decision has been made to proceed with construction and/or production, but which are not yet commissioned or are not yet operating at design levels; and
- **Production or Operating Mines** – mineral properties, particularly mines and processing plants that have been commissioned and are in production.

Globally it is an undisputed fact that the Mineral Resources and Mineral Reserves are the single largest asset of any company in the extractive industries, as noted by (Uberman, 2014; Ellis, 2012). The same argument was also highlighted in the extractive industries discussion document published in 2000 and in the 2010 versions. In each of the various stages of development, there are different factors that drive or affect the determination of the MAV. The following section summarises the factors that drive the MAV at the broad stages of development. These are explained as follows:-

1.4.1. Exploration Properties

The intrinsic value of an exploration property lies in its potential for the existence and discovery of an economic mineral deposit. In the mining industry, mineral exploration properties are optioned, joint ventured, bought, sold and traded on the basis of perceived exploration potential. Mineral exploration is undertaken in order to discover new deposits of minerals that may be commercially exploited. There are a number of different approaches and methods which are used to value mineral exploration properties, all of which are subject to a high degree of uncertainty commensurate with the low level of geological understanding of the deposit. Mineral exploration properties are those on which an economically viable mineral deposit has not yet been discovered. The intrinsic value of an exploration property is therefore based on the exploration potential. One measure of the exploration potential is the amount that could justifiably be spent on exploration in the anticipation of discovering an economic mineral deposit.

Exploration properties with undeveloped mineral resources range from grassroots acreage without any exploration history, to those containing mineralization (or a declared Mineral Resource) that is insufficiently explored, to well explored deposits which lack either continuity, or sufficient grade/tonnage, or have poor mineability or metallurgy such that they are not currently exploitable at the time of the evaluation. This does not imply that they do not have value.

Exploration properties are acquired for their perceived potential to host an economic mineral deposit. The challenge of exploration process is to reduce the odds in searching for or making proof of economic mineralisation beyond that of pure chance. Exploration attempts to focus in on prospective areas on the basis of what is already known or can be predicted from discovered mineral deposits. So the issue in not what ground is available but rather how the exploration is carried out. Modern exploration is a process which operates by stages. Generally, each stage of exploration is designed to arrive at the next decision point, (i.e., whether or not to continue exploration on a property, based on results of the previous stage). Each successive stage is generally more expensive, due to the progressively more detailed nature of the work required. Whenever an exploration programme progressed to the next stage, the value of the property may be enhanced, reduced, or remain the same, depending on how the results of the programme affect the perceived exploration potential.

The objective of the exploration process is to identify and concentrate work on the properties that show more promise in terms of exploration potential, and screen out the properties with less exploration potential. However, the information or assets generated from the exploration process would normally be classified into three broad categories namely:-

- the mineral exploration knowledge assets (referred to as Intellectual Property (IP)), comprising data and information that provides a detailed understanding of, *inter alia*, regional geology, general stratigraphy, ground water, environmental factors, soil and geotechnical characteristics, and is capable of being disposed of separately from any mineral rights;
- the specific understanding of the local geology and mineralisation for a specific property inseparable from the mineral rights (e.g. the Mineral Resources); and
- the asset created, based on the cost directly related to the acquisition of the mineral rights.

Obviously, the properties on which work demonstrates higher exploration potential are more valuable to exploration and mining companies. A corollary is that exploration properties on which work demonstrates little or no potential may have little or no value. The IP is usually developed only by companies that have recognized a potential that is consistent with their business plan, because many, if not most, exploration companies (licence holders at the time) develop the asset IP with the sole intention of passing it on to a larger company to develop (new licence holders).

It is clear that a business purchasing a mineral exploration knowledge asset for use in its extractive activities, is both the legal and economic owner of the mineral exploration knowledge asset and that these assets should be recorded in the owner's financial statements. It should be noted that timing of recognition is a matter determined by guidelines issued in IFRS 6 in conjunction with the company's specific accounting policy.

The information obtained from exploration projects influences the production and planning activities for a number of years. The expenditures incurred during exploration within a given accounting period, are therefore treated as expenditures on the acquisition of an intangible fixed asset, and included in the enterprise's gross fixed capital formation.

IFRS 6 provides guidance on the accounting and financial reporting on exploration and evaluation of Mineral Resources. The standard provides that the entity will establish a policy specifying that disbursements are recognized as exploration and evaluation assets, and will implement this policy consistently. In establishing such a policy, the entity will consider the extent to which disbursements may be associated with the discovery of specific mineral resources. According to IFRS (2012), the following are examples of expenditures that could be included in the initial assessment of the exploration and evaluation assets (the list is not exhaustive):-

- acquisition of exploration rights;
- surveying, geological, geochemical and geophysical assessment;
- exploratory drilling;
- excavations;
- sampling; and
- activities related to assessing the technical feasibility and commercial viability of extracting a mineral resource.

Over and above the disbursements recognised above, the company recognises that to be able to conduct these core activities, there are consequential disbursements that have to be incurred. These disbursements would be referred to as enabling costs. All these disbursements make up the cost of creating the IP or an exploration knowledge asset and the greater portion forms the mineral resource.

In cases where insufficient confidence exists in the technical parameters of the mineral asset, valuation methodologies rely almost entirely on the principle of historical cost, implying that an asset's value is correlated to the money spent on its acquisition, plus a multiple (premium or discount) of expenditure based on the principle of successful efforts.

In conclusion, the real value of an exploration property lies in its potential for the existence and discovery of an economically viable mineral deposit. Only a very small number of exploration properties will ultimately become mining properties, but until exploration potential is reasonably well tested, they have very little value.

1.4.2. Development Projects and Operating Mines

Development properties and operating mines are those on which an economically viable mineral deposit has been demonstrated to exist, with both Mineral Resources and Mineral Reserves declared, accompanied by appropriate engineering studies. This category includes properties on which the development of an economically viable operation is feasible, planned or under construction. These properties are at a sufficiently advanced stage of development that enough reliable information exists to value the property by DCF analysis, with a reasonable degree of confidence. In general, such information includes reasonably assured Mineral Reserves, workable mining plan and schedule, production rate, metallurgical test results and process recoveries, capital and operating cost estimates, environmental and reclamation cost estimates, commodity price forecasts and country specific regulatory estimates.

The VALMIN Code (2015), CIMVAL Code (2003) and SAMVAL Code (2016) commonly reflect that, the Cash Flow Approach or Income Approach relies on the 'value-in-use' principal and requires determination of the present value of future cash flows over the useful life of the Mineral Asset. Once technical studies establishing the basis for future economic exploitation have been conducted to a minimum of a prefeasibility study level, the DCF methodologies are applicable. It is industry practice that all mineral projects that are categorised as operating and developmental assets are valued using the Cash Flow Approach using the free cash flow capitalisation DCF valuation methodology. This methodology yields the most accurate, fair and reasonable results by capturing the pertinent aspects of the business' investment case, incorporating the impact of both technical, economic and current market assumptions, in formulating its opinion of the DCF value. A key characteristic of commodity based companies is their dependence on the price of the commodity for their cash flow and value. Multinational commodity companies are price takers in most cases, regardless of their size, because the global market is so large. Therefore, commodity company revenues are vulnerable to price trends and to volatility which accounts for most of their variance in revenues. However, other key value drivers of a mining property may include:-

- the extent and quality of its reserves;
- sales arrangements and payment terms;
- operating capital and extraction costs;
- productivity and efficiencies;
- applicable royalties, taxes and duties; and
- project, market and country risks that may affect mine cash flow or the discount rate applied to convert future cash flows to present value

All operating mines and developmental projects properties should be valued using the free cash flow capitalisation DCF valuation and the comparable market methodologies. Industry best practice requires that the DCF analysis be conducted on mineral properties with a minimum of a pre-feasibility study for the declaration of Mineral Reserves in all the CRIRSCO based mineral resources reporting codes.

There is only one exception: when a mining company is currently in production and is mining profitably based on a mine plan. In such circumstances the reporting codes allow the company to declare Mineral Reserves based on the mine plan.

The market based mineral asset valuation methodologies are applicable to all the mineral assets regardless of the stage of development. This is mainly because mineral assets exchange hands or are involved in transactions during their stages of development. These methodologies yield the most accurate, fair and reasonable results by capturing the pertinent aspects of the business' investment case and the current prevailing market conditions.

This thesis will limit the extent of the discussion on linking the MAV and financial reporting to developmental projects and operating mines only. It should be noted that all the other stages of development have been specifically excluded in the development of the framework, since the factors that drive value at these stages of development differ substantially, as discussed in this section. Hence the DCF analysis as the primary methodology supported by the comparable market methodologies as the secondary method has been used to conduct the analysis on the selected Case Study. Lattanzi (2002) pointed out that the DCF analyses were not appropriate for valuing properties without identified reserves. This methodology still provides a powerful tool for analysing investment decisions at various stages of exploration and mineral project evaluation. These evaluations should only be used within the mineral companies and never be disseminated to the public. These two methodologies will be discussed in detail regarding the major inputs or factors in the DCF analysis for both Mineral Project Evaluation and Mineral Asset Valuation. The market based methodologies will be utilised to corroborate with the income approach.

1.5. Major mineral asset valuation codes and standards

Currently there are four major national mineral asset valuation codes namely the VALMIN Code, CIMVAL Code, POLVAL Code and SAMVAL Code. The first official code to be published, the VALMIN Code, formed much of the basis for the development of the Canadian and South African codes. In addition to the four mineral specific valuation codes, the Uniform Standards for Professional Appraisal Practice (USPAP) is a general asset valuation code used within the United States. The USPAP was not reviewed in this Thesis since it contains no specific provisions for mineral assets and is limited to application within the United States, while the other codes are recognised across different jurisdictions through reciprocal recognition.

Each jurisdiction has its own rules and special local requirements that must be upheld. However, the increasing globalisation of the minerals industry makes it essential that international standards of project assessment and valuation, as well as reporting standards, be as similar as possible from the viewpoints of the relevant national regulatory and national professional bodies.

The same applies to the terms used. Even though the IVS terminology is well developed (mainly for Real Estate), the well accepted, historical terminology of the minerals industry cannot be totally disregarded.

1.5.1. VALMIN Code

The Australasian VALMIN Code sets out requirements for the technical assessment and valuation of mineral and petroleum assets and securities for Independent Expert Reports. The VALMIN Code was adopted by the AusIMM in February 1995 for the first time. A number of revisions have since been published as subsequent updates of the pathfinder document.

The VALMIN Committee was formed in 1991 in response to the Australian Securities Commission's withdrawal of NCSC Policy Release 149 which previously governed Independent Expert Reports (VALMIN Committee, 1995). The VALMIN Code was first adopted on 17 February 1995 and applied to all relevant reports required under the Corporations Law from 1 July 1995 (Onley, 2002). It was amended on 22 November 1997 and applied to all relevant reports required under the Corporations Law issued on or after 1 April 1998 (Onley, 2002). The VALMIN Code 2005 was approved on 29 April 2005 and superseded all earlier versions of the code.

The 2015 edition of the VALMIN Code is a forty-two page document governing the preparation of Independent Expert Reports required for the technical assessment and valuation of mineral and petroleum assets (VALMIN Code, 2015, p15). The code defines four report types:-

- Technical Assessment Reports which are intended to provide an estimate of technical value
- Valuation Reports which express an opinion of value;
- Independent Expert Reports which express an independent opinion on the mineral asset under consideration and in the case of a specific transaction, provides an opinion on the reasonableness of a transaction; and.
- Corporate presentations and new releases.

The VALMIN Code is binding on members of the AusIMM and AIG when preparing public Independent Expert Reports as required by the Corporations Law concerning Mineral or Petroleum Assets and Mineral or Petroleum Securities (VALMIN Code, 2015). The VALMIN Code does not have formal acceptance by the major stakeholders, including the bodies listed as supporting the code, meaning that the degree of support for the application and use of this code is diverse. These have been the same issues since the inception of the first and second versions of the VALMIN Code, as highlighted in the Independent Review of the VALMIN Code conducted by the board of the AusIMM through a taskforce headed by Goddard (2011).

The board highlighted some reasons as the need for the review of the VALMIN Code between 2001 and 2002, in terms of its effectiveness since its introduction, its practical application, degree of acceptance between members of the AusIMM and other professionals working in the field of MAV and the supporting bodies. The board issued an explanatory statement that the "i*ssues arising from recently received and reviewed ethics complaints with respect to non-compliance with the VALMIN Code indicate there is a considerable difference of opinion between 'independent experts' as to the requirements of the VALMIN Code, the prescriptive nature and complexity of the VALMIN Code and the 'binding' or 'non-binding' nature of the Guidelines and Aide Memoire. In addition, questions have been raised as to whether a breach of the VALMIN Code is automatically a breach of the Code of Ethics" (Onley, 2002, p83).*

The following issues were identified by the taskforce Onley, (2002, p87):-

- "*the VALMIN Code does not have the formal acceptance that the AusIMM would like, even though it was clear that there was a widespread support among all stakeholders for the code in principle;*
- *the response at VALMIN 01 and the subsequent 'CIMVAL draft Standards and Guidelines for Valuation of Mineral Properties' issued in February 2002, that the code is highly regarded internationally. MCA, ASX and ASIC have not adopted the Code as mandatory for all technical reports;*
- *the MCA endorses the VALMIN Code's use by AusIMM members, but does not require compliance by its members despite the fact that the VALMIN Code also has obligations for the commissioning entity. If the person who actually commissions the report is not an AusIMM member, there is no scope to ensure compliance;*
- *the ASX suggested that the VALMIN Code should have covered a wider range of reports for it to be incorporated into the ASX listing rules and also raised concern that AusIMM was not prepared to discipline its members and that it maybe necessary to impose external sanctions. At that point the VALMIN code was limited to Public Independent Experts Reports, as required by Corporations Law; and*
- *there appears to be some dissatisfaction amongst the stakeholders around the 'ownership of the VALMIN code with other organisations regarding the VALMIN Code as an 'AusIMM Code' and feel little or no responsibility for it*".

Notwithstanding the identified weakness of the VALMIN Code editions, the code was the pioneering code in the area of mineral asset valuation and formed the basis for all the other codes that were developed after it such as the CIMVAL Code and the SAMREC Code. It should be noted that the subsequent mineral asset valuation codes seem to have corrected the weakness encountered in the development of the VALMIN Code and the lack of broader stakeholder participation.

During the independent review of the VALMIN Code, some respondents' complaints about the committee membership structure were that it was dominated by practitioners or consultants who were by implication "self- serving" and/or people who were well-intentioned and well qualified in other fields but knew nothing about mineral valuation (Onley, 2002).

1.5.2. CIMVAL Code

The Canadian CIMVAL standards and guidelines were developed and are maintained by Canadian Institute of Mining, Metallurgy & Petroleum (CIM). The need for a valuation code in Canada was necessitated in January 1999, following the Bre-X "gold salting" scandal, when the Mining Standards Task Force of the Toronto Stock Exchange and the Ontario Securities Commission recommended that the CIM establish a committee to review and advice on approaches and methodologies for the valuation of mineral properties.

The CIMVAL Standard applies to valuations of mineral properties, excluding oil and gas, where required by regulatory bodies or where such valuations are prepared for public disclosure. The CIMVAL Code is divided into two sections; mandatory Standards and non-mandatory Guidelines. The Standards form the main requirements of the code and address areas including valuation tenets, qualifications of the valuer, the commissioning process, valuation approaches and report contents. The qualified person (QP) must comply with these standards. The Guidelines further elaborate on the Standards and provide "highly recommended" guidance as to their practical application and implementation in executing the valuation of the different mineral properties.

Several parallel and related developments in the early 2000's including Canada's NI 43-101, the broader international harmonisation effort, and the VALMIN Code had a formative influence on CIMVAL. CIMVAL standards incorporate the same fundamental principles and major features as VALMIN. They are also broadly consistent with Generally Accepted Valuation Principles (GAVP) making them amenable to any eventual international harmonisation.

1.5.3. SAMVAL Code

The previous version of the SAMVAL Code, published in 2009, was revised and updated and became effective from 2016. This was the result of work that had been conducted under the joint auspices of the SAIMM and the GSSA, which set up the SAMVAL Working Group in 2002, aimed at drafting a South African version of the mineral asset valuation code. After much deliberation, the first exposure draft of the document was released in 2006. The code was published in 2008 after further deliberation and input from various companies and individuals. Since its first publication, the SAMVAL Code has been put into practice and small advantageous potential amendments and additions have been highlighted and suggested. An amendment was issued in July 2009, which has since been superceded by the current version SAMVAL Code 2016.

The code was developed taking into account international evolution in the field of Mineral Asset Valuation, including the publication of the revised Australian VALMIN Code in 2005, the CIMVAL Code in Canada in 2003, and the International Valuation Standards Committee Guidance Note for Extractive Industry Valuation in 2007. Although all these mineral asset valuation codes are principle- based documents, similar to their various sister reporting codes for the reporting of Exploration Results, Mineral Resources and Mineral Reserves, there are material differences between these mineral asset valuation codes, not least of which is differences in definitions, purpose and terminology.

Consequently, the SAMVAL Working Group was reconstituted to focus on necessary amendments and update the code. The review was prompted by a number of events and developments that required diligence in MAVs. These include the changes made to SAMREC in 2008, SAMVAL in 2009, further SAMREC and SAMVAL discussions and position papers, developments in the IASB around the possible recognition of mineral resources and/or mineral reserves as financial assets that require valuation for disclosure in the annual financial statements and the general globalisation trends of mineral companies.

1.5.4. POLVAL Code

The Polish Association of Mineral Asset Valuators was established to form, integrate and activate Mineral Asset Valuators, enhance their skills and expertise, promote the Code of Ethics for Mineral Asset Valuators and monitor their ethical behaviour. It should be noted that this code makes use of the word ‘valuator’ which is synonymous to the word ‘valuer’ used in this thesis. The association was established in order to ensure that the mineral asset valuation is carried out by Competent Persons having relevant skills, and their reports on mineral asset valuation are reliable, thorough and understandable, and disclose all relevant material information required by investors and their professional advisers when making investment decisions (POLVAL Code, 2008).

The requirement to create a mineral asset valuation code in Poland arose following political changes in that country in the early 1990s resulting from the trading of geological and mining assets that occurred after 1989 which meant that over time it became necessary to assess and value mineral properties, (POLVAL Code, 2008). At that stage it was realised that mineral asset valuation is a highly specialised, complex and multi-stage assessment. For various reasons, the POLVAL Code (2008) was developed under Polish law that provides that mineral deposits are not components of the land but, are state-owned. Polish lawyers are of the opinion that the State Treasury solely owns mineral deposits that, cannot be extracted by surface mining. In this case, it is not legally permissible to transfer ownership of a deposit to a third party. Within the limits set by the laws, the State Treasury may, excluding other individuals, use mineral deposits and exercise the ownership rights in respect to these deposits by establishing mining rights. The powers of the Treasury are exercised by competent licencing authorities.

On the other hand, mineral deposits that can be extracted by surface mining belong to the owner of the plot of land. This legal interpretation stating that deposits extractable by surface mining are owned by the land-owner entails far-reaching conclusions regarding valuation responsibilities. The only individuals who are permitted to carry out the valuation of mineral deposits being extracted by surface mining are real estate valuers, who often do not have skills allowing for a reliable valuation of mineral deposits.

Both the Polish mining industry and financial markets need professionals in mineral asset valuation. To date, specialists in valuation and economic assessment of mineral assets, scattered throughout various companies and institutions, do not have an independent, self-governing organisation that could allow them to associate, or provide training and ensure a proper level of professional knowledge of its members. In response to this need, on 12 June 2006 in Zakopane, Poland, a meeting was held aimed at the formation of Polish Association of Mineral Asset Valuators.

The Polish Association of Mineral Asset Valuators was established on 13 June 2006 at the foundation meeting in Zakopane. The first General Meeting was held on 2 October 2006 in Krakow, Poland. On 31 May 2007, the Association was registered by the District Court for Kraków-Śródmieście (11th Commercial Department of the National Court Register) and on 1 June 2007 entered into the National Court Register under no. KRS 0000281978. On 10 May 2008, the Polish Code for Mineral Asset Valuation - POLVAL was adopted, and the first list of Mineral Asset Valuators was established.

1.5.5. International Mineral Valuation Committee (IMVAL)

Currently, there does not exist a common template or standard for mineral asset valuation. Instead, the four national codes, CIMVAL, SAMVAL, POLVAL and VALMIN exist, but these have differences in structure, definitions, scope, and jurisdictional requirements. In August 2011, the SAIMM contacted the major mining and metallurgy institutes and related societies internationally to assess interest in the coordination of updating AusIMM's VALMIN, CIM's CIMVAL, and SAIMM's SAMVAL and other bodies with interest in mineral asset valuation. The SAIMM received adequate responses to convene a meeting after the VALMIN Seminar Series in Brisbane in April 2012.

The purpose of coordinating the different updating efforts of the mineral asset valuation codes was to develop an international template or guideline. The participants represented at this meeting were the AusIMM, CIM, SAIMM, SME, IIMA and the Royal Institute of Chartered Surveyors (RICS), with the IVSC having an observer status. IIMA and SME, both USA-based, decided to participate in the Brisbane meeting and subsequent harmonisation process, despite not having developed their own national mineral asset valuation standard for their jurisdiction (Ellis, 2013).

The main reason for both the IIMA and SME to be involved in this initial meeting was to directly influence the harmonisation process towards developing a globally acceptable document useful to mining institutes, abiding by generally accepted valuation principles that might also prove to be a useful standards document for use in the USA jurisdiction (Ellis, 2013).

In April 2012, discussions were held in Brisbane between members of the valuation standards committees of major mining institutes and other institutions with special interest in mineral asset valuation, to establish a harmonisation project for mineral asset valuation codes. The International Mineral Asset Valuation Committee (IMVAL) was formed, with the main objective of developing a principles-based template of standards and guidelines for the valuation of mineral assets which, aligns with generally accepted valuation concepts, principles, and definitions in the International Valuation Standards 2013 Edition (IVS, 2013(a)). IMVAL's purpose is to lead harmonisation of mineral asset valuation standards, these being the three national codes, VALMIN, SAMVAL, and CIMVAL, the IVSs, and where appropriate, the IFRS. This harmonisation effort is aimed at providing a CRIRSCO-equivalent template for mineral asset valuation. The purpose is to provide an international standard for reference and adoption in national mineral asset valuation codes.

SAMVAL, CIMVAL, SME and IIMA completed a draft International Mineral Asset Valuation Standards Template which was released for stakeholder and public comment in the second quarter of 2016. The four fundamental principles are Competence, Materiality, Objectivity and Transparency. Additional principles of Independence and Reasonableness may apply to national codes. The draft template includes the general requirements for mineral asset valuations, mineral reserve and mineral resource definitions, and valuation reports but, leaves the selection of appropriate valuation approaches and methods to a properly qualified valuer.

1.5.6. Harmonisation of MAV Codes

The main aim of harmonising MAV national codes is to have a single set of valuation standards that are used globally in the valuation of mineral assets and securities. Given that the valuer decides on the valuation approach to use it is possible that the value for a particular mineral asset varies and depends on the view of the valuer. To reduce such inconsistencies, it is important to develop a uniform valuation standard hence the need for harmonisation of various national MAV codes (Njowa, *et al*., 2014).

Rendu and Miskelly, (2008) reported that in the ten to fifteen years prior to 2008, substantial progress had been made to achieve the goal of standardised reporting of information on mineral assets. A global committee or organisation known as the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) was formed in 1994 to align national minerals reporting codes for the reporting of exploration results, mineral resources and mineral reserves. In 2006, CRIRSCO published a template which was later updated in May 2013.

The template is now globally accepted and aligns national reporting codes by fostering a common understanding by harmonising the definitions, classification, estimation processes and the public reporting of exploration results, mineral resources and mineral reserves. The CRIRSCO-based alignment of the national reporting codes has in part, been catalysed by the increasing globalisation of investors and access to securities exchanges worldwide and is further supported by an overriding securities exchange principle of protecting the investors.

Mining has historically been an international business as most mineral companies have operations in different countries worldwide. This therefore implies that these companies have to report internationally to the different securities exchanges, investors, lenders and regulators from different countries. Additionally mineral project appraisers work globally and investors compare mineral projects internationally. In the area of Mineral Resources and Reserves classification and reporting CRIRSCO assisted in the unification of national codes by developing a set of common definitions resulting in some alignment and consistency in reporting codes from different countries (South Africa, Canada and Australia). This idea of harmonisation of codes in MAV did not exist until the formation of IMVAL. CRIRSCO has been encouraging the AusIMM, the SAIMM and the CIM to align their national MAV codes. This will ensure simplification of valuation reporting on the part of multinational companies because they will not need to use different valuation standards in different countries.

Since the Global Financial Crisis of 2008, capital has been scarce and there has been increased competition to its access. In addition the quickening pace in the globalisation of investment markets that enhances opening up of access to capital further necessitates the need for harmonisation of MAV standards. Access to capital requires that assurance is provided to investors through transparent and material disclosure of reliable information. Hence a global MAV code will bring consistency in valuation reporting assisting in access to capital by the mineral industry (Njowa, *et al*., 2014).

The IASC, the predecessor of the IASB was formed in 1973. Its objective was to harmonise accounting principles used in business around the world which was successful and by the end of 2000, its membership consisted of 153 professional accounting bodies in 112 countries (Ellis, 2002). Extending this to MAV, harmonisation will allow companies to provide valuation reports that meet the needs of investors from different countries without the need for modifications due to variations in valuation standards.

Additionally, most valuation professionals undertake valuation work globally to advice investors and lenders in comparing projects internationally. (Ellis, 2009) indicated that ±150 countries needed standards for local guidance on the reporting of MAV and that extractive industry companies adopting IFRSs needed standards to support the drive for current value financial reporting. The trend for international standards for reporting of valuations is further highlighted by the following (Ellis, 2009):-

- globalisation is driving global uniformity of standards because global uniformity is necessary in measurement and classification systems for all industry sectors for efficient, competitive international markets;
- there is a global convergence of private sector accounting standards on the IFRS, supplemented by local guidance and this will demand uniform valuation of assets and liabilities for those reports;
- existing minerals valuation standards in some countries, such as Australia and South Africa, may not mesh correctly with the International Valuation Standards (IVSs) being applied throughout their economies. For example, a property with minerals will be valued using the SAMVAL Code, while the land surface and facilities are valued using IVSs, thus creating potential for jurisdictional conflicts;
- the development of these codes was driven by the serious corporate failures in the minerals industries such as the Bre-X Scandal. Such failures led to a clamour for the development of codes for the reporting of mineral resources and mineral reserves during the 1990s, and the subsequent development of codes for the valuation of mineral assets; and
- a project for the convergence between IVSs and USA's USPAP is under way based on the 2006 Madison Agreement between the IVSC and the Appraisal Foundation. This is mainly driven by the fact that USPAP is not designed to support the USA's new current value (mark-to-market) financial reporting and that USPAP contains no mention of minerals or petroleum.

In the USA, neither the SME nor the IIMA have developed a minerals valuation standard. Both are participating in the IMVAL process for harmonisation of mineral valuation standards with other global mining and metallurgy institutes. The aim is to help assure uniformity of fundamental principles and provide a framework of application across all mineral valuation standards of significance globally and between the mineral valuation standards and the major comprehensive valuation standards such as the IVS and USPAP (Ellis, 2013).

1.6. Definition, purpose and uses of financial reporting

Financial reporting in the minerals industry is intended to provide information that is useful to a wide range of users in making business and economic decisions. The minerals industry is one of the world's most global industries, and as a result many countries are converging national accounting standards with IFRS in order to enhance the transparency and comparability of financial statements around the world.

In recent times, one of the uses of mineral asset valuations that is being used by accounting regulators is to incorporate “Fair Value” measurement into financial statements. The increasing use of “Fair Value” information is perceived by regulators, analysts and investors as a more objective approach to financial reporting.

1.6.1. Definition of financial statements

Financial statements can be defined as a structured representation of historical financial information prepared for the purposes of communicating an entity’s economic resources or obligations at a point in time or the changes therein for a specified period of time in accordance with a financial reporting framework. The notes to the financial statements ordinarily comprise a summary of significant accounting policies that have been adopted by the organisation in the preparation of the financial statements, including any additional explanatory information to elaborate on the information in the financial statements.

Usually financial statements refer to either a statement included in the complete set of general purpose financial statements. According to Fazal (2012) the term financial statements is usually used for a trading period for all or any of the following statements:-

- statement of financial position as at the end of a period (i.e. Balance Sheet);
- statement of Comprehensive Income or Income Statement for the period (i.e. Income Statement);
- statement of Cash Flows for the period;
- statement of Changes in Equity for the period; and
- notes to the financial statements, comprising a summary of significant accounting policies and other explanatory information.

Publication of a full suite of these financial statements for a mining company is a regulatory requirement for listed entities. This requires the entity to report on financial performance and position on an annual, quarterly or semi-annual basis. In addition, many entities also present a financial review by management that describes and explains the main features on an entity’s financial performance, financial position and principal challenges it faces. Financial statements reflect the effects of business transactions and events on the entity, however for a mining company one of the most important assets (i.e. the mineral resources and mineral reserves) are normally not shown in any of these statements. The different types of financial statements are not isolated from one another, but are closely related as illustrated in Figure 1.3 which shows the interrelationships between the income statement, balance sheet, cash flow statement and the statement of changes in equity as defined and described in Table 1.2. As a general interpretation it is often assumed that the complete financial report is about an entity’s financial position, financial performance, cash flows or fluctuations in equity. This represents a complete suite of the financial statements that the general users of financial statements would expect to get in the financial report.

When a mineral project is undergoing concept (scoping), pre-feasibility and feasibility studies, it also has to be subjected to an economic evaluation before the final board approval to implement the project. Valuation metrics such as net present value (NPV), payback period and internal rate of return (IRR) are used. These metrics require part or all equity investment depending on the debt: equity ratio for the discount rate determination. They are based on project cash flows and NPV represents “additional wealth” expected to be created by the project. In other words a project will impact on the entity’s financial position, financial performance, cash flows and changes in equity. It therefore makes sense that it should be possible to develop a link to harmonise financial reporting and mineral asset valuation.

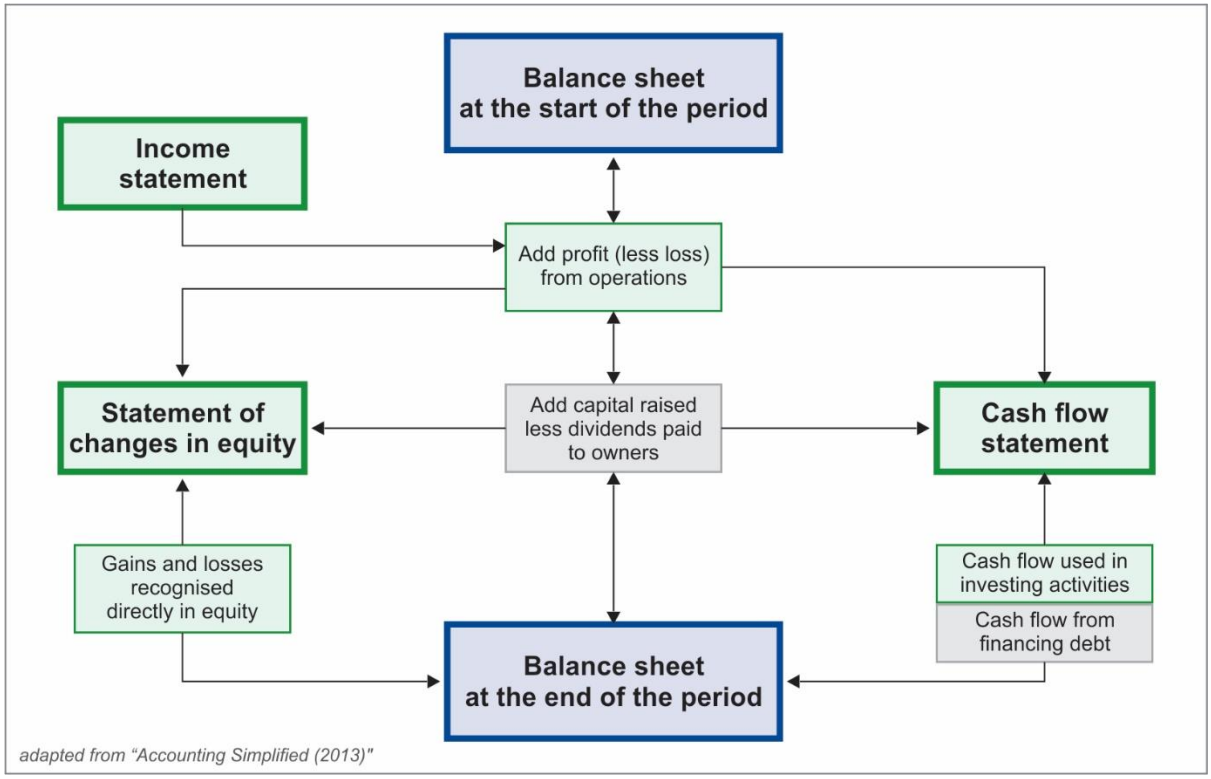


Figure 1.3: Relationship between financial statements

(Adapted from (Accounting-Simplified, 2013)

As indicated earlier financial statements are financial reports presented following a certain set of instructions as outlined by applicable financial reporting frameworks, for example the IFRS. IFRS represents a set of generally accepted financial reporting standards used by companies to prepare financial statements. This is a critical source of information published annually, at a minimum, and useful to various stakeholders (such as shareholders, debtors, clients, employees and governments) in understanding a company's financial performance and management’s stewardship of the company’s resources.

Major economies have initiated a process to consider convergence or adoption of IFRS in the near future, even the United States (US GAAP as developed by the Financial Accounting Standards Board (FASB) - being the other most important set of financial reporting standards) where cross-listed firms on the US stock markets have been permitted to file statements prepared under IFRS since 2007.

With the increasing globalisation of financial markets and of mineral companies, the use of a single set of financial reporting standards across countries is viewed as having increased the comparability of financial statements across borders. It also reduces the cost of preparing the consolidated financial statements of groups made up of companies conducting business in different countries around the world.

Financial reporting standards have been in the spotlight since the banking crisis, more specifically those requiring the measurement of financial assets and liabilities at “Fair Value”. In September 2009, G20 leaders met in Pittsburgh in the USA and asked the accounting standard setters IASB and counterpart, the FASB to work towards a single set of high quality global accounting standards by June 2012. Convergence, however, is proving challenging and is likely to be pushed further out.

Table 1.2: Summary description of the different components of financial statements

BALANCE SHEET	INCOME STATEMENT	STATEMENT OF CHANGES IN EQUITY	CASH FLOW STATEMENT
Balance Sheet, or Statement of Financial Position, is directly related to the Income Statement, cash flow statement and statement of changes in equity. Assets, liabilities and equity balances reported in the Balance Sheet at the period end consist of: • *Balances at the start of the period;* • *The increase (or decrease) in net assets as a result of the net profit (or loss) reported in the income statement;* • *The increase (or decrease) in net assets as a result of the net gains (or losses) recognised outside the income statement and directly in the statement of changes in equity (e.g. revaluation surplus);* • *The increase in net assets and equity arising from the issue of share capital as reported in the statement of changes in equity;* • *The decrease in net assets and equity arising from the payment of dividends as presented in the statement of changes in equity;* • *The changes in composition of balances arising from inter balance sheet transactions not included above (e.g. purchase of fixed assets such as mineral assets or mineral project, receipt of bank loan, etc).* • *Accruals and Prepayments, Receivables and Payables*	*Income Statement, or Profit and Loss Statement, is directly linked to Balance Sheet, Cash Flow Statement and statement of changes in equity. The increase or decrease in net assets of an entity arising from the profit or loss reported in the income statement is incorporated in the balances reported in the Balance Sheet at the period end. The profit and loss recognised in Income Statement is included in the cash flow statement under the segment of cash flows from operation after adjustment of non-cash transactions. Net profit or loss during the year is also presented in the statement of changes in equity.*	*Statement of Changes in Equity is directly related to the Balance Sheet and Income Statement. Statement of changes in equity shows the movement in equity reserves as reported in the entity's Balance Sheet at the start of the period and the end of the period. The statement therefore includes the change in equity reserves arising from share capital issues and redemptions, the payments of dividends, net profit or loss reported in the Income Statement along with any gains or losses recognised directly in equity (e.g. revaluation surplus).*	*Statement of Cash Flows is primarily linked to the Balance Sheet as it explains the effects of change in cash and cash equivalents balance at the beginning and end of the reporting period in terms of the cash flow impact of changes in the components of Balance Sheet including assets, liabilities and equity reserves. Cash flow statement therefore reflects the increase or decrease in cash flow arising from: Change in share capital reserves arising from share capital issues (in the minerals industry a mineral project can be funded in this manner) and redemption; Change in retained earnings as a result of net profit or loss recognised in the Income Statement (after adjusting non-cash items) and dividend payments; Change in long term loans due to receipt or repayment of loans (mineral asset can be funded on a combination of different debt instruments and equity); Working capital changes as reflected in the increase or decrease in net current assets recognised in the Balance Sheet; Change in non-current assets due to receipts and payments upon the acquisitions and disposals of assets (i.e. investing activities).*

Adapted from (Accounting-Simplified, 2013)

1.6.2. Purposes of financial reporting

The purpose of financial statements is to provide relevant information about the financial position, performance, and changes in the financial position of an entity. They are created to help users make wise economic decisions. Financial statements should be understandable to the non-professional. Annual reports should be comparable when reporting assets, liabilities, equity, income, and expenses. Stakeholders use these reports for different purposes.

Sergeeva and Lebedevaa (2016) defined the key purpose of financial reports as to provide all interested users with the information on financial statement of a company, its assets and activities based on principles of materiality, transparency, completeness and timeliness. On the other, the investors rely on these public financial reports to make their investments decisions on acquisitions or sales of companies, participation in long-run projects in the field of minerals exploration, mine development and mining operations, as well as on deals with securities of issuers.

The primary users of general purpose financial reporting are current and potential investors, lenders and other creditors, who use that information to make decisions about buying, selling or holding equity or debt instruments and providing or settling loans or other forms of credit (IASB, 2010). The primary users need information about the resources of the entity not only to assess an entity's prospects for future net cash inflows, but also how effectively and efficiently management has discharged their responsibilities to use the entity's existing resources (IASB, 2010).

The IASB framework sets out the concepts that shape the preparation and presentation of financial statements for external users and the framework does not have the status of an accounting standard. This is also the case with the 'Statement of Principles' from in the United Kingdom Accounting Standards Board (ASB), The IASB framework assists (IASB, 2013, p3):-

- *"in the development of future IFRS and in its review of existing International Accounting Standards;*
- *in promoting the harmonisation of regulations, accounting standards and procedures relating to presentation of financial statements by providing a basis for reducing the number of alternative accounting treatments permitted by international standards.*
- *preparers of financial statements in applying international standards and in dealing with topics that have yet to form the subject of an International Accounting Standard;*
- *auditors in forming an opinion as to whether financial statements conform with IFRS;*
- *users of financial statements in interpreting the information contained in financial statements prepared in conformity with IFRS; and*
- *those who are interested in the work of IASB, providing them with information about its approach to the formulation of accounting standards".*

The IFRS framework notes that general purpose financial reports cannot provide all the information that users may need to make economic decisions. They will need to consider pertinent information from other sources as well. The IFRS framework notes that other parties, including prudential and market regulators, may find general purpose financial reports useful. However, the IASB considered that the objectives of general purpose financial reporting and the objectives of financial regulation may not be consistent. Hence, regulators are not considered a primary user and general purpose financial reports are not primarily directed to regulators.

1.6.3. Uses of financial reporting

The objective or use of financial statements is to provide information about the financial position, performance and changes in the financial position of an enterprise that is useful to a wide range of users in making economic decisions in compliance with the IASB framework (Accounting-Simplified, 2013). Financial statements provide useful information to a wide range of users in the following broad ways (Accounting-Simplified, 2013, p1):-

- "*Managers require Financial Statements to manage the affairs of the company by assessing its financial performance and position and taking important business decisions;*
- *Shareholders use Financial Statements to assess the risk and return of their investment in the company and take investment decisions based on their analysis;*
- *Prospective Investors need Financial Statements to assess the viability of investing in a company. Investors may predict future dividends based on the profits disclosed in the Financial Statements. Furthermore, risks associated with the investment may be gauged from the Financial Statements. For instance, fluctuating profits indicate higher risk. Therefore, Financial Statements provide a basis for the investment decisions by potential investors. In the mineral industry the ability to generate consistent free cash flow the better the mining investments, the market tends to value such a company better than its comparable company;*
- *Financial Institutions (e.g. banks) use Financial Statements to decide whether to grant a loan or credit to a business. Financial institutions assess the financial health of a business to determine the probability of a bad loan. Any decision to lend must be supported by a sufficient asset base and liquidity;*
- *Suppliers need Financial Statements to assess the credit worthiness of a business and ascertain whether to supply goods on credit. Suppliers need to know if they will be repaid. Terms of credit are set according to the assessment of their customers' financial health;*
- *Customers use Financial Statements to assess whether a supplier has the resources to ensure the steady supply of goods in the future. This is especially vital where a customer is dependent on a supplier for a specialised component. In the mining industry the production capacity determines the level that a project will be contributing to the global production and will also influence its average cost of production;*

- *Employees use Financial Statements for assessing the company's profitability and its consequence on their future remuneration and job security;*
- *Competitors compare their performance with rival companies to learn and develop strategies to improve their competitiveness;*
- *The general public may be interested in the effects of a company on the economy, environment and the local community; and*
- *Governments require Financial Statements to determine the correctness of tax declared in the tax returns. Government also keeps track of economic progress through analysis of Financial Statements of businesses from different sectors of the economy. Expected taxes are reflected in the MAV in the form of the corporate tax and royalties*".

1.7. Major financial reporting standards applicable to extractive industries

Extractive activities are the exploration for and discovery of minerals, oil and natural gas deposits, developing those deposits and extracting the minerals, oil and natural gas. Extractive activities are excluded from the scope of several, otherwise relevant standards, and thus there is no specific accounting guidance for extractive industries. This has resulted in a diversity in accounting and disclosure practices in the extractive industries. However for the IASB to be able to implement the IFRS they had to introduce an interim accounting standard, IFRS 6, to give guidance on the accounting of exploration for and evaluation of mineral resources. The range of disclosure requirements and accounting policies highlighted the significant flexibility allowed by IFRS 6 and the lack of general guidance in IFRSs in respect of mining activities, including terminology.

There is no comprehensive set of accounting standards that specifically refer to the extractive industries and over the last two decades various boards have been trying to develop a set of comprehensive standards for financial reporting for the extractive industries or a global standard for the valuation of mineral assets. The next sub-sections explore the different initiatives that have been pursued by the IASB and the IVSC.

1.7.1. IASB and IFRS initiatives

The IASC had a project on 'extractive industries', led by an IASC Steering Committee on Extractive Industries, which considered a broad range of issues including reserves and resources estimation, historical and valuation based concepts of measurement of resources, related assets, treatment of removal and restoration costs, impairment, revenue, inventories and arrangements to share risks and costs (Deloitte, 2014). In order to address part of the IASC committee's charter, a project on 'extractive industries' was commissioned in 1998 by an IASC Steering Committee on Extractive Industries. After the IASC Steering Committee filed its report in 2000, it was disbanded after issuing the Extractive Industries Issues Paper in November 2000 (IASC, 2000).

The aim of this Issues Paper was to identify the important financial reporting issues in the extractive industries and to evaluate the merits of alternative ways of resolving those issues. The tentative views detailed in the Issues Paper paid particular attention to the need for enterprises in the extractive industries to provide relevant and reliable information that users of their financial statements can use as a basis for economic decisions. The information disclosed should enable users to compare the financial position and financial performance of extractive industries enterprises in different countries. The information disclosed should also be comparable similar transactions by enterprises that are not in the extractive industries. Furthermore, the IASC Board and the Steering Committee would continue to make use of IASC's framework for the preparation and presentation of Financial Statements in developing the principles to be set out in a final standard on the extractive industries. The committee and the board could not resolve these issues and this specific committee was disbanded.

The IASB undertook a short-term project on the accounting for exploration and evaluation of expenditures, designed to make limited improvements to accounting practices without requiring major changes that might be reversed in any comprehensive project on extractive activities. This short-term project led to the issuing of IFRS 6, "Exploration for and Evaluation of Mineral Resources" in December 2004 to facilitate the implementation of the IFRS from January 2005. IFRS 6 is part of the IFRS group of accounting standards and was specifically developed for the extractive industries. The objective of IFRS 6 is limited to specifying the financial reporting of exploration for and evaluation of mineral resources; that is the expenditure spent for exploration and the evaluation of mineral resources before the commercial viability has been demonstrated (IFRS, 2012). It should be emphasised that there are other general accounting standards applicable to the extractive industries and these will be discussed in detail in Chapter 2, when exploring the current financial reporting framework.

The IASB found the report to be inadequate for its standards-setting purposes. A new project team was convened by the IASB in 2004, comprising of national standard-setters from Australia, Canada, Norway and South Africa. The project team undertook research on extractive activities by considering a broad range of issues including resources and reserves estimation, and historical and current value measurement of resources and produced a discussion document in 2010. Again the comments received from the stakeholders, interested and affected parties could not be reconciled to form the basis of a comprehensive accounting standard and this project was also abandoned.

In addition to these steps, a project team of national standard-setters from Australia, Canada, Norway and South Africa undertook a research project on extractive activities. This project had a narrower focus, dealing with the nature of the unique assets arising in the extractive process in terms of exploitation or mining rights and access to, and information about, possible mineral or oil and gas resources and reserves (Deloitte, 2014). The IVS is designed to be compatible with IFRS which are published by the IASB and the aim of both organisations to harmonise global reporting in the closely related activities of financial reporting and valuation reporting (Abergel, 2014).

However, since 2000, the IVSC and IASB have pursued separate, but related projects to develop standards to address the unique characteristics of the extractive industries. This has culminated in several exposure drafts for comments and it has been difficult to reconcile the issues to develop an exemplary standard.

In December 2012, the IASB discontinued the Extractive Activities Project as the findings could not conclusively lead to the development of an IFRS standard for extractive activities. Instead a broader research project on intangible assets was initiated. This project was designed to assess the feasibility of developing one set of reporting requirements for investigative, exploratory and developmental activities across a wide range of activities. The valuation of mineral assets is a more complex undertaking and even the IASB has failed over a period of more than 15 years to develop an IFRS standard to guide MAV. This complexity implies that harmonisation of valuation codes should initially be based on high-level commonality among the codes to progressively draw in the more complex issues (Njowa *et al*, 2014).

1.7.2. International Valuation Standards Committee initiative

The IVSC is an independent global standard-setter for the valuation profession and pre-2008 had a strong inclination towards real estate valuation. Its mission is to set and maintain effective high-quality global standards for the execution of valuations by the valuation profession, thereby serving the public interest. Part of the IVSC's mission is to reduce diversity in valuation standards by enabling convergence. This may eventually lead to the development of a set of globally accepted international valuation standards.

The IVSC first convened an Extractive Industries Task Force of international mining and petroleum industry valuation experts in early 2001. The IVSC Board, at its Annual Meeting in September 2002, approved the Task Force's proposed approach for the rapid development of an Extractive Industries Standard in addition to the International Valuation Standards. The initial purpose was for the Task Force to review the Extractive Industry Issues Paper on financial reporting for the extractive industries, published by the predecessor body of the IASB, and draft the IVSC's responding submission. In a June 2001 submission, the IVSC's Board advised the IASB that it supported and approved the development process for an Extractive Industries guidance section of the International Valuation Standards (IVS) by the Extractive Industries Task Force. This would allow a truly international extractive industries standard to be referenced by the IASB and be part of the IFRS's in one form or another.

To guide the valuation of assets in the extractive industries, the IVSC published Guidance Note 14 (GN 14) titled, "*Valuation of Properties in the Extractive Industries"* in 2005. The purpose of the GN 14 was to provide clarification and guidance on the valuation of assets in the extractive industries. GN 14 was republished in the International Valuation Standards (IVS) 2007 (8th Edition).

The 2007 IVS Edition (8th Edition) remained the effective set of IVSs until December 2011, although in February 2010, the IVSC Standards Board (IVSB) had voted to withdraw GN 14. A critical review process commissioned by the IVSC resulted in proposed major changes to the IVS structure, style, and content, and as an outcome of the review, all guidance notes were withdrawn, including GN 14 in 2010. The content and principles of some guidance notes were reincorporated into new sections of the revised 2011 IVS and the extractive industry guidance provided by GN 14 was not re-incorporated into subsequent editions in 2011 and 2013 (Abergel, 2014). The Improvement Project required a review of general standards. However, since the GN 14 required a thorough review that was beyond the scope of the Improvement Project, it was prudent for the GN 14 to be withdrawn. The project resulted in restructured and reformatted standards which were approved by the IVSC Board in May 2011 and published in July 2011.

In October 2012 the IVSC then revisited valuation in extractive industries and published a discussion document on valuation in the extractive industries aimed at gathering industry consultations on a variety of issues. In the IVSC discussion paper, the following weaknesses were noted about the IVSs in general, not GN 14 specifically (IVSC, 2012b, p 2):-

- "*A real estate bias – while the IVS had included material on the valuation of other asset types for a number of years, their origins as a set of real estate standards meant that there remained an undue emphasis on this sector;*
- *A focus on financial reporting – there was substantial reference to, or commentary on, the IFRS. This led many to believe that the IVS was only relevant to valuations under the IFRS and had no application either for valuations for financial reporting under other accounting standards or for other purposes;*
- *A lack of clarity of purpose – there was confusion between "technical standards", i.e. relating to valuation processes, and "professional" standards relating to the conduct of valuers. It recommended that the future standards be principles based and avoid excessive prescription; and*
- *Improvements were needed to structure and writing style - the "Guidance Notes" followed a similar rigid structure to the "Standards" and contained prescriptive language, which implied that the guidance notes were mandatory rather than guidance material*".

The entire IVS document is mandatory and any valuation prepared under the IVS must comply with all parts the document. GN 14 also referenced the United Nations Framework classification (UNFC) and CRIRSCO definitions in some instances but, did not clarify the relevance or use of these definitions in the valuation process.

Further, GN 14 relied on requirements in the IVSs through extensive referencing to avoid duplication and being a prescriptive standard. However, the opinion expressed by the IVSB, was that the GN 14 did not provide sufficient guidance on the valuation inputs, assumptions, types of value and, purposes and methodologies that should be considered in MAV.

It is generally agreed that the IVSB's view and similarly propose that the IMVAL template should not be prescriptive and should also reference the relevant IVSs and the CRIRSCO template in order to provide sufficient guidance.

The original GN14 differed from existing national mineral asset valuation codes in terms of scope, valuation principles, definitions, engagement requirements and the content of a typical valuation report. In 2013 IVS outlined similar valuation principles, approaches, engagement requirements, and report content requirements consistent with VALMIN, CIMVAL, and SAMVAL. The high level guidance provided by the IVS is designed to apply to all industry types and all global markets, and is therefore principles-based in order to accommodate a range of valuation circumstances.

1.8. Importance of interfacing MAV and financial reporting as an extension to integrated reporting

One of the consequences of globalising mining finance is a necessity to apply uniform accounting and valuation standards that are clearly understood and consistently applied by the global investment community, which requires more information through the new global trend of integrated reporting. However, each country has unique circumstances, which sometimes makes it difficult to align domestic practice with international requirements.

South Africa is no exception and issues such as its political history, a taxation regime enforcing different rules on different mineral producers and a unique mineral rights ownership distribution, are barriers to internationalisation. The economy is in a transitional phase as a result of the many and diverse policy documents following the change in political dispensation in 1994. Many of these policy documents have recently been implemented through new legislation and, in the case of mining, negotiations are continuing in order to ensure an acceptable outcome.

Similar issues exist in other major mining countries such as Australia, Canada, United Kingdom and the USA, hence the need for harmonisation of the core principles at an international level. These peculiar circumstances will be discussed later in detail in relevant sections of this report. The importance of interfacing the MAV with financial reporting is aimed at increasing disclosure to the stakeholders who use this information for either investment and/or economic decisions.

1.9. Research question and relevance

Accounting harmonisation is converging towards IFRS for financial reporting, while MAV harmonisation has been converging towards IMVAL for MAV reporting. However, there is no link between MAV and financial reporting. Globally, different organisations with special interest in the extractive industries have developed policy and guidelines for their own specific needs, but have never been coordinated.

At present there is no direct link between a project (mining revenue, capex, opex costs) that is being reported through the company's financial statements and the project mineral asset valuation, partly because of the different rules guiding these two different reporting systems and requirements.

The first aim of harmonisation would be the development, in the interest of the investors and the public at large, of a high quality, understandable and enforceable global valuation framework with definitions that can also adopted by IFRS for general purpose financial reporting. In 2002, Trevor Ellis commented that *"it is important that the valuation procedures and reporting requirements for all types of mineral asset valuation mesh with those generally accepted by the global financial and accounting community."*(Ellis, 2002, p3).

From the foregoing sections and considering that efforts are underway to harmonise MAV Codes, it can be noted that this research seeks to provide answers to the question, "*What are the emerging trends in the requirements for financial reporting of mineral assets and can the mineral asset valuation methodologies be harmonised together with emerging requirements in financial reporting to reduce the gaps among valuation codes and between mineral asset valuation codes and financial reporting requirements?".*

The research study is relevant to the MAV and financial reporting professional bodies and professionals in several ways. Firstly, it provides ways of bridging the gap between MAV and financial reporting as evidenced by the different initiatives that have been conducted by different organisations globally in an effort to establish a global standard or guidelines for the valuation of mineral assets and how information on the value of the mineral assets could be incorporated in the integrated annual reporting system. With the current standards and guidelines, the value of the mineral assets can only be found in the financial statements only if the asset was bought from another entity and a value of the asset is recorded on the balance sheet as part of the purchase price allocation process.

1.10. Research aims and objectives

This thesis explores key issues in the global harmonisation or alignment of the four national MAV codes and the other related codes and guidelines, to the financial reporting of the mineral asset in the financial statements. It will focus on the current financial reporting standards, the emerging trends in the extractive industries and the relationship between financial reporting by the business entities involved in the extractive industries and the valuation of mineral assets. The information contained in the financial reports should be comprehensive to those who have a reasonable understanding of the mining business and economic activities to enable them to study the information with reasonable diligence.

It further discusses the challenges that the minerals industry faces in the field of MAV. It draws on international experience and includes a discussion on the unique considerations that the South African mineral asset market must take into account in establishing a code for this purpose, as such a code could later be aligned with international practice. These are the local issues that are influencing and affecting both the MAV and financial reporting and there is an increase in emphasis by the major mining companies in their integrated annual reports.

1.11. Limitations and exclusions

The discussion on mineral asset valuation does not include discussions on the valuation of oil and gas properties as these are not associated with producing solid minerals. As much as the high level valuation approaches are the same, the technical and economic fundamentals that affect, drive and influence the valuations are very different. In addition, this thesis does not cover any discussion on the valuation of exploration, defunct mining properties and the valuation of environmental liabilities on mining properties since these are more on the periphery of the subject of mineral asset valuation and financial reporting. However, the overlap between these areas and core matter covered in this report will be covered only to the extent that it is relevant to the subject matter.

1.12. Methodology

The publication of the IASB Discussion Paper on the Extractive Industries for public comment in 2010, and being part of the committee that were discussing and preparing the responses to the IASB marked the beginning. This was the initiator of this research work after realising that the extractive industry lacks a comprehensive financial reporting guidance and a common framework among the national MAV reporting codes. The period during which the research was undertaken can be described as a period of applied learning, researching, understanding mineral asset valuation and framework development on how the MAV codes could be harmonised as the first step towards the development of a comprehensive accounting standard for the extractive industries.

This research was conducted using the following methodology:-

- Undertaking extensive literature review on mineral asset valuation and the findings in the 2001 and 2010 IASB Discussion Papers on Extractive Industries;
- Review of the major national MAV codes in use globally, to understand their similarities and differences, with the aim to harmonise these MAV codes;
- Review the IFRS applicable in the extractive industries;
- Conducted extensive research on each MAV conducted in the work environment;
- Conducted interviews with Valuations Experts, Analysts, Financial Managers and Mining Audit partners in the industry; and
- Review mining analysts' reports on mining companies

1.13. Expected outcomes

The objective of this thesis was to demonstrate the developmental evolution for a potential harmonisation framework of the MAV codes globally, through creation of a body similar to CRIRSCO. This would then assist in resolving some of the complex issues that are peculiar to the extractive industries, in an effort to assist the IASB to create a set of comprehensive accounting standards for the extractive industries. This would form a solid basis for creating a framework to harmonise MAVs with existing and emerging financial reporting requirements and to be able to implement and adoption such frameworks in the work environment when conducting valuations of mineral assets.

1.14. Chapter Summary

The historical overview in financial reporting and MAVs were discussed in this chapter to provide a background to the issues and frameworks to be developed and validated in this thesis. The chapter covered the definitions, purposes and uses of MAVs, followed by a general background discussion on the fundamental factors that drive value in mineral assets at different stages of development. An introduction to national MAV codes and standards that have been developed in different jurisdictions and the definitions, purpose and uses of financial reporting was also discussed. The last sections covered an introduction of the major financial reporting standards applicable to the extractive industries and the importance of interfacing MAV and financial reporting as an extension to integrated reporting. Lastly the chapter discusses the research question, its relevance, objectives, methodology, limitations and expected outcomes.

2. LITERATURE REVIEW OF DEVELOPMENTS IN MAV AND FINANCIAL REPORTING FRAMEWORKS

2.1. Chapter overview

This chapter discusses the historical developments and the current status quo on the subject of valuing mineral assets in the extractive industries covering both the developments within the mining technical and the accounting professions. The chapter concludes by identifying the gaps and shortfalls of all these global efforts and how this research provides potential solutions to these gaps and shortfalls.

A variety of frameworks and methodologies aimed at ascertaining the estimated monetary value of the minerals in the ground have been developed since the start of the 20th century within the broader extractive industries. These developments were championed by different organisations, securities exchanges, governments and mining institutes around the globe. In countries where mineral resources are significant to the gross domestic product (GDP), specific accounting standards and mineral resources valuation guidelines have been developed for certain of the accounting and valuation issues unique to the sector. These frameworks developed in the different regions/countries specifically address their own requirements within the jurisdiction in which they are applied. In addition, the regional differences exist on different stock exchanges and the challenge is then how these differences are incorporated into a single framework. The main developments in this area of study can broadly be classified into two categories, namely those requirements emanating from the mining technical professionals and financial reporting requirements emanating from the accounting professionals. However, these efforts have been conducted in isolation and have therefore lacked formal coordination between all the interested and affected stakeholders in the extractive industries and across the regions. Even within these two professions, the efforts in the development of the frameworks and methodologies of valuing mineral assets were never coordinated in a way that creates some form of code or guideline that would be acceptable with any of these two professions or a global generally accepted international framework.

The development of these frameworks and methodologies have been more localised and isolated because of the following broad reasons:-

- the requirements of either the mining technical evaluations and valuations differ from the requirements for financial reporting in the extractive industries;
- mining countries develop frameworks and guidelines specifically for that mining nation and the prevailing requirements;
- the requirements of a securities exchange that is mainly focused on the extractive industries for example the Toronto Stock Exchange (TSX) and Australian Stock Exchange (ASX) dictate a specific focus; and
- different commodities such as the precious metals, base metals, bulk commodities, oil and gas, require different treatment with respect to valuation.

The next sections discuss the general definition of a framework, as well as the MAV frameworks. Subsequent sections then address financial reporting frameworks.

2.2. Definition of a framework

In general, a framework is defined as a conceptual structure intended to serve as a support or guideline for the building of something that expands the structure into something useful in the development of a solution to an existing problem or to meet a certain objective (Rouse, 2015). In other words, as explained in the Business Dictionary (2007) a framework is a broad synopsis, summary, or skeleton of interlinked pieces which supports a particular approach to a specific objective, and serves as a guide that can be adjusted as required as a refinement to achieve an optimum solution by adding or deleting items.

In accounting, the conceptual framework provides the foundations on which its accounting standards are based. The framework creates a basis in assisting the users of final reports in interpreting information contained within the financial statements and provides an understanding of the principles on which they are prepared. "*A statement of the functions of financial statements included in a framework document increases the robustness of the standard setting process, ensures consistency and assists in the development of future standards*" (IASB, 2010 p36). Harmonisation of these frameworks will form the basis for the development of globally accepted standards.

According to Rouse (2015), in information technology, a framework is often a layered structure indicating what kind of programs can or should be built and how they would interrelate with the rest of the system. Some computer system frameworks also include actual programmes or offer programming tools for use in the framework. A framework may be built for a set of functions within a system and how they interrelate; the layers of an operating system; the layers of an application subsystem; how communication should be standardised at some level of a network.

2.3. Developments in MAV frameworks

Since the beginning of the 20th century, substantial progress had been made to achieve the goal of standardised reporting of exploration results, mineral resources and mineral reserves under the umbrella organisation known as CRIRSCO. CRIRSCO, which was formed in 1994 under the auspices of the Council of Mining and Metallurgical Institutes (CMMI), is a grouping of representatives of organisations that are responsible for developing mineral reporting codes and guidelines in Australasia (JORC), Canada (CIM), Chile (National Committee), Europe (National Committee Pan-European Reserves & Resources Reporting Committee (PERC)), Mongolia (MPIGM), Russia (NAEN), South Africa (SAMREC) and the USA (SME). The combined value of mining companies listed on the stock exchanges of these countries accounts for more than 80% of the listed capital of the mining industry. In 2006, CRIRSCO published a reporting template for the extractive industries, which was later updated in May 2013.

The CRIRSCO template provides a platform that aligns national reporting codes by fostering a common understanding by harmonising the definitions, classification, estimation processes and the public reporting of these estimates. The CRIRSCO-type codes are widely accepted, but the CRIRSCO template itself is not necessarily used globally.

The CRIRSCO-based alignment of the national reporting codes has in part, been catalysed by the increasing globalisation of investors and access to securities exchanges worldwide that is further supported by an overriding securities exchange principle of protecting the investors. However, it should be noted that there is an alternative code such as the UNFC or the fact that the USA has not adopted a CRIRSCO-type code as part of its regulations. The UNFC, is widely used by the United Nations for the reporting of mineral resources or deposits in countries regardless of their economic extractability or feasibility. It should be noted that the current Chinese National Standard for reporting of exploration results, mineral resources and mineral reserves differs to international reporting standards in both their underlying principles and nomenclature. It is an example of a national code that contains elements of both the CRIRSCO-type and the UNFC classifications.

The standardisation of minerals reporting codes created a framework or base to define mineral resources. Once mineral resources are defined through this framework, it should become easier for the next step of valuation of such mineral resources. This should facilitate the development of a global MAV template through the harmonisation of the national valuation codes since the mineral resources are already defined through a globally accepted template. The use of the CRIRSCO international template ensures common understanding, interpretation and classification of the resources. The CRIRSCO template provides guidelines and common definitions in the classification of mineral resources, as they form the basis of property that would be valued. In addition, the CRIRSCO-type reporting codes requires that a Competent Person ensures that the mineral resources reported to the public using the definitions and classifications contained therein. It is important to understand an extractive entity's minerals or oil and gas resources and reserves because they are the most significant assets or among the most significant assets of those entities since they constitute a source of future cash flows (IASB, 2010). This assertion was echoed by Ellis (2012) who stated that, a mineral resource estimate, if one exists, will be an important input in developing a valuation estimate of a mineral property, together with other extensive information such as geological, environmental, regulatory and permitting, political and social, infrastructure, products and product markets, cost estimates and details from transactions of mineral properties with similar characteristics.

The history of international reporting standards and reserve classification in the extractive industry has its backbone on the Australian mining industry (Table 2.1). Australia was the pioneer in realising that the mining industry needed 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 for regulating the extractive industry. JORC was formed in 1971 and released the first edition of the JORC Code in 1989.

The code was well accepted in Australasia and in ten years of use it got an international recognition and acceptance. Hence this code became the template that South Africa used in the process of developing its specific reporting document that was published in March 2000. The history and the development of the reporting code in the Australasian context forms 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 are reviewed at high level, as these formed the basis for the creation and development of the mineral asset valuation codes. The general reporting principles and attributes that should be complied with, for pertinent information that is issued onto public domain will also be discussed. Finally the lessons that can be drawn from the discussions are highlighted and recommendations made.

Table 2.1: Historical Development of Mineral related Codes and Guidelines

DATE	PLACE	EVENT
1909	United States	Publication of Hoover : Principles of Mining
1971	Canada	National Policies Statement 22 (NP22) 'Use of Information and Opinion re Mining and Oil Properties by Registrants and Others'
1971 - 1985	Australia	JORC formed and documentation of JORC guidelines on classification and reporting of mineral resources
1980	United States	"Circular 831, Principles of a Resources or Reserves Classification of minerals" by US Bureau of Mines and US Geological Survey
1981	United States	SEC Industry Guide 7 (IG7) published: Description of property by issuers engaged or to be engaged in significant mining operations
1981	South Africa	Publication of a text by the Chamber of Mines of South Africa titled South African Mine Valuation
1981	Australia	Mineral Industry Consultants Association (MICA) formed
1983	Canada	National Policies Statement 2 - A (NP2-A) 'Guide for Engineers, Geologists and Prospectors submitting reports on mining properties to Canadian Provincial Securities Administrators'
May-1984	Australia	AusIMM/PESA conference 'The Valuation of Mining and Petroleum Properties and Companies'
Mar-1989	Australia	First Edition of the JORC Code published and incorporated into Australian Stock Exchange (ASX) listing rules and adopted by AusIMM
Sep-1989	Australia	Minval '89' conference in Sydney.
Apr-1990	Australia	National Companies and Securities Commission (NCSC) Policy Statement release No. 149 'Expert Reports on Mining and Petroleum Securities and Other Assets'
Jul-1990	Australia	NCSC Practice Note Release No.333
Jun-1991	Australia	NCSC becomes Australian Securities Commission (ASC). Release no longer in effect
Apr-1991	Australia	AusIMM organises first meeting of Mineral Valuation (VALMIN) Committee: task to replace NCSC release No. 149,examine question of an institute mineral valuation code
1992	New Zealand	JORC Code incorporated into New Zealand Stock Exchange (NZX)
Sep-1994	Sun City, South Africa	First meeting of the CMMI International Resources/Reserves Definitions Group (Now CRIRSCO)
Oct-1994	Australia	VALMIN '94 conference in Sydney: draft VALMIN Code discussed, focus on valuation methods
1995	Australia and Canada	ASC Information Release 95-12: ASC will refer to VALMIN when reviewing mining exploration prospectuses and takeover documents. In Canada, Ontario Securities Commission (OSC) begins reviews of NP22 and NP2-A
Jun-1995	Australia	First Edition of the VALMIN Code published
Nov-1996	Geneva, Switzerland	Publication of the "United Nations International Framework Classification for Reserves/ Resources – Solid Fuels and Mineral Commodities"
Mar-1997	Indonesia and Canada	Bre-X Scandal
Jul-1997	Canada	Mining Standards Task Force (MSTF) formed by TSE/OSC in wake of Bre-X scandal. The task force was tasked to recommend best practices for reporting of mineral exploration and mining

DATE	PLACE	EVENT
Oct-1997	Denver, Colorado	Second Meeting of the CMMI International Resources or Reserves Definitions Group " The Denver Accord" (Now CRIRSCO)
Jan-1998	South Africa	Southern African Institute of Mining and Metallurgy (SAIMM) and the Geological Society of Southern Africa (GSSA) form the South African Resources and Mineral Reserves Committee (SAMREC)
Feb-1998	Australia	Second Edition of the VALMIN Code published; expanded to include petroleum assets/securities
Jul-1998	Canada	MSTF report issues interim report. The Canadian Securities Administrators (CSA) release proposed National Instrument 43-101 (NI 43-101) Standards of Disclosure for Exploration, Development and Mining Properties
Oct-1998	Geneva, Switzerland	Third meeting of the CMMI International Resources or Reserves Definitions Group First Meeting with the UN-ECE
Feb-1999	Canada	MSTF issues Final Report 'Setting New Standards', 66 recommendations for Canadian regulatory and self-regulatory organisations. TSE upgrades listing requirements for natural resources companies reinforcing the disclosure policies. "Setting New Standards, Recommendations for Public Mineral Exploration and Mining Companies" Published by Toronto Stock Exchange and Ontario Securities Commission
May-1999	Canada	CIM forms Special Committee on Valuation of Mineral Properties (CIMVAL) at recommendation of the MSTF
Nov-1999	Geneva, Switzerland	Fourth Meeting of the CMMI international Resources/ Reserves Definitions Group
		Second Meeting with the UN-ECE "the Geneva Accord"
Mar-2000	South Africa and Canada	Release of the first edition of the SAMREC code and Mining Millennium 2000 conference in Toronto hosted by PDAC/CIM
Feb-2001	Canada	NI 43-101 comes into effect in all jurisdictions represented by the CSA, by replacing NP22 and NP2-A
Mar-2001	Australia	AusIMM forms VALMIN Code Review Task Force; submissions solicited. The VALMIN Code Review Task Team final report published in 2002
Oct-2001	Australia	VALMIN '01 conference held in Sydney with an international focus; attendees from Canada, US, RSA and Chairman of IVSC. ASC becomes the Australian Securities Investment Commission (ASIC). Paper presented by Macfarlane at the conference proposed the creation of the South African valuation code to complement the SAMREC code
2001	South Africa	The SAMVAL Working Group of the SAMREC/SAMVAL Committee (SSC) formed under the auspices of the SAIMM and the GSSA
Apr-2001	Canada	CIMVAL Committee publishes Draft Discussion Paper
2000 -2003	UK, USA, Canada etc	Identical mineral resources reporting codes and guidelines adopted by SA, Canada, USA (SME), UK/ Western European countries, Chile and Peru, all based on 1999 JORC Code
Mar-2002	South Africa	SAIMM convenes colloquium in Johannesburg 'Valuation of Mineral Projects and Properties: an African Perspective', with participants from AusIMM, CIM, IVSC and IASB
Mar-2003	Canada	CIM adopts CIMVAL Standards. TSX:V incorporates modified CIMVAL into listing requirements through Appendix 3G 'Valuation Standards and Guidelines for Mineral Properties,' restricts resources valuation
2004	Australia	Release of 2004 JORC code

DATE	PLACE	EVENT
Apr-2005	Australia	Third edition of the VALMIN Code published
2007	South Africa	Release of exposure drafts of the SAMVAL code circulated for industry comments
Jul-2007	Australia	ASC Policy Statement 74 & 75 and Practice Notes 42 & 43 superceded by ASIC regulatory Guides RG 111 'Content of expert reports' and RG 112 'Independence of Experts'
Apr-2008	South Africa	First Edition of the SAMVAL Code published and the adoption of the SAMVAL Code in the JSE listing requirements.
Jul-09	South Africa	Issued the revised SAMVAL code
2010	China	CIMVal adopted by Hong Kong Stock Exchange through Chapter 18 (HKEX)
Feb-2011	Australia	Review of the VALMIN Code initiated
Oct-2011	Australia	VALMIN Seminar Series conference in Perth mainly focusing on international harmonisation focus with the SAMVAL and IVSC in attendance
Apr-2012	Australia	VALMIN Seminar Series conference in Brisbane and the creation of IMVAL by the Brisbane Group
Feb-2012	South Africa	SAIMM and GSSA reconvenes the SAMVAL and SAMREC working groups for review and update of the SAMVAL and SAMREC Codes
Dec-2014	South Africa	SSC publishes the SAMOG Code to regulate and guide the reporting of oil and gas properties in Southern Africa
Jun-2015	South Africa	SAMVAL and SAMREC working groups will publish the updated SAMVAL and SAMREC Codes for public and industry comments
Dec-2015	Australia	VALMIN Code 2015 Edition
May-2016	South Africa	SAMREC and SAMVAL Code 2016 Edition
May 2016	United States	Society for Mining, Metallurgy, and Exploration, Inc. (SME). SME Standards and Guidelines for Valuation of Mineral Properties
July-2016	(SA, UK, Canada, USA)	International Mineral Property Valuation Standards Template (IMVAL Template), Second Edition

Compiled from : Rendu (2000); Ellis (2012);Njowa (2006); Abergel (2014) and Njowa *et al* (2014)

The Australian VALMIN Code is generally recognised as the earliest and most influential technical assessment and mineral asset valuation code in the modern reporting guidelines for the determination of the approximate value of the mineral assets or property. According to Stephenson *et al* (2008), Canada enjoys a good reputation as the capital market of choice for global exploration and mining companies. The USA is acknowledged as a highly influential global capital market where many of the major international mining and exploration companies have a single or dual listing. In recent years the United Kingdom (UK) and China have also been highly influential global capital markets with a relatively higher number of new listings for exploration and mining companies looking to secure capital for the development of their mining properties.

In response to the Bre-X scandal, one of the biggest in the history of mining, Canada moved to adopt its own standards in 2000 when securities regulators formed a task force to investigate the conduct and practices of Canadian mining companies. After four years of industry consultation, the CIM published the final version of its CIMVAL standards in February 2003.

2.3.1. VALMIN framework

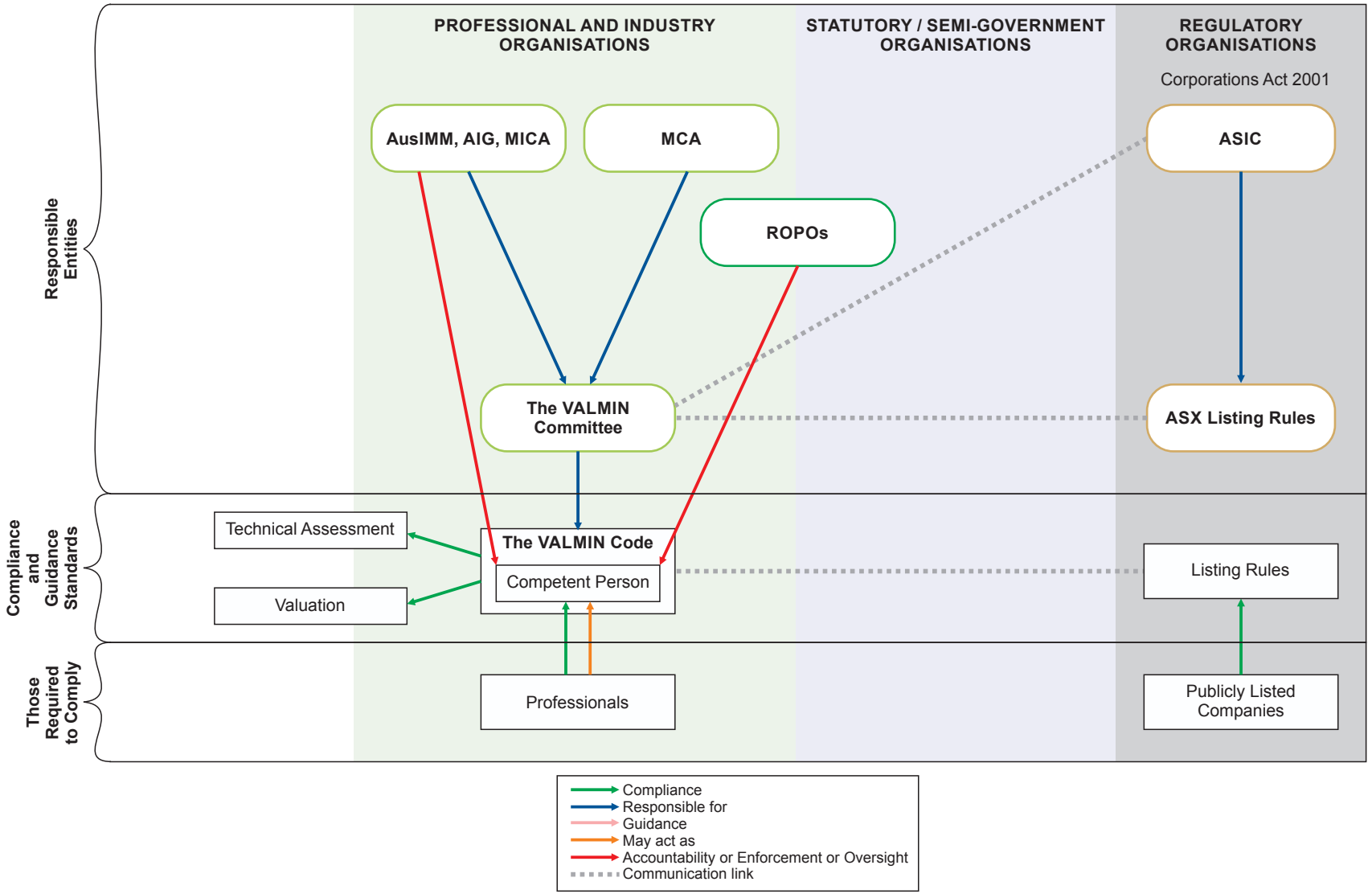
In Australia, there is only one securities regulator, the ASIC and one national stock exchange, the ASX, although small regional stock exchanges have been set up in recent years. The JORC Code has been incorporated as an appendix to the listing rules of ASX since 1989, when the first edition of the code was published and on the New Zealand Stock Exchange since 1992, making compliance with the JORC Code compulsory for listed companies in both Australia and New Zealand.

The VALMIN Code is the responsibility of the VALMIN Committee, established in April 1991 to review and replace the National Companies and Securities Commission (NCSC) Policy Statements in the area of technical assessments and valuation of mineral assets. The VALMIN committee is a joint committee of the AusIMM, AIG and MCA, with representation from the ASX and Financial Services Institute of the Australasia region.

ASIC oversees the operation of the ASX and administers the Federal Corporations Act. Australian securities law has been substantially modernised in recent years. The core of these laws are found in the Corporations Act 2001, which contains provisions governing takeovers, fundraising and financial products, services and markets (Wikipedia). “The Corporations Amendment (Financial Market Supervision) Act 2010 allows ASIC to make rules for market operators, market participants, other prescribed entities and financial products traded on relevant markets. Market integrity rules are legislative instruments. ASIC requires Ministerial consent before making any rules and any rules are subject to Parliamentary disallowance.” (ASIC website). ASIC can require listed companies to comply with ASX listing rules, giving them a degree of legal status in certain situations. The ASX placed its operational supervisory functions to ASX Markets Supervision, a separate subsidiary of ASX. The subsidiary was created to provide greater transparency and accountability of ASX’s supervisory operations and to address the perception of conflict between ASX’s regulatory and commercial functions.

One of the major institutional weakness of the VALMIN Code, is that both the ASIC and ASX were involved in the VALMIN committee that created the code, but have not adopted the code into the listing requirements or Act for technical assessment and valuation of mineral assets in Australia and New Zealand. Although the VALMIN code is not included as part of the ASX Listing Requirements, both JORC and VALMIN are recognised in the following manner, “disclosure in documents lodged with ASIC needs to comply with the JORC Code and/or VALMIN Code, or it may be taken to be misleading.

Figure 2.1: The Australian institutional framework for the VALMIN Code and its relationships



Source: Stephenson et al (2008)

However, even if disclosure complies with these codes, it will not automatically comply with the legal requirements, or ASX Listing Rules 5.15–5.19 and guidance". (ASIC website). This code is perceived as the pathfinder document and is recognised globally as the most influential code to the development of similar codes in other major mining countries such as Canada, South Africa and Poland. All these codes have since been adopted into their respective national stock exchange's listing rules making it compulsory to comply with this code, when conducting valuation of mineral assets in these jurisdictions.

A VALMIN practitioners must be a member or fellow of the AusIMM, AIG or a Recognised Overseas Professional Organisation (ROPO) included in a list promulgated by the ASX from time to time on advice from the VALMIN committee. ROPOs are similar to Canada's recognised foreign association (RFA), but with more stringent recognition conditions. Both ROPOs and RFAs may be self-regulatory professional organisations or statutory and semi-government organisations.

In assessing a proposed takeover or merger for a mining company listed on the Australian Securities Exchange (ASX), it is a long-established practice in the Australian mining industry for the directors of the target mining company to commission an 'independent expert' (Expert) to provide an opinion as to whether the proposed transaction is fair and reasonable and therefore in the best interests of the mining company's shareholders as prescribed by ASIC RG 111 content of expert reports. The Expert's assessment of the proposed transaction is based on the value of the mineral and other assets of the mining company. The mineral assets could include operating mines, development projects that are in construction or for which a feasibility study is in progress or has been undertaken, and exploration projects. The other assets could include cash, shares in another company and non-mineral assets. The Expert typically does not have the specialist capability required to assess the technical aspects of the mining operations and projects, and does not have the expertise to value the exploration projects. The independent technical specialist's report (ITSR) is prepared by someone who is qualified as a Specialist as defined in the VALMIN Code, and in accordance with the JORC Code.

It is generally agreed that the lack of the inclusion of the VALMIN Code into the listing requirements has been a setback for this code to be considered as the global most widely used code, even though the ASX and ASIC require all valuations to be estimated using VALMIN code to avoid possible misleading reports . In recent times, the CIMVAL Code seems to be gaining traction as the globally most widely used code, due to the fact that it was incorporated into the listing rules in China through the Hong Kong Stock Exchange (HKEX), as a code of choice. Whilst listings in Australia and South Africa still require compliance to VALMIN and SAMVAL codes respectively. According to Spence (2012), the HKEX is becoming a significant player in the mining financial markets to the emerging mining and exploration companies, mainly the junior and the mid-tier mining and exploration companies, whereas the large established mining houses have their primary listings in the USA, UK or Australia. The HKEX in the recent times have provided the required capital and liquidity for the mining companies and these companies are increasingly using the HKEX for initial public offerings (IPO).

In addition, the adoption the reporting and valuation codes has simply opened up the HKEX to new business in that part of the world and is now more than likely providing a direct link to Chinese financial interests.

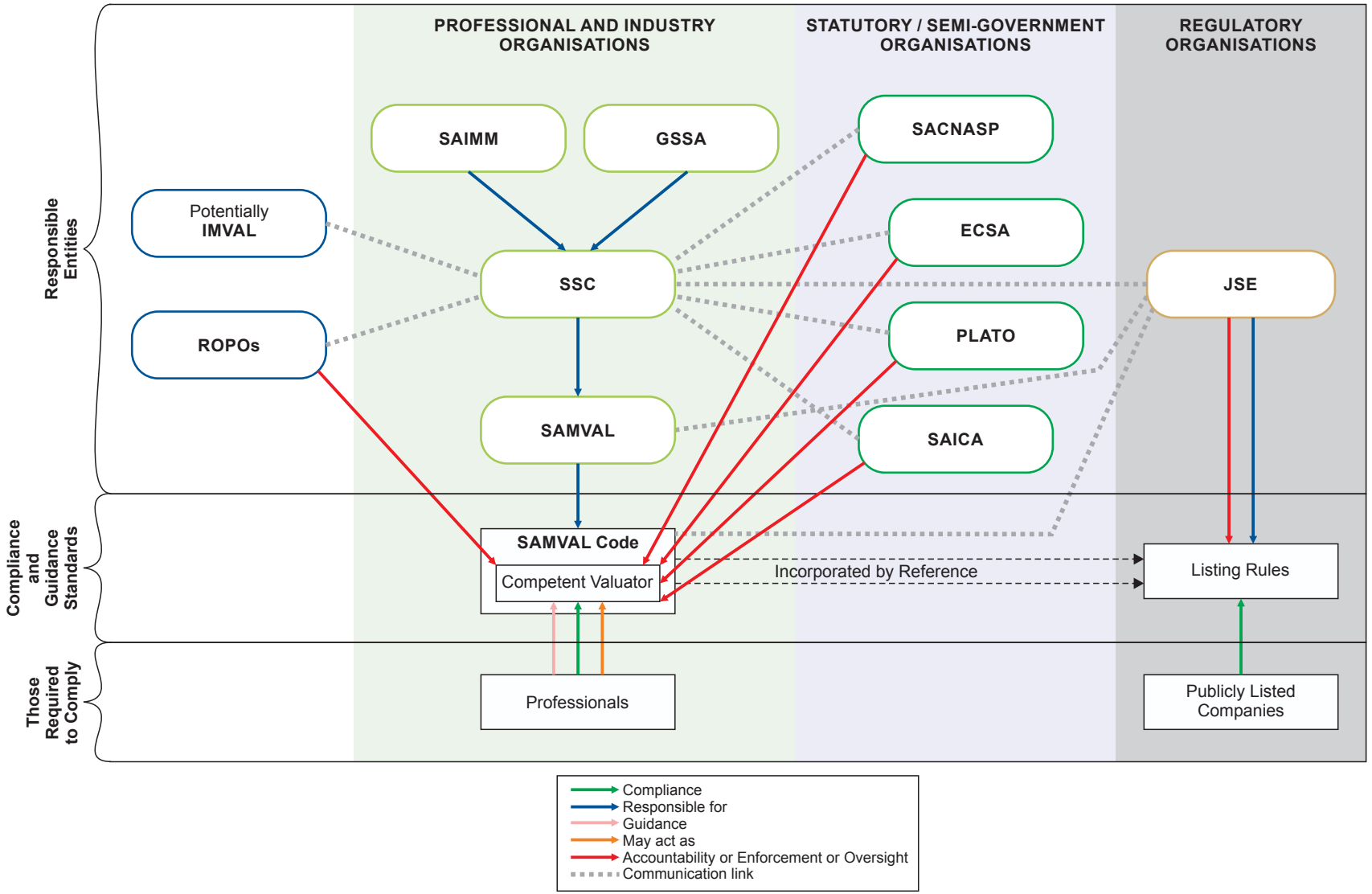
2.3.2. SAMVAL framework

The committee formed to develop the SAMREC Code initially was subsequently given the mandate to develop the SAMVAL Code. This resulted in the formation of the SAMREC SAMVAL Committee (SSC), as a joint committee formed by the SAIMM and the GSSA and is thus underpinned by approximately 5, 000 industry professionals. The SSC formed the SAMVAL Working Group comprising interested parties which are broadly representative of the South African mining industry. The SAMVAL Working Group was formed in 2002 with the first SAMVAL draft released in 2006 for industry comments in 2007 (Table 2.1). All comments received from interested and affected parties were considered and the final SAMVAL code was representative of broad industry consensus. Additionally, the committee is further supported by a number of other professional organisations such as the Investment Analysts Society (IAS) and the Council of Banks. The SAMVAL Working Group formed a number of sub-committees to address various issues in the valuation of mineral assets and to investigate trends and movements in the international community whilst maintaining a close relationship with the JSE.

The initial SAMVAL Code was modelled around the existing MAV codes (Table 2.1) in other jurisdictions such as Australasia and Canada, the IVSC GN 14, IASB (2000) discussion document. In the South African context, there were no existing guidelines or historical documentation from which the SSC could “develop” a code. In addition to the technical specialists who formed part of the reporting, a number of financial institutions were also included, such as the IAS and the Institute of Chartered Accountants (SAICA) as well as a broadening of the base of the SAMVAL Working Group by including the members of the SAMREC Working Group.

The SAMREC and SAMVAL codes (2016 Edition) are complete and were ratified by the councils of both the SAIMM and the GSSA and incorporated in the JSE’s Section 12 and Section 8 listings rules. The JSE adopted the SAMREC Code and the SAMVAL Code. All references in this section to the SAMREC Code and the SAMVAL Code will be deemed to include any other relevant code(s), which the JSE has approved.

Figure 2.2: The South African institutional framework for the SAMVAL Code and its relationships



Source: Stephenson et al (2008)

2.3.3. CIMVAL framework

At the beginning of 2004 the TSX Venture Exchange, where most Canadian juniors trade, made the standards mandatory for all those listed on the exchange. These standards include the CIMVAL code, NI 43-101 and the accompanying definitions and guidelines. The Canadian Securities Administrators (CSA) is a forum for the 13 Canadian provincial and territorial securities regulators that coordinate and harmonise regulation of the Canadian capital markets. National Instruments have legal status, an important point for companies listed in the USA and Canada. Stock exchange listing rules require listed companies to comply with both listing rules and National Instruments. While the CSA is primarily responsible for the development of National Instruments, it is up to each of the provincial/territorial securities regulators to adopt (or not to adopt) the Instrument. If adopted, enforcement of the Instrument is the responsibility of the provincial/territorial regulator. All members of CSA have adopted NI 43-101, but no National Instrument has been created for the valuation of mineral assets and the different regulators have adopted the CIMVAL code by reference.

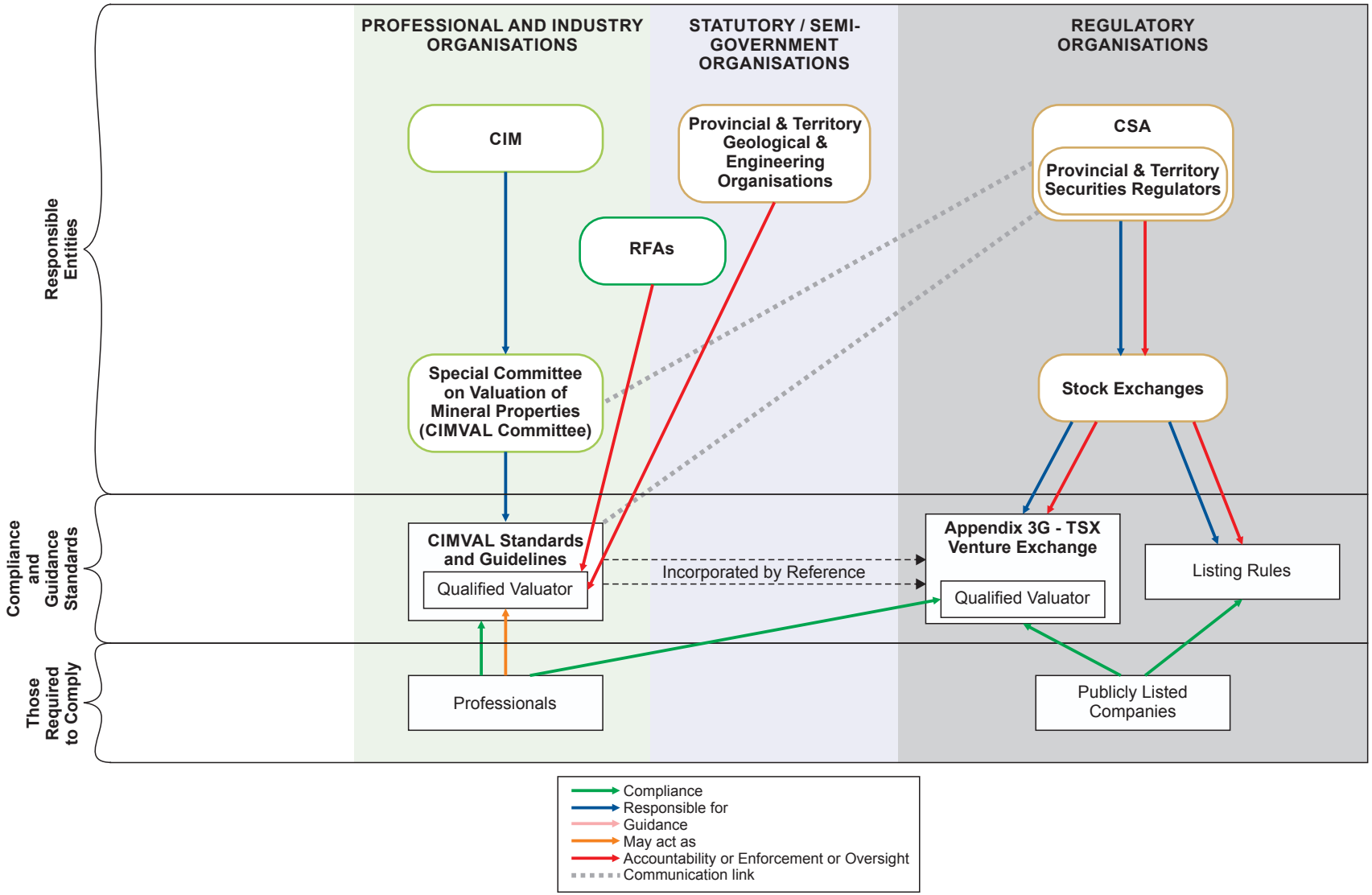
Stock exchanges provide the systems that enable investors and issuers to trade in a fair, transparent and liquid market. The Toronto Stock Exchange (TSX) is Canada's senior equities market and includes the TSX Ventures Exchange, which provides access to capital for companies at the early stages of growth. Stock exchange listing rules require listed companies to comply with both listing rules and National Instruments.

The Canadian Institute of Mining, Metallurgy and Petroleum (CIM) adopted and approved the CIMVAL Standards in February 2003. Later that year, the Toronto Stock Exchange – Venture (TSX-V) incorporated CIMVAL into its regulations.

The TSX-V regulations under Appendix 3G – 'Valuation Standards and Guidelines for Mineral Properties' state that *"the Exchange requires that CIMVAL Standards be used by Issuers and their professional advisors when preparing valuations and valuation reports on mineral properties. The CIMVAL guidelines should be followed by Issuers and their professional advisors in preparing valuation reports on mineral properties".(CIMVAL, 2003, p3).* CIMVAL also specifies a number of requirements and guidelines for a Qualified Valuer, who must belong to one of the provincial/territorial geological, geoscientific or engineering organisations or to a Recognised Foreign Association (RFA) listed in Appendix A of the code.

In 2010, the HKEX promulgated new mining regulations under Chapter 18. The regulations establish criteria for mining company listings and IPOs. The regulations utilise the 'Competent Evaluator' concept; and for mineral asset valuations, CIMVAL is required among its reporting standards.

Figure 2.3: The Canadian institutional framework for the CIMVAL Code and its relationships



Source: Stephenson et al (2008)

The Chairman of the CIMVAL committee, Spence (2012), commented that CIMVAL has developed a strong relationship with the Chinese authorities and regulators in matters relating to valuation of mineral properties in the Chinese jurisdiction. In particular CIMVAL has nurtured relationships with the Chinese Ministry of Lands and Resources (MOLAR) and the Chinese Association of Mineral Resources Appraisers (CAMRA). CAMRA is a quasi self-regulatory organisation (SRO) established by MOLAR to set rules and administer personnel responsible for mineral property valuation and estimation of resources and reserves. CIMVAL provided advice and suggestions which aided the Chinese as they developed their own standards for the valuation of mineral properties. This development is part of current efforts to harmonise valuation codes.

The Canadian authorities' are having deliberations with the Chinese counterparts with regards to the Chinese National Standard for resource-reserve classification and the Chinese valuation codes. This highlights the current efforts to harmonise codes in general amongst the member countries.

2.4. Developments in financial reporting frameworks

The mining industry is one of the most important global industries. The introduction of the IFRS by the accounting fraternity is an effort to harmonise and standardise financial reporting globally. Most countries now require companies to prepare financial statements in accordance with IFRS. Most regulatory bodies in many countries have converged their national standards with IFRS, except the United States that still uses generally accepted accounting principles (GAAP). The move for the major countries to adopt or harmonise with IFRS has advanced the transparency and comparability of financial statements in the world (PWC, 2007). In the developments taking place is the on-going convergence with US GAAP and interest from the Securities and Exchange Commission (SEC) in how US GAAP should be applied to the mining industry in conjunction with the IFRS.

This thesis aims to develop a framework to link the financial reporting of the mining industry and MAV given the challenges that the world faces in the general markets and the extractive industry markets, as discussed also in Njowa *et al* (2014). The various reasons that this research was undertaken, were to understand the current guidelines, rules and best practice being used globally for the financial reporting within the mining industry and how this would link with the mineral asset valuation in the future. The need for this detailed literature review on the current suite of accounting standards used in the mining industry has arisen due to (PWC, 2007, p5):-

- *"the absence of a specific extractive industries standard under the IFRS;*
- *the adoption of the IFRS by entities in the extractive industries across a number of jurisdictions, with an overwhelming acceptance that applying the IFRS in the mining industry will be a continual challenge;*
- *increased globalisation which has led to continued increase in exposure to sophisticated financial instruments and merger and acquisition transactions;*

- *an increased focus on mine closure liabilities, including environmental and restoration liabilities; and*
- *on-going transition projects on accounting standards in a number of other jurisdictions, for which companies can draw on the existing interpretations of the industry*".

In 1988, the IASB commissioned a group of national standards setters to undertake a research project to form the first step towards the development of an acceptable approach to resolving accounting issues that are unique to upstream extractive activities. The primary focus of the research project was on the financial reporting issues associated with mineral reserves and mineral resources. 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.

The main reasons why the IASB undertook a project devoted specifically to the extractive industries, was that for many decades, differences of opinion have existed among accountants, analysts, and other interested persons over the appropriate financial reporting principles for activities of enterprises involved in the extractive industries. This excludes the opinion of the mining professionals, in terms of their interpretation and the purposes of conducting such activities. This would even add another dimension to these areas of divergence. Among accountants and analysts the major areas of divergence are (IASC, 2001):-

- the extent to which the expenditure of finding, acquiring, and developing mineral deposits or resources should be capitalised;
- the methods of depreciating (amortisation) capitalised costs;
- the degree to which quantities and values of mineral resources, rather than costs, should affect recognition, measurement, and disclosure; and
- the definition and measurement of mineral resources and mineral reserves.

These differences of opinion have led to divergences in accounting standards and practices between countries and within individual countries. Even in the few countries in which financial reporting standards have been prescribed for one of these industries, alternative treatments have been allowed and are commonly used. Not only are various accounting methods permitted, but supplemental disclosures in the financial reports also vary widely from country to country (IASC, 2001). The result of these differences is that financial statements of companies that have similar operating and economic characteristics are often not comparable across different jurisdictions (IASC, 2001). In addition, in many countries, there are divergences in accounting standards and practices between enterprises in the petroleum industry and enterprises in mining industries.

Table 2.2 summarises the historical development of the potential accounting and/or valuation standard development from the accounting fraternity. It shows that different boards within the accounting fields have pursued the development of standards or guidelines with very little success. These boards lack the technical knowledge of these extractive industries to be able to develop an acceptable accounting and/or valuation standard for entities involved in the extractive industries. Table 2.2 summarises the efforts of both the IASB and IVSC as these are sister organisations.

Table 2.2: Historical Development of potential Mineral related Standards, Codes and Guidelines with the Accounting Realm

DATE	EVENT
1973	International Accounting standards Committee formed (precursor to IASC and later IASB)
1981	International Assets Valuation Standards Committee (IAVSC) formed (precursor to the IVSC)
Nov-2000	IASC publishes 'Extractive Industries Issues Paper'
Apr-2001	IASC becomes IASB; International Financial reporting Standards (IFRS) complement existing International accounting standards (IAS)
2001	IVSC Extractive Industries (IVSC EI) Expert group formed
Jun-2001	IVSC EI Expert group submit report to IASB rebutting conclusions of IASC's 2000 report
Jun-2001	IASB forms team to study issues raised by IVSC EI Expert group report
Jun-2003	IVSC request IVSC EI Expert group to develop EI best practice technical paper
Jun-2004	IASB published IFRS 6 'Exploration for and evaluation of Minerals Resources'
Jan-2005	IVSC publishers Guidance Note 14 (GN 14) as part of IVS 2005 edition
Jun-2006	Committee for Mineral Reserves International reporting standard (CRIRSCO) published Ist version of International reporting Template for Exploration results ,mineral resources and mineral reserves
Jan-2007	IVSC republishes GN 14 as part of IVS 2007
2007	EI Best practice technical paper completed , dispute with IVSC Standards board
2008	EI Expert group disbanded
Feb-2010	IVSC withdraw GN 14 ; did not meet requirement for IVS 2011
Apr-2010	IASB publishers Extractives Activities Discussion paper
Mar-2011	AIMA adopts extractive Industries export group
2011	IVSC convenes new IVSC Extractive Industries expert Group
Aug-2011	SAIMM initiates effort for simultaneous update of CIMVAL , VALMIN , SAMVAL
Apr-2012	Brisbane conference result in 'Brisbane Accord' ;AusIMM , CIM ,SAIMM , SME ,AIMA ,RICS ,IVSC in attendance
Jul-2012	new IVSC EI Expert Group published discussion paper
Jul-2012	International harmonisation effort named International Mineral Valuation (IMVAL) Committee
Nov-2012	Working group established to produce draft IMVAL code based on GN 14
Dec-2012	IASB abandons extractive activities project , merges effort into Intangible asset project

Source : Abergel (2014)

IVS (June, 2010) indicated that the IVSB did not approve new funding for extractive valuation standards. Instead, the IVSB would collaborate with the extractive industries players in regard to the level of interest in valuation standards for extractive industries. Currently there is no proposed standards and/or valuation methods for extractive industries.

2.4.1. Developments in the IFRS framework

In general the accounting fraternity developed the *Framework for the Preparation and Presentation of Financial Statements* which was issued in 1989 by the IASC and adopted by the IASB in 2001. The framework is concerned with the general purpose financial statements, aimed at providing common information needs of a wide range of users. The framework deals with the following:-

- the objective of financial statements;
- the qualitative characteristics that determine the usefulness of information in the financial statements;
- the definition, recognition and measurement of elements from which financial statements are constructed; and
- concepts of capital and capital maintenance.

There is no consensus within the accounting fraternity, some believing that some accounting practices that have developed in the extractive industries appear to be contrary to the IASC Framework and International Accounting Standards (IASC, 2001). One example is the capitalisation, by some enterprises, of all preproduction costs including those that did not increase an enterprise's mineral reserves during the reporting period.
Some consider that this practice is inconsistent with the IASC Framework's definition of an asset as a resource from which future economic benefits are expected to flow to the enterprise.

Paragraph 39 of the IASC Framework stresses the need for comparability of financial statements. Users must be able to compare the financial statements of an enterprise through time in order to identify trends in its financial position and performance. Users must also be able to compare the financial statements of entities conducting similar mining activities. There is a need for harmonisation of the financial reporting standards and trend towards the adoption of the IFRS.

The mining activities start with the exploration and evaluation of the deposit and provided it meets company expectations the mine can be developed and commercial production can commence as illustrated in Figure 2.4. After commercial production, as an industry norm and required by most of the national authorities the mining entities are required to close and rehabilitate these mining operations. The complexity arises from the fact that appropriate accounting treatment needs to be adopted in line with the phases of the mining life cycle. The current standards that are applicable to the different stages of the mining life cycle are summarised in Figure 2.4.

The main focus of the extractive industries research project was on the financial reporting issues associated with mineral reserves and mineral resources to enable the development of a comprehensive accounting standard for the extractive industries. This aimed to bring consistency to all areas of financial reporting in the extractive industries.

Figure 2.4: The current IASB and IFRS accounting standards and applicability into the extractive industries

	Exploration	**Evaluation**	**Development**	**Production**	**Closure and rehabilitation**
	Discovering resources	Technical and commercial feasibility of resources to making decision to develop and produce	Gaining access to the resources	Achieving access to resources at a commercial level	Resources depleted and mine closed / equipment removed and restoration of ground commences
Specific Accounting Standard	IFRS 6	IFRS 6	No specific standard has been developed (This is subject to the Extractive Industry Project by the IASB or IVSC		Legal or constructive obligations
Other Applicable Accounting Standard or Interpretation	-	-	IAS 16 - Property plant equipment IAS 23 - Borrowing costs	IFRIC 20 - Stripping costs IAS 2 - Inventories IAS 16 - Property plant equipment IFRS 11 - Joint arrangements IFRS 3 - Business combinations	IAS 37 - Provisions, Contingent Assets and Contingent Liabilities
Typical Financing Sources	Equity IAS 32 - Venture Capital Existing company cash flows				Ring fenced investments Requirements from applicable laws
			IAS 32 - Debt (different type of debt) Hedge security IFRIC 4 - Off-take agreements		
Standard applicable to all the stages of the life cycle of a mining operation	IAS 36 - Impairment of Assets				
	IAS 38 - Intangible Assets				

by Godknows Njowa, 2017

During the preparation for the migration from the GAAP to IFRS, the IASB recognised that for the successful implementation of the IFRS in the extractive industries, there was a need for an interim standard. The interim standard would be within the IASB framework for the presentation of financial statements ('the IASB Framework"). IFRS 6 was first issued in December 2004 and applies to financial reports issued from 1 January 2006 as an interim standard to provide specific guidance on the accounting treatment of exploration and evaluation expenditure spent by an entity, before technical feasibility and commercial viability has been established. Accounting for these expenditures can have a fundamental impact on the financial statements of a mining entity, particularly for junior exploration and mining companies with no producing mineral assets, hence the recognition by the ISAB that IFRS should include specific guidance in the treatment of such costs.

The IASB framework defines an asset as "*a resource controlled by an entity as a result of past events and from which future economic benefits are expected to flow to the entity*," (PWC, 2007, p 12). According to the framework an asset should be recognised when (PWC, 2007):-

- there is a reasonable likelihood that future economic benefit will flow to the entity either through commercial exploitation of a mineral deposit or sale of exploration or mining rights;
- the asset has a cost or value that can be measured reliably using the actual expenditure incurred; and
- the entity should have a legal right to explore the specified area and exploit any mineral deposits within the area.

To determine how the exploration and evaluation expenditure would be treated under the IASB framework, an entity has to determine the unit for cost allocation. It is common practice in the mining industry to allocate cost between areas of interest based on the geological areas. Any expenditure incurred before any legal rights to explore the area of interest would normally be expensed. According to the IFRS definition of exploration and evaluation, capital expenditure only applies after the entity has obtained the legal rights to explore the area (PWC, 2007). Exploration expenditure is often spent on the hope or anticipation that that there will be economic benefits, even though success rates tend to be low.

In a mining extraction project, a Final Feasibility Study is often needed before the entity can demonstrate that future economic benefits are probable. In the strict application of the ISAB framework, all costs incurred in the preparation of the Final Feasibility Study and the preceding studies need to be expensed. In some situations, where the feasibility study is not required to demonstrate economic feasibility, the entity will capitalise all these costs. Under IFRS 6, a mining entity has to determine an accounting policy specifying expenditures on how exploration and evaluation activities will be capitalised (PWC, 2007). In addition, this standard does not provide guidance on the treatment of general and administration overheads that are directly attributable to exploration and evaluation activities. The standard just mentions that the mining entities need to determine a policy on the treatment of such costs.

It should be noted that there is no specific accounting or reporting standard that has been developed to cover the rest of the phases of a mine's operations ranging from development, production and closure and rehabilitation, except International Financial Reporting Standard Interpretations Committee (IFRIC) 20 titled the '*Stripping costs in the production phase of a surface mine'*. IFRIC 20 sets out authoritative guidance on accounting for costs incurred by mining companies in removing waste materials to gain access to mineral ore deposits ("stripping costs"). Costs incurred to remove overburden during the development phase are outside the scope of the Interpretation. Grant Thornton (2011, p1) further commented that "*in the absence of a comprehensive IFRS on accounting in the extractive industries sector, various inconsistent accounting practices have emerged. IFRIC 20 should lead to greater consistency on one important but quite specific issue. We have no objection to IFRIC 20, but also we think that issuing guidance on narrow issues such as this does not respond adequately to the need for a broader review of accounting practices in the extractive sector*". This further supports the notion that a comprehensive accounting standard for the extractive industry would have been more appropriate.

The cut-off between evaluation and development is determined once the technical feasibility and commercial viability of extracting the mineral deposit has been established and a decision to develop the project has been given by the board of directors. Various organisations such as the IVSC, IASB and IFRS have been working on different projects to try to establish an accounting standard and/or valuation standard for the extractive industries, with little or no success in resolving the complex issues. In this thesis the various research efforts conducted by these organisations are discussed in detail in the appropriate sections.

The IFRIC 20 implemented in January 2013, was the first interpretation specific to production surface mines. Previously there was no IFRS that specifically addressed deferred stripping activities by mining companies or development (Njowa *et al*, 2015). Therefore an entity conducting surface mining operations would develop a company specific accounting policy for the treatment of these costs for disclosure in the financial statements under the IFRS (Njowa *et al*, 2015). This practice led to a global diversity of practice in the treatment of these costs. The main challenge in accounting for stripping costs in the production phase is that the costs incurred may benefit both current and future periods. This interpretation seeks to normalise or spread the cost of stripping activities over the amount of ore exposed from these stripping activities. This made comparability of financial statements of mining companies involved in surface operations difficult due to the diverse accounting policies developed and applied by different mining companies to suit their specific requirements and financial objectives.

In conclusion, financial accounting in the extractive industries is still in its infancy and generally financial reporting is highly regulated. The main reason for this is to maintain the integrity of the financial markets since this information is released into the market. Companies must comply with the accounting standards in terms of how to record the transactions and make calculations, how figures are reported and in what order those reports must be constructed.

For example, the Financial Accounting Standards Board, or FASB, under the influence of the Securities and Exchange Commission, or SEC, establishes financial accounting rules in the United States. The sum of these rules is referred to as generally accepted accounting principles (GAAP) or U.S. GAAP.

2.4.2. IVS framework

The IVSC develops and maintains international standards on how to undertake and report general valuations in different sectors and markets, especially those that will be relied upon by investors, creditors, auditors and other third party stakeholders. It supports their adoption and use. IVSC also supports the need to develop a framework of guidance on best practice for valuations of the various classes of assets and liabilities and for the consistent delivery of the standards by properly trained professionals around the globe, placing paramount importance on protecting the public interest.

"*The IVS framework includes all the generally accepted valuation concepts, principles and definitions upon which the International Valuation Standards are based. The framework should be considered and applied when following the individual standards and valuation applications*" (IVSC, 2013b, p1).

The generally accepted valuation concepts, principles and definitions which forms part of the IVS framework includes:-

- valuation and judgement;
- independence and objectivity;
- competence;
- price, cost and value;
- the market;
- market activity;
- market participants;
- basis of value;
- entity specific factors;
- market value;
- fair value;
- investment value;
- transaction costs;
- special value;
- synergistic value;
- assumptions;
- forced sale;
- valuation approaches;
- market approach;
- income approach;

- cost approach; and
- valuation inputs.

The IVS framework is designed to apply to a wide spectrum of valuation assignments, in different sectors and markets and for different classes of assets and liabilities. The underlying fundamental assumptions is that a valuation must be appropriate for its intended purpose and it is important that the recipient also understands what is to be provided and any limitations on the use of the valuation, (IVSC, 2011). These concepts and principles were discussed in relevant sections in this thesis.

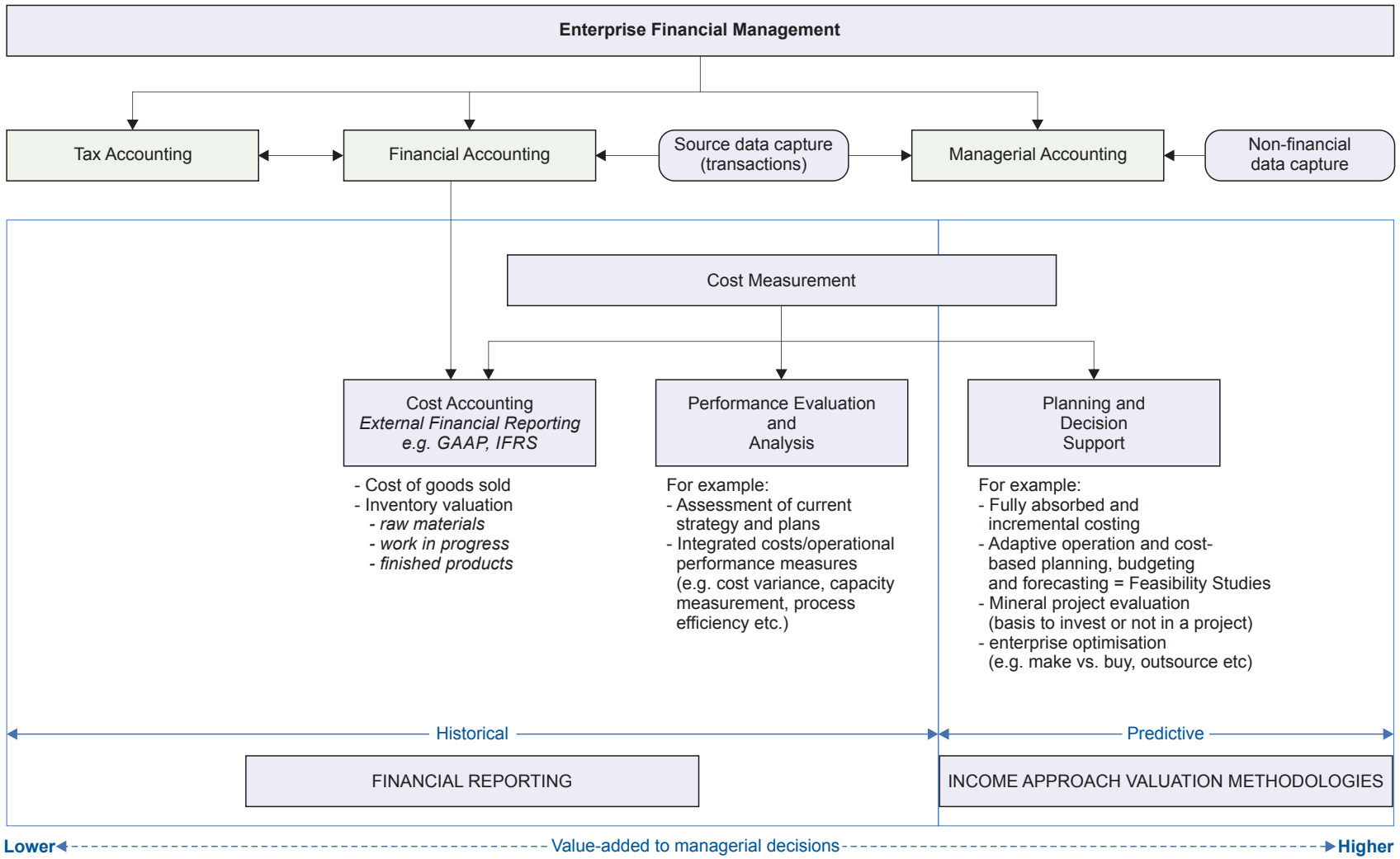
2.4.3. Perceived developments in financial reporting

Figure 2.5 illustrates the relationship between tax accounting, financial accounting and managerial accounting conducted when preparing enterprise financial management. It should be noted that both tax accounting and financial accounting focus only on historical transactions and how the enterprise has performed in the past, whereas managerial accounting is to some extent informed by what happened in the past as some kind of basis to predict and budget for what is expected in the future. This information is considered more valuable to the decision making process and this also forms the basis of any valuation of that enterprise.

Financial accounting is mainly focused on collection and recording of information on the transactions that have occurred in a financial year as the basis for the preparation of financial statements. This branch of accounting has some internal uses, but it is much more concerned with financial reporting of the results and informing those outside of the company. The financial statements produced through financial accounting are designed to disclose business performance and financial health. In other words, financial accounting is created for a company's investors, creditors and regulators, whereas managerial accounting is created for a company's management as an aid for planning and decision making. The DCF analysis is an extension of the managerial accounting mainly used in the minerals industry to best predict the profitability of a mining operation in the future either for mineral project evaluation or for mineral asset valuation. Both these concepts will be discussed in detail in later sections. Lattanzi (2002, p 3) described the DCF as "*a forward-looking methodology which requires that forecasts be made with respect to technical and economic conditions which will prevail in the future*". All predictions of the future are inherently uncertain, but the level of uncertainty will be materially reduced if adequate data are available from which to project future rates of production and future costs. The more comprehensive the available data, the more reliable the discounted cash flow evaluation will be.

The information created through financial accounting is entirely historical and the resulting financial statements contain data for a defined period of time. Managerial accounting looks at past performance as the basis for the creation of forward looking business forecasts of what the entity will likely do.

Figure 2.5: The relationship between tax accounting, financial accounting and managerial accounting



Source: Professional Accountants in Business Committee (2009)

For many years, investors and creditors have often used the financial statements to create their own forward looking business forecasts of how the entity will perform in the future as the basis of the company valuation. These valuations underpin their investment decision and are premised on their understanding of the business, what they anticipate the company will do and the general market outlook as their own major assumptions. In this way, financial accounting is not entirely backwards-looking. Nevertheless, under the current IFRS no future forecasting is allowed in the financial statements.

2.5. Chapter summary

This chapter has revealed that a variety of frameworks and methodologies aimed at ascertaining the estimated monetary value of the mineral assets have been developed since the start of the 20th century within the broader extractive industries. These developments were championed by different organisations, securities exchanges, governments and mining institutes around the globe. These include Australia, Canada and South Africa. Mainly in countries where mineral resources are significant to the GDP, specific accounting standards and mineral resources valuation guidelines have been developed for certain of the accounting and valuation issues unique to the sector as discussed in this chapter. These organisations developed framework solutions to suit their own specific circumstances and requirements within the jurisdiction in which they operate.

In the financial reporting space the reporting frameworks were created for the general enterprise and not specific to the extractive industries. However, there were policies created to resolve specific issues regarding accounting for specific transactions that are peculiar only to the extractive industries, and the application of the current accounting standards to the extractive industries were explored in this chapter.

Various organisations such as the IVSC, IASB and IFRS have been working on different projects to try to establish an accounting standard and/or valuation standard for the extractive industries, with little or no consensus in resolving the complex issues. In conclusion, it was established that there is currently no specific accounting standard to provide guidance on the financial reporting for companies in the extractive industries, except the IFRS 6 and the IFRIC 20. Efforts conducted by these organisations were discussed in detail in this chapter and support the fact that currently there in no established framework that links financial reporting and MAV. This is the reason why Chapter 3 discusses harmonisation of MAV codes while, Chapter 4 discusses financial reporting standards in the mineral industry.

3. COMPARISON OF MAJOR MAV CODES AND DEVELOPMENTS TOWARD HARMONISATION

3.1. Chapter overview

This chapter discusses the fact that the standardisation of minerals reporting codes by CRIRSCO created a solid framework or base to define mineral resources and mineral reserves. Once mineral resources are defined through this framework, it should become easier for the next step of valuation of such resources and reserves. A detailed comparison of the major national MAV codes will be discussed and compared for similarities and differences in approaches, to establish how the harmonisation framework can be structured. The precursors to the development of a global MAV template are also discussed in detail. Lastly, it is noted that developed harmonisation framework was published in Njowa *et al* (2014).

3.2. Introduction

Companies involved in the minerals industry have been exposed to operating in more than one jurisdiction for over a century, although this practice has been amplified in recent decades by globalisation. Globalisation is a system that has become a dominant feature and has been analysed by several authors such as Thomas L. Friedman who in 1999 published the book, '*The Lexus and the Olive Tree'*, to explore this concept. Globalisation of trade and financial services has enhanced the exposure of companies involved in the minerals industry by accelerating their involvement across diverse geographical locations such that they now often operate, have shareholders or occasionally engage consultants, in more than one country. This development required that the way information on mineral assets is reported in the public domain or as industry best practice, be standardised in order to provide a common understanding, irrespective of geographical location or regulatory jurisdiction. Globalised standards facilitate common understanding and interpretation of information. The information reported on mineral assets can generally be classified into three broad categories namely reports on mineral resources, technical assessments and valuations. Globally, there are currently many Competent Persons for resource and reserve reporting and technical professionals for technical assessment reporting but, very few Competent Valuers for valuation of these mineral assets because mineral asset valuation is a relatively emerging discipline.

The use of the CRIRSCO international template ensures common understanding, interpretation and classification of the resources. The CRIRSCO template provides guidelines and common definitions as agreed in the Denver Accord for the classification of exploration results, mineral resources and mineral reserves, as they form the basis of property that would be valued. Common to these definitions is the reduction of variations at a high level. This thesis therefore, assumes harmonisation to imply reducing the degree of variation in the international valuation practices at a high level, in terms of how mineral assets are defined, valued and reported in the public domain or as industry best practice.

In the last few decades, the international financial markets have witnessed some scandals connected with lack of accountability, incompetency, bias and misleading reports on mineral resources and mineral reserves and the related mineral asset valuations. This scandalous behaviour was exacerbated through a lack of uniform standards and requirements determining both the principles of public reporting of mineral resources, valuation processes, competence and responsibilities of Competent Persons and mineral asset valuations. The direct results of the fraudulent/misleading activities resulted in drastic falls in stock prices and bankruptcies of the respective mining companies, for example the Enron and the Bre-X scandals.

In order to avoid such scandals in the future, major mining countries embarked on the development of guidelines, standards and codes (policy documents) to be used in conducting and reporting of exploration results, mineral resources and mineral reserves in the minerals industry. The primary intention of these documents was to control the quality and reliability of the information being disseminated to the public. These assignments are conducted by qualified or Competent Persons who are accountable to ensure that they were appropriately accurate, reliable and comprehensive.

In recent years, the world has developed into a global village with increasing accessibility and mobility in terms of capital markets, trade and financial services. Such developments are driving the need for development and implementation of uniform reporting and investment appraisal standards. These would be in the form of international accepted global standards and framework for public reporting, and would include, but not limited to the following:-

- Accounting and financial reporting standards i.e. International Financial Reporting Standards (IFRS);
- Mineral resources and mineral reserves reporting guidelines i.e. CRIRSCO; and
- Valuation standards including a global mineral asset valuation guideline, with the potential for the development of a global uniform valuation standard or guideline for the extractive industries.

An attempt by the IVSC and IASB to develop a global accounting standard for the extractive industry attests to the desirability to develop internationally recognised valuation guidelines or a global framework for the valuation of mineral assets. On the international arena, the accounting fraternity seems to be ahead of everyone else in the attempt for the development of an international accounting and reporting standard to be included or adopted in the IFRS. However, the various attempts have not been successful. This chapter therefore discusses national MAV codes by looking at how the VALMIN, CIMVAL and SAMVAL codes can be harmonised at a high level.

3.3. Why harmonise national MAV codes?

Several arguments support the harmonisation of the national MAV codes. Firstly, there is currently no single, internationally recognised template for the valuation of mineral assets. In addition there have been scandals in recent decades, such as the Bre-X scandal of 1997, which have revealed a lack of accountability, incompetency and misleading reports on mineral resources and mineral reserves reported on international financial markets. These scandals may be attributed to a lack of uniform standards and requirements for the public reporting of mineral resources, valuation processes, competence and responsibilities of Competent Persons and Competent Valuers.

Some leading mineral-rich countries, mining and metallurgical institutes and their respective stock exchanges therefore developed guidelines, standards and codes to guide the reporting of exploration results, mineral resources and mineral reserves. Currently, two prominent global standards for public reporting that are closely related to MAV are:-

- International Financial Reporting Standards (IFRS) for accounting and financial reporting standards; and
- CRIRSCO template for reporting exploration results, mineral resources and mineral reserves.

Firstly, an international valuation template will complement these standards and form a foundation from which the accounting fraternity may develop a future global accounting standard for financial reporting of mineral assets. This would help to resolve the existing argument that mineral assets appear together with other assets on the balance sheets of mineral corporations.

Secondly, existing valuation codes assign responsibility to the valuer to select the valuation approach and methodologies to value a mineral asset. The inconsistencies arise because the valuation codes provide guidelines on the valuation methodology only to ensure consistency, not what the actual input values should be. The Competent Valuer must ensure the value estimate is reasonable and transparent, but not that they are the same as other estimates by other valuers. Inconsistencies in the value estimate occur because it requires assessment and choice by individual valuers, and so it is important to have a common international template that assists in limiting such variations.

Thirdly, access to capital requires the preparation of reports for investors based on the principles of transparent and material disclosure of reliable information. Since the Global Financial Crisis of 2007-2008, access to capital for the inherently high-risk extractive industry has been difficult to obtain. A global valuation template would enable consistency in valuation and reporting of mineral assets and so increases levels of confidence to improve capital flow to the minerals industry.

Lastly, the need to harmonise valuation codes is supported by two further points which are:-

- The Hong Kong Exchange and Clearing Ltd, which is one of the leading global exchanges in the minerals sector, publicly commented on the difficulties caused by the absence of a single, well-recognised international MAV template; and
- Ellis (2009) indicated that ±150 countries needed standards for local guidance on the valuation of mineral assets and the reporting of such results.

3.3.1. High-level comparison of major national MAV codes

At national level, almost all the major mineral producing countries had specific parallel standard development initiatives. Initially, it was the development of standards and guidelines for the reporting of exploration results, mineral resources and mineral reserves, driven by their respective mining and metallurgical institutions. The mining institutions realised the need for an additional valuation component to be added to the standards and guidelines. This has led to the promulgation of several mineral asset valuation codes across the globe.

These international and national developments and initiatives shape the current framework for mineral asset valuation and common international valuation reporting standards in these major mining countries. This section discusses the results from the review of technical papers available online and details salient features in MAV between the countries (Canada, Australia and South Africa). The USA stock exchange and the SEC do have regulations and guidelines for mineral asset valuation, but they are inconsistent to the MAV discussed in the thesis, due to the lack of a specific MAV code. The valuation of mineral properties in the USA is excluded from further discussion here because the SEC valuation principles do not currently conform to those outlined in other MAV codes as described here.

The codes for the reporting on mineral asset valuation have been developed and are generally country specific, such as the Canadian CIMVAL Code, the Australasian VALMIN Code and the South African SAMVAL Code. The proliferations in codes have resulted in a set of codes that are virtually irreconcilable, and which differ widely in terms of scope, definitions, approaches, jurisdictions, etc. The lack of a single well recognised International Code caused the Hong Kong Exchanges and Clearing Ltd to contact the CIMVAL for assistance in the development of new listing rules for mineral and exploration companies seeking listing in Hong Kong.

In order to identify areas where IMVAL can harmonise the major national valuation codes to create a globally acceptable valuation template, it is important to compare and contrast the existing codes in the areas of scope, definitions, principles, valuation approaches and methodologies. The codes being evaluated are the CIMVAL, VALMIN and SAMVAL codes and other relevant documents that are directly related to the subject matter.

3.3.2. Scope

The scope of each of the three codes (VALMIN, CIMVAL and SAMVAL) covers the valuation of both metallic and non-metallic 'solid mineral' assets (Table 3.1). However, the VALMIN Code differs from the other two codes by including the valuation of petroleum assets such as producing oil and gas fields. Petroleum is any naturally occurring hydrocarbon, whether in a gaseous or liquid state. Assets valued under the CIMVAL Code include oil shale and oil sand (tar), uranium, coal and energy fuels as long as these commodities can be mined, but excludes oil and gas. Harmonisation will therefore require agreement on scope, inclusions and exclusions. There is consensus that the IMVAL template should initially exclude the valuation of oil and gas assets because IMVAL does not currently possess the requisite oil and gas competencies. Central to this argument is that by comparison to the oil and gas industries, solid mineral deposits inherently require greater definition for meaningful evaluation and sophisticated geological modelling is generally more difficult to apply. On the contrary, oil and gas resource estimation uses very sophisticated reservoir modelling techniques on very few production wells or boreholes leaving 'oil shale and oil sand' as the likely cross-over point for convergence between 'solid minerals' and 'oil and gas'. The differences in resource estimation procedures place a restriction on downstream valuation techniques that can be applied. It is contended here that the IMVAL template should initially exclude the valuation of securities and mining corporations with multiple assets as such valuations are commonly understood to fall under the jurisdiction of other professional associations that have their own regulations and codes guiding the valuation of those specific assets.

The inclusion or exclusion of technical assessments in the scopes of the codes can be resolved by understanding the difference in the outputs between MAV and technical assessment reports. The definitions included in the VALMIN 2005 edition provide a clear distinction between these terms to a general reader, whereas the VALMIN 2015 edition is a summarised version suitable for an educated reader with prior knowledge of the issues. VALMIN (2005, p 22) defined Technical Assessments (definition number 34 (D34)) as, "*appraisals prepared by an Expert or Specialist, of the technical aspects of a Mineral or Petroleum Asset. They may involve the review of such matters as geology, resources, reserves, mining methods, metallurgical processes and recoveries, petroleum engineering, provision of infrastructure and environmental aspects.*"

Table 3.1: Comparative summary for scope covered in the three codes (Source: VALMIN, 2015; CIMVAL, 2003 and SAMVAL, 2016)

SECTION	SUB-SECTION	CIMVAL Code	SAMVAL Code	VALMIN Code	KEY ISSUES OR COMMENTS
Scope	Inclusions and exclusions	Includes valuation of both metallic and non-metallic mineral assets, such as bedrock, alluvium, placers, industrial minerals, dimension stone, aggregates and energy fuels that can be mined to include coal, uranium, oil sands and oil shale. Includes solution mining, but *excludes oil and gas properties*. Excludes valuation of corporations that hold the mineral properties.	Includes valuation of all 'solid mineral' assets but, *excludes oil, gas and water*. The code is silent on the valuation of securities or mining corporations.	Includes valuation of all minerals, and *oil and gas assets*. The 2005 Edition reads as though one can value securities and companies yet this is not the case, as there are significant additional regulatory guidelines, corporate law, licences, and experience and membership requirements to value securities.	A critical issue on inclusions and exclusions is whether the IMVAL template will include both solid minerals, and *oil and gas assets*. Consideration should also be given on whether the IMVAL template will include the valuation of securities and mineral corporations.
	Purpose	The purpose is for the code to provide standards and guidelines for valuation of mineral properties to be used by the mining industry in general and to be adopted by Canadian securities regulators and stock exchanges.	The purpose is for the code to be the minimum standard for the public reporting of mineral asset valuations.	The purpose is to provide a set of fundamental principles and supporting recommendations regarding good professional practice to assist those involved in the preparation of Independent Expert Reports that are public and required for the assessment and/or valuation of Mineral and Petroleum Assets and securities. The VALMIN Code has a dual role since it also gives guidelines for technical assessments.	The three codes share a common purpose of mineral asset valuation. A critical issue is whether harmonisation will include technical assessments, since the VALMIN Code includes technical assessments, whereas the other codes do not.
	Standard of Value	"Value" primarily refers to Fair Market Value. If some other type of value is utilised, a clear definition must be provided by the Qualified Valuer. Fair Market Value means the highest price, expressed in monetary terms, obtainable in an open and unrestricted market between knowledgeable, informed and prudent parties, acting at arm's length, with neither party being compelled to transact (Income Tax Act of Canada).	Although there is no specified definition of value, the code refers to it as, "value relates to future expectations and is the present value of all future benefits expected to be received".	Value is the Market Value of a Mineral or Petroleum Asset or Security. It is the amount of money (or the cash equivalent of some other consideration) determined by the Expert in accordance with the provisions of the VALMIN Code for which the Mineral or Petroleum Asset or Security should change hands on the Valuation Date in an open and unrestricted market between a willing buyer and a willing seller in an "arm's length" transaction, with each party acting knowledgeably, prudently and without compulsion.	The CIMVAL and VALMIN codes share a common standard of value at a high level. However, the current deliberations in South Africa have concluded that Fair Market Value does not exist; hence it should be either Market Value or Fair Value. VALMIN 2015 have since settled for Market Value
	Mineral Asset	Means any right, title or interest to property held or acquired in connection with the exploration, development, extraction or processing of minerals which may be located on or under the surface of such property, together with all fixed plant,	Means any right to explore or mine (or both) that has been granted or entity holding such property or the securities of such an entity including but not limited to all corporeal and	Means all property including but not limited to real property, intellectual property, mining and exploration tenements held or acquired in connection with the exploration of, the	The definitions of a Mineral Asset among the three codes are not materially different with each jurisdiction emphasising on

		equipment, and infrastructure owned or acquired for the exploration, development, extraction and processing of minerals in connection with such properties. Such properties shall include, but not be limited to, real property, unpatented mining claims, prospecting permits, prospecting licenses, reconnaissance permits, reconnaissance licenses, exploration permits, exploration licenses, development permits, development licenses, mining licenses, mining leases, leasehold patents, and crown grants, licenses of occupation, patented mining claims, and royalty interests.	incorporeal property, mineral rights, mining titles, mining leases, intellectual property, personal property (including plant equipment and infrastructure), mining and exploration tenure and titles or any other right held or acquired in connection with the finding and removing of minerals located in, on or near the earth's crust. Mineral Assets can be classified as Dormant Properties, Exploration Properties, Development Properties, Production Properties or Defunct Properties.	development of and the production from those tenements together with all plant, equipment and infrastructure owned or acquired for the development, extraction and processing of minerals in connection with those tenements. Most Mineral Assets can be classified as either exploration areas, advanced exploration areas, pre-development projects, developments projects or operating mines.	different aspects of the same asset.

VALMIN (2005, p 22) further defined what is expected to be included in the Technical Assessment Reports (D35) as, *"the technical assessment of those elements such as mining, petroleum engineering, metallurgy, environmental impacts, capital and operating costs and actual and/or projected production that may contribute to the actual and/or potential economic output from Mineral or Petroleum Assets as may be required to assess the economic benefit of those assets and then to determine their Technical Value"*. The Technical Value (D36) was then defined as, "*an assessment of a Mineral or Petroleum Asset's future net economic benefit at the valuation date under a set of assumptions deemed most appropriate by an Expert or Specialist, excluding any premium or discount to account for such factors as market or strategic considerations*" VALMIN (2005, p 23). Based on the foregoing definitions, it is suggested that technical assessments should be excluded from the initial IMVAL template in order to avoid unnecessary overlaps with MAV, notwithstanding that these technical assessments, if available, will be an important input in the MAV process to determine a value for a mineral property.

3.3.3. Comparison of the 'Standard of Value'

The '*standard of value*' adopted in the VALMIN and CIMVAL codes is the "Fair Market Value" (Table 3.1). According to the VALMIN Code (2015, p 28), the Market Value of a mineral asset is "*the estimated amount (or the cash equivalent of some other consideration) for which the Mineral Asset should exchange on the date of valuation date, between a willing buyer and a willing seller in an arm's length transaction, after appropriate marketing where the parties had acted knowledgeably, prudently and without compulsion*". Note that this is referred to as "Fair Market Value" in the VALMIN Code (2005) edition. In addition, the VALMIN (2015, p 28) introduced the term 'Technical Value' which is defined as "*an assessment of a Mineral Asset's future net economic benefit at the valuation date under a set of assumptions deemed most appropriate by a practitioner, excluding any premium or discount to account for market considerations*". However, the CIMVAL Code acknowledges that other types of value may be required depending on the purpose of the valuation and prevailing circumstances. As a principle-based standard, the code requires the Qualified or Competent Valuer to define the value that is being estimated in a particular circumstance. The SAMVAL Code does not define the standard of value and leaves the Competent Valuer with the responsibility to define what the value that will be estimated on a case-by-case basis.

The SAMVAL Working Group converged on the standard of value as "Fair Market Value, Fair Value or Market Value". Gordon (1952, p152) defined *'fair market value' "as the price at which a sale would take place between a willing seller and a willing buyer, neither being under compulsion to trade and both having reasonable knowledge of the material facts".* According to Jones (2013), fair market value in respect of a mineral asset is defined as the amount of money (or cash equivalent of some other consideration) determined by a relevant expert for which the mineral asset should change hands on the relevant date in an open and unrestricted market between a willing buyer and a willing seller in an arm's length transaction, with each part acting, knowledgeably, prudently and without compulsion.

The current definition of Market Value in the VALMIN (2015), is exactly the same as the definition of "Fair Market Value" in the VALMIN (2005) edition. The fair market value usually comprised of two components, the underlying technical value of the mineral asset, and a premium or discount related to market, strategy or other considerations. The technical value is defined as, an assessment of a mineral asset's future net economic benefit at the valuation date under a set of assumptions deemed most appropriate by a relevant expert or specialist, excluding any premiums or discount to account for such factors as market or strategic considerations. Jones (2013) also noted that, while never stated as part of the definition, it has always been recognised that the sale must be at arm's length in a free market. This definition and general understanding of the term has been adopted in the CIMVAL and VALMIN codes. In the United States, USPAP and Uniform Appraisal Standards for Federal Land Acquisitions specify Market Value as the default valuation basis.

Market value is defined in the International Valuation Standards (IVS) 2013 as, "*the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion*" (IVSC, 2013a, p5). The definition given here is not applicable to financial reporting within the IVS framework and its application to all types of property encompasses both assets and liabilities. The guidance to IVS 300 also shows that Fair Value, as defined in IFRS and the US GAAP, is for most practical purposes the same as the IVS Market Value. However, due to the broader meaning of 'fair value,' variances occur which could lead to investor confusion.

Ryan (2008, p4) defined Fair Value accounting as, *"a financial reporting approach in which companies are required or permitted to measure and report on an on-going basis certain assets and liabilities (generally financial instruments) at estimates of the prices they would receive if they were to sell the assets or would pay if they were to be relieved of the liabilities"*. In addition, Ryan (2008, p5) quoted the Financial Accounting Standard No. 157 (FAS 157) on Fair Value Measurements, which defined fair value as, "*the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date"*. In this definition, reference to "arm's length transaction" and "willing parties" was ignored. The same definition of fair value was adopted in IFRS 13 reflecting an ideal "exit value" whereby firms' exit the positions they currently hold through orderly transactions with market participants at the measurement date, not through forced sales. The definition of fair value implies that it is directly linked to observable facts. In the USA, the SEC delegated the power to determine the accounting and auditing standards to the Financial Accounting Standards Board (FASB) which has developed expertise on current value of financial instruments. Hence, the definition of fair value based on the notion of 'exit price', which is generally applicable to financial instruments, is not applicable to mineral assets.

From the preceding discussions it is apparent that there are negligible differences between fair market value and market value to conclude that the harmonisation process adopts either Fair Market Value or Market Value as the standard of value as recently alluded to in the VALMIN (2015) edition. This further confirms that there is minimal difference between Fair Market Value and Market Value as it is applied in the extractive industry based on the current global interpretation and industry best practice. However, there is a significant difference to be noted that the definition of fair value as advocated by FAS 157 and IFRS 13 could potentially lead to misunderstanding of the premise of the value reported in financial reporting and to that reported in MAV. Even in circumstances where the principle definition is the same with the accounting profession and the best practice in the extractive industries, the principles and interpretation are divergent. This further supports the research on linking the MAV to financial reporting in the minerals industry.

On the other hand the US Federal Government has defined the market value as (Ellis, 2006, p112) "*the most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably and the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and passing of title from the seller to the buyer under conditions whereby:-*

- *buyer and seller are typically motivated;*
- *both parties are well informed or well advised, and acting in what they consider their best interest;*
- *a reasonable time is allowed for exposure in the open market;*
- *payment is made in terms of cash in United States Dollars (USD) or in terms of financial arrangements comparable thereto; and*
- *the price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale*.".

The Uniform Appraisal Standards for Federal Land Acquisition (UASFLA) requires that appraisals abide by USPAP as a minimum set of standards, in which the US Supreme Court defines "fair market value" "*as the amount of in cash or on terms reasonably equivalent to cash, for which in all probability the property would be sold by a knowledgeable owner willing but not obligated to sell to a knowledgeable purchaser who desired but is not obligated to buy. In ascertaining that figure, consideration should be given to all matters that might be brought forward and reasonably be given substantial weight in bargaining by persons of ordinary prudence, but no consideration whatever should be given to matters not affecting market value"* (Ellis, 2001, p26). It can be seen that the US courts have ruled that the definitions of fair market value and market value could be different but these two are closely related.

From the preceding definitions it can be seen that the market value and fair market value have similar meaning internationally (Ellis, 2001). Given the negligible differences between fair market value and market value the harmonisation process may adopt either Fair Market Value or Market Value as the standard of value.

However, caution should be noted that the definition of fair value as advocated by FAS 157 and IFRS 13 could potentially lead to misunderstanding of the premise of the value reported in financial reporting and to that reported in MAV. It should be further noted that the term fair market value may have its origins in the accounting term fair value. A “fair value” estimate may not meet the market value requirements for adequate time for exposure in an open market for an orderly disposal, without any compulsion (Ellis, 2001).

3.3.4. Fundamental valuation principles or tenets

The common principles or tenets governing the application of the three national valuation codes are transparency, materiality and competence. In addition to the three common principles, the CIMVAL Code added two more principles namely, independence and reasonableness, whereas the VALMIN Code only added independence, while the SAMVAL Code referred the additional principles to regulatory bodies. Table 3.2 is a high-level summary of how overarching principles and values from various codes and regulatory bodies are considered across various jurisdictions in order to illustrate the extent of their adoption.

Table 3.2: Summary of values or principles from various codes and regulatory bodies

SELECTED PRINCIPLES	SAMVAL	CIMVAL	VALMIN	IVSC	ASVCF	ECSA	SACNASP	JSE
Materiality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Transparency	Yes	Yes	Yes	No	No	No	No	No
Competence	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Independence	No	Yes	Yes	No	No	No	No	Yes
Reasonableness or Faithful Representation	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Neutrality	No	No	No	No	Yes	No	No	No
Dignity of the Profession	No	No	No	Yes	No	Yes	Yes	yes
Prudence	No	No	No	No	Yes	No	No	Yes
Confidentiality	No	No	No	Yes	No	No	No	Yes
Integrity and/or Objectivity	No	No	No	Yes	Yes	Yes	Yes	Yes

Note: SAMVAL – South African Mineral Asset Valuation Code (2009, 2016); **CIMVAL** – Canadian Standards and Guidelines for Valuation of Mineral Properties (2003); **VALMIN** – Australasian Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities for Independent Expert Reports (2015); **IVSC** – International Valuation Standards Council – Code of Ethical Principles for Professional Valuers (2011) and International Valuation Standards (2013); **ASVCF** – Australian Standard for Valuing Commercial Forests; **ECSA** – Engineering Council of South Africa – Code of Conduct; **SACNASP** – South African Council for Natural Scientific Professions – Code of Conduct; **JSE** – Johannesburg Securities Exchange – Code of Ethics.

Table 3.3: Comparison of principles among the national mineral asset valuation codes (Source: VALMIN, 2015; CIMVAL, 2003; SAMVAL, 2008 and 2016; CRIRSCO International Template, 2013)

SECTION	SUB-SECTION	CIMVAL Code	SAMVAL Code	VALMIN Code	CRIRSCO DEFINITIONS OR ISSUES CRITICAL TO IMVAL TEMPLATE
Principles	Materiality	*Materiality or Material* refers to data or information which contributes to the determination of the Mineral Property value, such that its omission might result in the reader of a Valuation Report coming to a substantially different conclusion on the value of the Mineral Property. Material data and information are those which would reasonably be required to make an informed assessment of the Mineral Property value.	*Materiality* implies that a Public Report contains all the relevant information that investors and their professional advisors would reasonably require and expect to find, for the purpose of making a reasoned and balanced judgement regarding the Mineral Asset Valuation.	*Material/Materiality* means: a) the contents and conclusions of a Public Report; b) any contributing assessment, calculation or the like; and c) data and information of such importance that their omission may result in a reader of the Public Report reaching a different conclusion than would otherwise be the case.	*Materiality* requires that a Public Report contains all the relevant information which investors and their professional advisors would reasonably require and reasonably expect to find in a Public Report, for the purpose of making a reasoned and balanced judgement regarding the Mineral Asset Valuation.
	Competence	*Competence or Competent* means having relevant qualifications and relevant experience.	The Public Report is based on work that is the responsibility of suitably qualified and experienced persons who are subject to an enforceable Professional Code of Ethics.	*Competence or Competent* requires that the Public Report be based on work that is the responsibility of suitably qualified and experienced persons who are subject to an enforceable Professional Code of Ethics.	Competence requires that the Public Report should be based on work that is the responsibility of suitably qualified and experienced persons who are subject to an enforceable Professional Code of Ethics or rules of conduct.
	Transparency	*Transparency and Transparent* means that the material data and information used in (or excluded from) the valuation of a Mineral Property, the assumptions, the valuation approaches and methods, and the valuation itself must be set out clearly in the Valuation Report, along with the rationale for the choices and conclusions of the Qualified Valuer.	The reader of a Public Report must be provided with sufficient information, the presentation of which is clear and unambiguous, to understand the report and not be misled.	*Transparency or Transparent* means clear and unambiguous. These qualities, used as the basis of a Public Report, must apply to the data and information and the presentation thereof. This may include the assessment of Resources, Reserves, extraction, mining, processing and marketing issues, the valuation approach adopted and the methodology or methodologies used, all of which *must* be clearly set out in the Public Report**.**	Transparency requires that the reader of a Public Report is provided with sufficient information, the presentation of which is clear and unambiguous, so as to understand the report and not to be misled.
	Independence	*Independence* means that, other than professional fees and disbursements received or to be received in connection with the valuation concerned, the Qualified Valuer or Qualified Person (as the case requires) has no pecuniary or beneficial (present or contingent) interest in any of the Mineral Properties being valued, nor has any association with the Commissioning Entity or any holder(s) of any rights in Mineral Properties which are the subject of the valuation, which is likely to create an apprehension of bias.	The issue of independence is dealt with at the regulatory body. There are specific instances where independent mineral asset valuation is required.	*Independent or Independence* means that the Experts and/or Specialists must be able to satisfy any relevant legal tests of Independence and must be, and be perceived to be, willing and able to undertake an impartial assessment or valuation and to prepare an Independent Expert Report that is free of bias. The Australian Securities and Investments Commission (ASIC) regulates the Australian Securities Exchange (ASX) and provides additional guidance on Independence through RG112.	CRIRSCO views the issue of independence as a "hot potato". This issue is discussed in detail in this thesis because the three national MAV codes have all considered it in one way or another, and there is no general acceptance among the member countries.
	Reasonableness	*Reasonableness* means that other appropriately qualified and experienced valuers with access to the same information would value the property at approximately the same range. A Reasonableness Test serves to identify valuations which may be out of step with industry norms. It is not sufficient for a Qualified Valuer to determine that he/she personally believes the value determined is appropriate without satisfying an objective standard of proof (adapted from NI 43-101CP, Section 1.6).	Reasonableness is excluded.	Reasonableness is excluded as it is considered a product of Competence, Materiality and Transparency. There is a possibility that ASIC may reject it since it can create confusion with Fairness and Reasonableness Reports.	Reasonableness needs to be excluded from valuations to avoid confusion and misinterpretation of application.

The three common principles were adopted from the respective national companion codes for the reporting of exploration results, mineral resources and mineral reserves, namely the SME Industry Guide 7, JORC and SAMREC codes, due to the fact these codes were developed from the same framework that was later adopted by CRIRSCO. It should be noted that the CIM Definition Standards, including the associated NI 43-101 does not specifically mention these principles. However, it can be implied that these principles apply since they form part of the CRIRSCO template of which the CIM Definitions Standards comply to. The main focus of these codes is for more transparency, complete and non-misleading disclosure by providing all relevant and material information that investors and their professional advisors would reasonably require and expect to find for the purpose of making a reasoned and balanced judgement regarding the reporting of exploration results, mineral resources and mineral reserves. It would therefore, be prudent for the harmonisation process to adopt the applicable CRIRSCO definitions with minor modifications as suggested in Table 3.3, since these definitions are already agreed upon by the member countries. Table 3.3 shows the comparison of these national mineral asset valuation codes and the CRIRSCO template.

There is considerable resemblance of the principles and values to which valuers are expected to adhere, especially the first five principles, even though different jurisdictions utilise different wording to suit their specific requirements and application principles. For example, the SAMREC and SAMVAL Codes in South Africa exclude the 'independence' principle, although there are specific instances where it needs to be demonstrated in the preparation of Competent Person's Reports (CPRs) for substantial transactions under the JSE Listing Requirements. Independent Competent Persons and Valuers must ensure that the CPRs reflect true and accurate information on which investors base their decision making. In the Australian context, an additional Regulatory Guide 112 (RG 112) was prepared by the ASIC to guide any person who commissions, issues or uses an Expert Report. RG 112 explains how ASIC interprets the requirement that an expert is independent of the party that commissions the Expert Report and other interested parties. The Australian Corporations Act requires that an expert must be and appear to be independent, especially in the provisions requiring an Expert Report for certain takeover bids, schemes of arrangement or any compulsory acquisitions.

There are two basic interpretations of the word "independence" by professionals in the minerals industry. Firstly, it is used to describe "independence of mind" (i.e. the ability to exercise objectivity without compromising professional judgement), and secondly to imply independence from any direct relationship with either the asset, the party commissioning the valuation or the recipient or beneficiary of the valuation. As a matter of principle, no one can argue with the first interpretation, but the second is dependent on the purpose of the valuation, and can differ significantly depending on the circumstances. This term is therefore explored further.

In Section 290.8 of the Code of Ethics for Professional Accountants, the International Federation of Accountants (IFAC) defined key independence requirements as (IFAC, 2006, p 1210):-

- *"Independence of Mind: the state of mind that permits the expression of a conclusion without being affected by influences that compromise professional judgment, allowing an individual to act with integrity, and exercise objectivity and professional scepticism; and*
- *Independence in Appearance: the avoidance of facts and circumstances that are so significant that a reasonable and informed third party, having knowledge of all relevant information, including safeguards applied, would reasonably conclude a firm's, or a member of the assurance team's, integrity, objectivity or professional scepticism had been compromised".*

The Code of Ethics establishes ethical requirements for accounting professionals and requires them to comply with both definitions. However, in the Code of Ethics for Professional Accountants the use of the word "independence" on its own may create misunderstandings because as noted in Section 290.9 of the code, *"standing alone, the word may lead observers to suppose that a person exercising professional judgment ought to be free from all economic, financial and other relationships. This is impossible, as every member of society has relationships with others. Therefore, the significance of economic, financial and other relationships should also be evaluated in the light of what a reasonable and informed third party having knowledge of all relevant information would reasonably conclude to be unacceptable*" (IFAC, 2006, p 1138).

The IVSC realised the complexity around the definition of "independence" during the preparation of the Code of Ethical Principles for Professional Valuer's published in December 2011. Consequently, the IVS 2013 standards have now removed "independence" as one of the principles, but maintained the principle of objectivity. The IVSC realised that the critical issue was not independence, but circumstances that could potentially threaten the objectivity of the Valuer since there is no single definition of a Valuer's status or a list of relationships that encompasses every threat to objectivity that may arise. The IVSC therefore addressed the need for objectivity, threats to objectivity and safeguards that may be taken to mitigate or avoid threats in the Code of Ethical Principles for Professional Valuers. From an IVSC position, any valuation should show that the judgements can be seen to have been done in an environment that promotes transparency with the necessary degree of objectivity.

For companies listed on the JSE, the established industry norm is that independence requirements for a 3-year mineral resources and mineral reserves review cycle would provide a sufficient level of comfort that the mineral resources and mineral reserves declared in a mineral company's annual report, which is prepared by internal Competent Persons, are a true reflection of the company's mineral assets based on the forecasted long term commodity prices. However, a 3-year review cycle will not suffice for MAVs which are relatively volatile compared to the reporting of exploration results, resources and reserves since they are subject to assumptions that change on a daily basis, such as commodity prices and exchange rates.

Lastly the same logic could be applied, that MAV independent reviews should also be done on a 3 year cycle because the MAVs are estimated using the mineral resources and mineral reserves. In other jurisdictions, the issue of independence was left out of the codes so that it could be addressed elsewhere in national general regulatory frameworks. It is therefore suggested that the IMVAL template should exclude independence as a core principle.

3.3.5. Comparison of competency and qualifications of Valuer

The requirements for necessary qualifications, ability and sufficient relevant experience in mineral asset valuation are common to all three national valuation codes and the IVS (Table 3.4). They require that experience must be in the relevant category of mineral asset. This was also reflected in the Guidance Note 14 (GN 14) titled, "*Valuation of Properties in the Extractive Industries*" (IVSC, 2005). The principle difference is in the area of registration, where some jurisdictions require the competent valuer to have registered and be issued with a licence and others just require registration with the prescribed professional body. In terms of competency, there are two different schools of thoughts. The first is premised on the concept that for someone to be a competent valuer he/she should have relevant industry experience in a technical discipline (such as geology, mining engineering or metallurgy) and the necessary commercial knowledge and understanding. This is the concept adopted by Australia in the VALMIN code 2015 edition; the reasoning behind is that the technical understanding of the mining operations and how these issue affect the profitability is the most important in the valuation of the mineral asset. The value of a mineral project is driven by the way the mineral resources and mineral reserves are extracted, since the mineral reserves is the single biggest asset for a mining company and it would affect the future cash flows. Hence it is important to understand the technical issues and how they impact the future cash flows. This could be considered as an "aspirational" approach in that it calls for one person to be skilled to a certain level of proficiency in all aspects required for financial valuation. The weakness of the aspirational approach is that few people will be sufficiently experienced in all the necessary disciplines to qualify as a Competent Valuer.

The second concept is that a valuator must have a general understanding and experience in how a mine operates and if not, can be assisted with competent technical specialists. This concept could be considered as a "pragmatic" and calls for one person to act as Lead Competent Valuer collating input from different specialists. As an emerging discipline, this would assist in countries that are still developing competency in this discipline. The weakness of this pragmatic approach is that some professionals would lack the understanding of how the technical aspects link back to the valuation of the mineral asset. The mere fact that the Lead Competent Valuer has to rely on specialist input, may not solve the problem due to the fact that the input might be received and still not accounted appropriately in the valuation results due to lack of fundamental technical understanding of the issues. This is the stance implied as taken by the South Africans in the SAMVAL code 2016 edition.

It is also noted that the various jurisdictions have different requirements for competence to conduct mineral asset valuations. These differences can be summarised as follows:-

- SAMVAL refers to registration with a statutory body (SACNASP, ECSA or South African Geomatics Council (SAGC) previously known as PLATO or membership of the GSSA or SAIMM;
- VALMIN refers to professional expertise and possible licencing; it also refers to the requirement for professional body registration and disciplinary procedures; and
- CIMVAL requires that the Valuer is regulated by or is a member in good standing of a Professional Association or a Self-Regulatory Professional Organisation (SRO).

The differences in defining competence within the organisations that specialise in valuations can be summarised as follows:-

- According to IVSC (2012a) a Professional Valuer is a member of a Valuation Professional Organisation that is in membership of IVSC. It also notes that a Professional Valuer must be able to demonstrate knowledge, skills, values, ethics and behaviour that are professional. It further specifies that a Professional Valuer will comply with the conditions of any statutory system of licencing or other regulatory requirements relating to the market or sector in which the Professional Valuer operates; and
- IIMA provides Certification as a Minerals Appraiser as part of membership of IIMA, provided that the educational, experiential and demonstration report requirements are satisfied.

The common principle that exists is the requirement for registration with a recognised SRO. Reciprocity through the current relationships for Recognised Overseas Professional Organisation (ROPO) can easily deal with this in relation to SAMVAL, VALMIN and CIMVAL.

The issue of qualifications is critical and is acknowledged in all the valuation codes. However, with the exception of the School of Mining Engineering at University of the Witwatersrand, which introduced a postgraduate course in MAV in 2014, there are no other formal postgraduate qualification in mineral or petroleum asset valuation. Most major universities with a mining school have a related mineral economics postgraduate course, which do not teach the intricate issues around the valuation principles as it applies to mineral project and mineral companies. The question is whether these related courses have sufficient content for mineral asset valuation.

3.3.6. Comparison of valuation approaches and methods

There are three generally accepted approaches to valuation namely; the Income, Market and Cost Approaches. Certain valuation methods are more widely used and may be more generally acceptable as industry practice than others (See Table 1.1), although this could change over time.

Some methods can be considered to be primary methods for MAVs, while others are secondary methods or rules of thumb, considered suitable only to check MAVs by primary methods. These codes acknowledge that there is no one single “appropriate” method, but rather a number of different methods that each have a different degree of “applicability”. It should be noted that the valuation approaches adopted by Canada and South Africa are almost identical to each other, but with some minor country-specific variations. For example, in both countries the Expert has the sole responsibility to select the suitable and appropriate valuation approach and methodology, but in Australasia these are not specified and Experts must select valuation methodologies from those in common use. Since the implied valuation approaches are already common to all three codes, the harmonisation process only needs to develop appropriate definitions.

This should not be a difficult exercise for the members from the NROs on the IMVAL committee. All the codes specify that the Valuer has the responsibility to decide on which valuation approaches and methods to use depending on the nature of valuation, his/her expertise and training, local standards and stages of development of the mineral or petroleum asset.

In all cases the Valuer must justify their decision. In terms of the number of valuation approaches to apply the:-

- SAMVAL Code states that the Competent Valuer must apply at least two (2) valuation approaches;
- CIMVAL Code states that more than one (1) valuation approach should be used (unless otherwise justified by the Qualified Valuer);
- VALMIN Code states that if more than one (1) approach is used, the Expert should comment on how the valuation compares and the reason(s) for selecting the value adopted; and
- IVS framework states that any valuation requires the Valuer to apply one or more valuation approaches (IVSC, 2013b).

Since the three national valuation codes are in general agreement at a high level on valuation approaches and methodologies, minor variations can be addressed at a national level. In the past, it was only the VALMIN Code that did not provide guidance on the applicability of valuation approaches and methodologies depending on the stage of development. Previously the valuer had the responsibility to select both the approach and methodology based on the understanding of the circumstance at hand and the international best practice based on published papers. However, in the VALMIN code 2015 edition, this guidance has since been included, similar to the SAMVAL and CIMVAL codes. Due to such developments, the MAV codes maybe be considered to be aligning closer to each other.

Table 3.4: Comparison of competence and registration requirements among the national mineral asset valuation codes and the IVS

SECTION	CIMVAL Code	SAMVAL Code	VALMIN Code	IVS	COMMENTS
Competence	Code requires a Qualified Valuer to demonstrate extensive experience and be registered with a Professional Association or a self-regulatory Professional Organisation.	Code requires a Competent Valuer to possess necessary qualifications, ability and sufficient relevant experience in valuing mineral assets and be registered with an appropriate professional association.	Competence or Competent means having relevant education, qualifications, experience, professional expertise and holding appropriate licences (where required). An Expert should have at least 10 years of relevant and recent general mining experience and at least 5 years in the assessment or mineral asset valuation while a Specialist may be retained by the Expert to prepare sections of the report concerning the matters which the Expert is not personally competent and should have at least 5 years' relevant and recent experience.	A Valuer is a person who possesses the necessary qualifications, ability and experience to conduct a valuation. Licensing may be required in some states before one can act as a Valuer. Additionally, Professional Valuers should attend Continuing Education offerings on a regular basis to enable professional growth and to stay abreast of developments in the valuation profession.	Common issues around Competence are necessary qualifications and relevant experience, while licensing may be required. Only the VALMIN Code 2005 does not specify the requirement for registration with a professional body, but specifies the minimum number of years of relevant and recent experience required. A juristic person cannot be a competent valuer. In the 2015 edition, registration is mandatory.
Professional Association and/or Registration Requirements	Code specifies criteria for a self-regulatory Professional Association where engineers, geoscientists or both should be registered.	Code lists the recognised local professional bodies where engineers, geoscientists or both should be registered. Provision is also made for recognition of registration with a Recognised Overseas Professional Organisation (ROPO) or other organisations recognised by the SSC on behalf of the JSE Limited.	Code specifies criteria for a self-regulating Professional Association where engineers, geoscientists or both should be registered.	IVSC requires Professional Valuers to meet requirements on formal education, professional or board examinations, experience and code of conduct or code of ethics.	All three codes recognise that registration with professional bodies is sufficient, while the IVSC has more stringent requirements on formal education, professional or board examinations, experience and code of conduct.
Mineral Asset Valuation Approaches	Recognises the three generally accepted approaches namely; Income, Market, and Cost Approaches.	Recognises the three generally accepted approaches namely; Cash Flow, Market and Cost Approaches.	The Expert and Specialist must make use of the valuation methods suitable for the mineral or petroleum asset or securities under consideration.	Recognises the three generally accepted approaches namely; Income, Market and Cost Approaches.	All three codes recognise the three generally accepted mineral asset valuation approaches, but the VALMIN Code does not specifically mention them.
Selection of Valuation Approach and Methodology	The Qualified Valuer has the responsibility to decide and justify which valuation approaches and methods to use.	The Competent Valuer is responsible for choosing approaches and appropriate underlying methods of mineral asset valuation.	Decisions on the valuation methodologies to be used are solely the responsibility of the Expert or Specialist and must not be influenced by the Commissioning Entity.	The IVSC does not specifically identify these.	The concept is common to all the three codes hence it is the established current industry best practice.

3.4. Lessons from relevant precursors to harmonisation of mineral asset valuation codes

A number of initiatives have been conducted globally in an effort to provide comprehensive guidelines or standards in either financial reporting or valuation of corporations involved in the extractive industry. These initiatives may not have been as successful as originally anticipated, but the lessons learnt during these processes are likely to assist in the development and potential implementation of the IMVAL template. These initiatives by the IVSC, IASB and CRIRSCO provide relevant insights into harmonisation of valuation. It should be noted that all these efforts by different organisations with interests in the extractive industries to develop a standard or guidelines were never widely coordinated.

3.4.1. IVSC initiatives

The detailed discussion on the IVSC initiatives around the efforts conducted by the organisation in an effort to develop a valuation standard or guideline for the valuation of assets in the extractive industries was covered in Section 1.7.2. The main reason for such initiatives was to explore the practicality of a set of globally accepted international valuation standards for the extractive industries. Further, GN 14 relied on requirements in the IVS's through extensive referencing to avoid duplication and being prescriptive. However, the opinion expressed by the IVSB, was that the GN 14 did not provide sufficient guidance on the valuation inputs, assumptions, types of value and, purposes and methodologies that should be considered in MAV. It is concluded that the IMVAL template should not be prescriptive and should also reference the relevant IVSs and the CRIRSCO template in order to provide sufficient guidance.

3.4.2. IASB initiatives

The IASB develops and issues, in the public interest, the IFRS which are a set of international accounting standards as discussed in detail in Section 1.7.1. The standards state how particular types of transactions and other events should be reported in financial statements. These financial reporting standards allow companies worldwide to produce financial reports that are essentially similar across different jurisdictions, and provide high quality, transparent and comparable financial information. The financial reports require little or no modification across countries for easy comparison by investors, indicating that globally harmonised standards facilitate common understanding and interpretation across different regulatory jurisdictions. IFRS 6 is part of the IFRS group of accounting standards and was specifically developed for the extractive industries. The objective of IFRS 6 is limited to specifying the financial reporting of exploration for and evaluation of mineral resources, that is the expenditure spent for exploration and the evaluation of mineral resources before the commercial viability has been established or demonstrated (IFRS, 2012).

The Extractive Industries project team undertook research by considering a broad range of issues including resources and reserves estimation, and historical and current value measurement of resources. It produced a discussion document in 2010 considering the issues raised in the 2000 discussion document and the comments that were submitted as part of the public review of that document. However, in December 2012, the IASB discontinued the Extractive Activities Project as the findings could not conclusively lead to the development of an IFRS standard for extractive activities. Instead a broader research project on intangible assets was initiated. This project was designed to assess the feasibility of developing one set of reporting requirements for investigative, exploratory and developmental activities across a wide range of activities. Valuation of mineral assets is a complex undertaking that even the IASB has failed over a period of more than 15 years to develop an IFRS standard to guide MAV. This complexity implies that harmonisation of valuation codes should initially be based on high-level commonality among the codes and progressively draw in the more complex issues.

3.4.3. Lessons from the CRIRSCO process

The international initiative to standardise reporting definitions for mineral resources and mineral reserves had its roots at the 15th Council of Mining and Metallurgical Institutes (CMMI) Congress held in Sun City, South Africa in 1994. The Mineral Definitions Working Group (later called CRIRSCO) was formed after a meeting at that Congress. The grouping comprised of National Reporting Organisations (NROs) that are responsible for developing mineral reporting codes and guidelines in Australasia, Canada, South Africa, the USA, UK, Ireland and Western Europe. Chile was not represented at the 1994 meeting and only joined CRIRSCO later. Russia, the Philippines and a raft of other jurisdictions are currently considering joining CRIRSCO and this will make it a broader organisation. CRIRSCO is an international advisory body without legal authority and relies on NROs to ensure regulatory and disciplinary oversight at a national level.

In 2006 CRIRSCO published a template and subsequently updated it in May 2013. The template does not replace the national reporting codes, but acts as an over-arching model and guideline for any country wishing to align its reporting code to globally acceptable standards, while incorporating country-specific requirements which may be of a legal and investment regulatory nature. The purpose of the CRIRSCO-aligned reporting standards is to provide a minimum standard for the reporting of mineral assets and to ensure that public reports contain all the information which investors and their professional advisors would reasonably require for the purpose of making a balanced judgement regarding an investment decision (Stephenson *et al*, 2008).

Table 3.5 summarises the major historical developments from the creation of CRIRSCO to the first major breakthrough (the Denver Accord) when NROs reached an agreement on the definitions on mineral resources and mineral reserves including their respective sub-categories.

Table 3.5: Summarised CRIRSCO timelines and historical developments (Source: CRIRSCO Website)

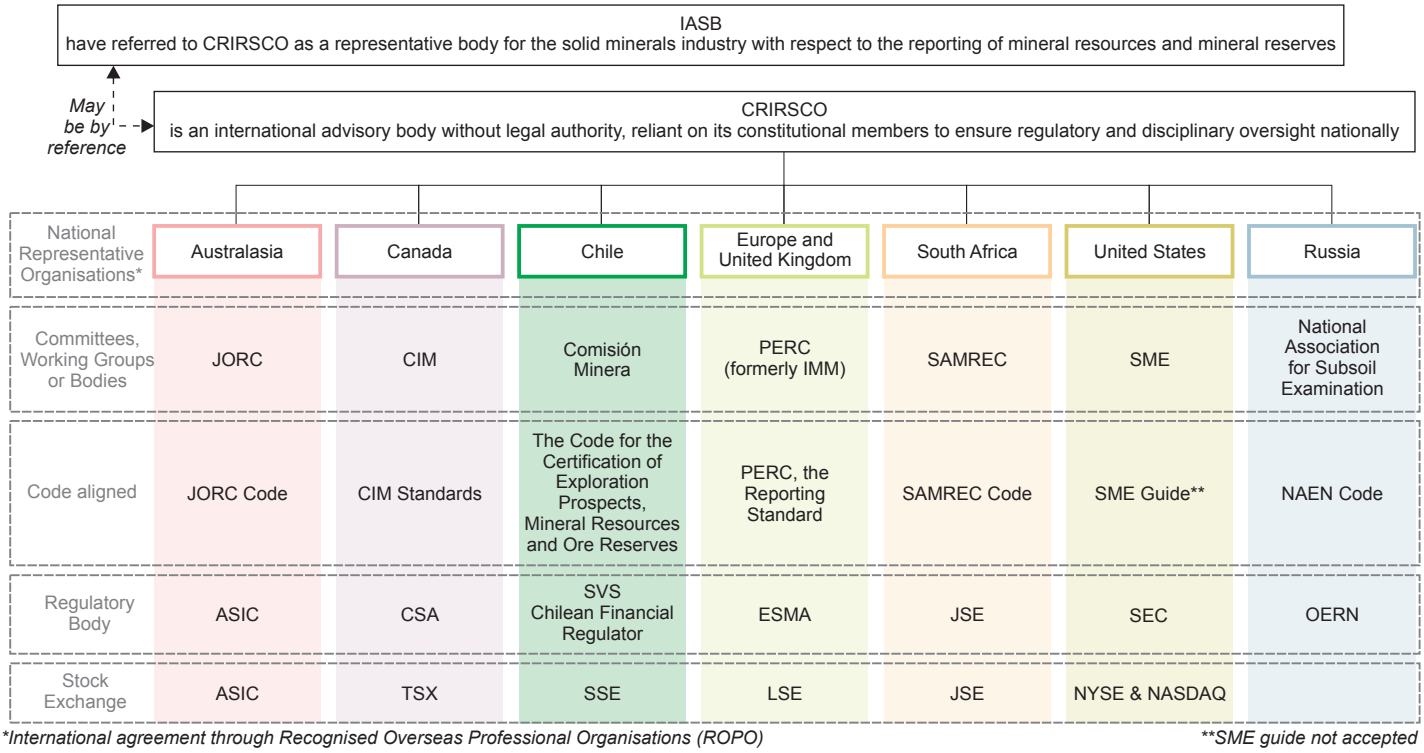
DATE	HISTORICAL DEVELOPMENT
September 1994	The Mineral Definitions Working Group (later called CRIRSCO) is formed at the 15th CMMI Congress, Sun City, South Africa, with the objective of developing a set of international standard definitions for the reporting of mineral resources and mineral reserves.
March 1997	Bre-X scandal occurs and causes the initiative to assume greater urgency.
October 1997	Representative countries reach an agreement (the Denver Accord) on the definitions of two major categories: Mineral Resources and Mineral Reserves, and their respective sub-categories: Measured, Indicated and Inferred Mineral Resources, and Proven and Probable Mineral Reserves.
October1999	An agreement is reached with UN Economic Commission for Europe to incorporate the CMMI-CRIRSCO resource/reserve definitions UNFC giving the CMMI-CRIRSCO definitions a true international status, resulting in uniform international definitions for Mineral Resource and Mineral Reserves.
2000 to 2003	Updated version of JORC Code is released in Australia, followed by release of similar codes in South Africa, Canada, USA, UK/Ireland/W. Europe, Chile, and Peru.
2005	CRIRSCO is advisor to the IASB on Mineral Resources and Mineral Reserves. IASB indicates its preference to use existing reporting systems, primarily the CRIRSCO Template and the Petroleum Resources Management System (PRMS).
July 2006	CRIRSCO publishes the International Reporting Template for the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves (the CRIRSCO template). The template does not replace existing national reporting codes but intends to provide a guideline for countries developing their own reporting standards, and a benchmark for comparison with other international reporting systems.
2007	CRIRSCO becomes a Task Force of the ICMM to provide it with the strong industry support it needs to carry out its mandate.
2013	CRIRSCO published an updated International Template.

The Denver Accord marked the first major achievement in the global harmonisation of the reporting of exploration results, mineral resources and mineral reserves. The relationships between CRIRSCO, SROs, national Working Groups and the regulatory bodies are illustrated in Figure 3.1.

Critical success factors fundamental to the adoption and implementation of the CRIRSCO template were that the template:-

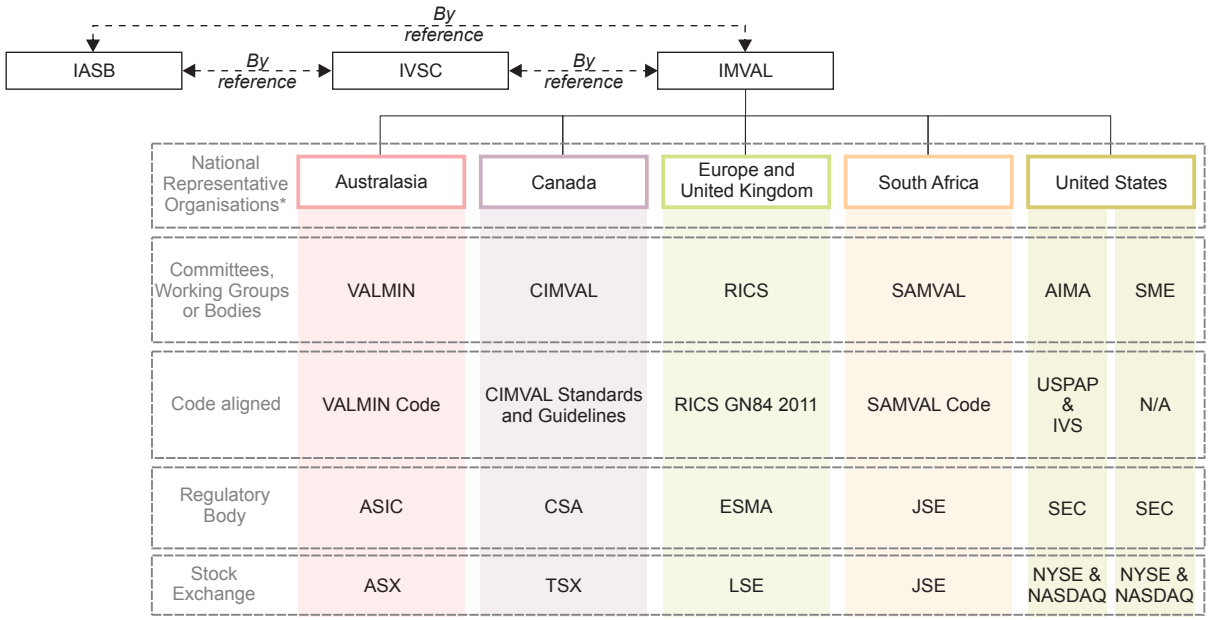
- is a set of definitions and principles established on the basis of similarities emanating from standards prepared by the different NROs;
- was developed by capitalising on the similarities among the various national reporting codes;
- was not designed to replace national reporting standards, but to augment them;
- was developed by the minerals industry in consultation with regulatory authorities and the interested and affected stakeholders (wide consultation important);
- recognised international agreements on Recognised Overseas Professional Organisations (ROPOs) to let a Competent Person from one NRO to act as Competent Person in another; and
- is intended as a guideline for countries developing their own reporting standards, and a benchmark for comparison with other international reporting systems, including UNFC and the Society of Petroleum Engineers (SPE) Guidelines.

Figure 3.1: Comparison of CRIRSCO and proposed IMVAL structures indicating potential relationships



*International agreement through Recognised Overseas Professional Organisations (ROPO)

**SME guide not accepted



*International agreement through Recognised Overseas Professional Organisations (ROPO)

IASB	International Accounting Standards Board
CRIRSCO	Committee for Mineral Reserves International Reporting Standards
JORC	Joint Ore Reserves Committee
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
PERC	Pan-European Reserves and Resources Reporting Committee
SAMREC	South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves
SAMVAL	South African Code for the Reporting of Mineral Asset Valuations
NI43-101	National Instrument for the Standards of Disclosure for Mineral Projects, overseen by the Canadian Securities Administrators
SME	Society for Mining, Metallurgy and Exploration
NAEN	Russian Code for the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves
ASIC	Australasian Securities and Investments Commission
SVS	Superintendencia de Valores y Seguros de Chile
ESMA	European Securities and Markets Authority
JSE	Johannesburg Stock Exchange
OERN	Russian Society of Subsoil Use Experts
TSX	Toronto Stock Exchange
LSE	London Stock Exchange
SSE	Santiago Stock Exchange
SEC	US Securities and Exchange Commission
NASDAQ	National Association of Securities Dealers Automated Quotations

Source: Adapted from MacFarlane (2011), Njowa et al (2014)

One weakness of the CRIRSCO template notable from Figure 3.1 is the lack of regulatory backing by the securities regulators in some jurisdictions. IMVAL therefore, needs to lobby the securities regulators to avoid experiencing a similar pitfall. Some of the concepts that can be adopted in the creation of a CRIRSCO-equivalent IMVAL template would be:-

- as a first step, the NROs need to reach an agreement similar to the Denver Accord, on definitions, scope, principles and valuation approaches;
- specify at a high level the qualifications, criteria and experience required for a Competent Valuer or Qualified Person;
- setting out the high-level responsibilities of the Competent Valuer or Qualified Person, the associated specialist experts and the Board of Directors with regards to the reporting of valuation results; and
- the template should not regulate the procedures or the selection of the appropriate valuation approaches or methodologies used by the Competent Valuer to estimate the value of the Mineral Asset thereby emulating the CRIRSCO framework.

3.5. Proposed structure for an IMVAL template

Figure 3.2 is a radar depiction of key features of the major valuation codes in Canada, Australasia and South Africa. The figure presents salient features of valuation principles, purpose, minerals covered and the asset level that are common to all three codes. The IMVAL template should have a skeletal positioning within the three codes as illustrated by the encircled envelope in Figure 3.2 in order to allow national codes to add jurisdiction-specific details. As such, the IMVAL template skeletal envelope should broadly encompass:-

- The three key principles of Materiality, Competence and Transparency. The principle of ‘Reasonableness’ should be excluded to avoid misinterpretation and inappropriate application, while individual jurisdictions should be allowed flexibility to decide when and where ‘Independence’ is required;
- A purpose that covers MAV which is already common to all three valuation codes;
- All solid minerals excluding oil and gas since IMVAL does not currently have the requisite competency to advice on oil and gas valuation reporting;
- At an asset level i.e. at a project level as minimum that only covers exploration results, mineral resources and mineral reserves. but excludes mineral corporations and their associated securities, in order to align the definition of mineral assets to the CRIRSCO template; and
- A standard of value which should be ‘Market Value’.

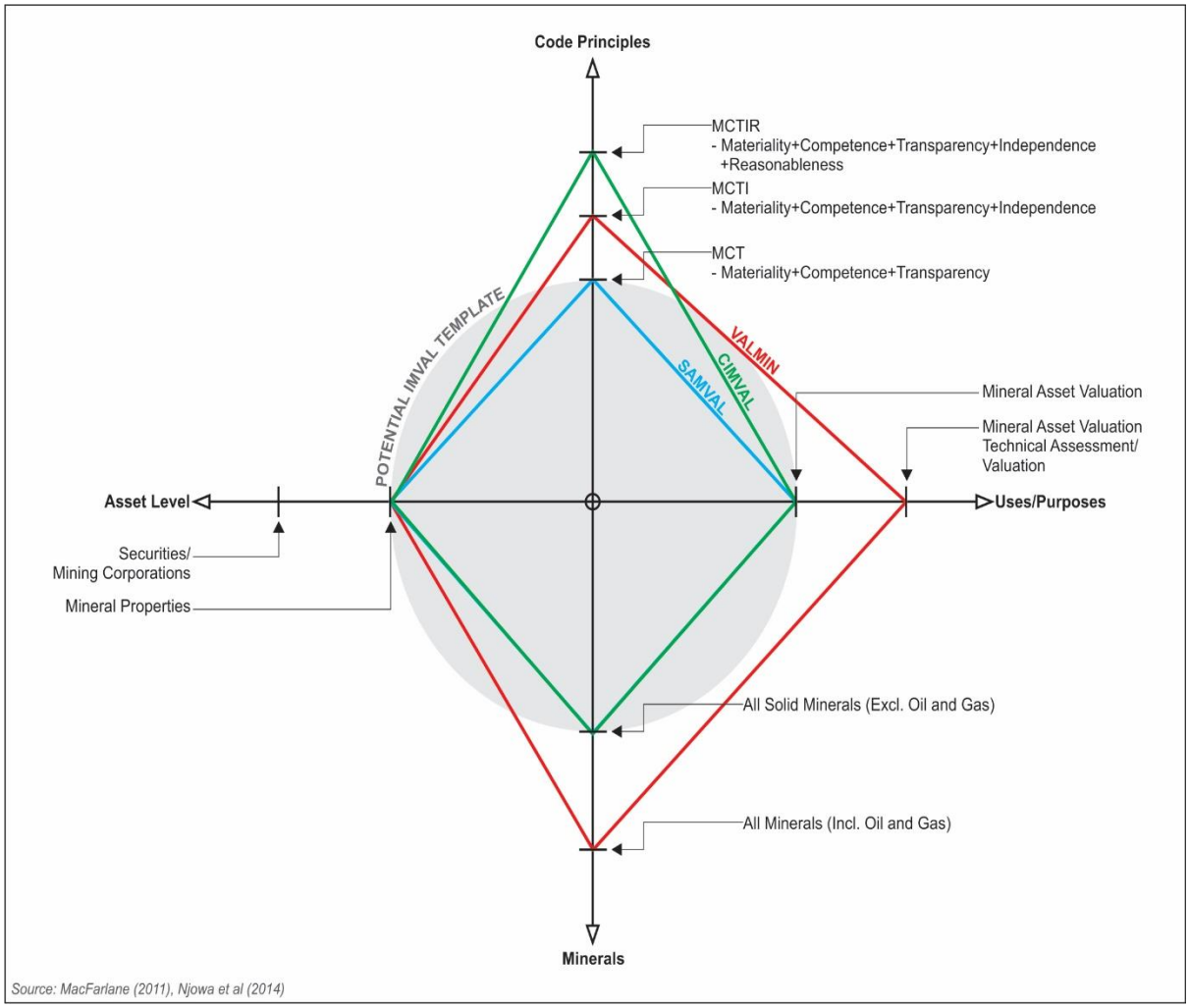


Figure 3.2: Radar depiction of key features of major mineral asset valuation codes

The skeletal framework is being proposed as a minimum standard common to all three codes, but providing flexibility for future inclusion of aspects not covered at this stage. This takes cognisance of valuation debates on whether such a template should also include valuation of mineral corporations or their securities. Should future debates strongly favour a more inclusive framework then the skeletal framework could be expanded in consultation with other professional bodies involved in the valuation of mineral corporations and their securities. It is expected that the skeletal template will evolve over time and enable other outstanding issues to be resolved. These issues include questions such as:-

- Should mineral assets be recognised as financial assets on company balance sheets?
- Should oil and gas eventually be included in the IMVAL template and if so how?
- Should the IMVAL template include valuation of securities of mineral corporations or should these be just addressed by reference to the accounting profession valuation methodologies for securities?

3.6. Chapter Summary

The key arguments that were discussed in this chapter are that the VALMIN Code, CIMVAL standards, SEC Industry Guide 7, IASB discussion documents and SAMVAL Code were developed as a result of extensive research and considerable deliberations and thoughts in their formulation. These codes and standards comes with some wealth of experience from application in regions where these codes were developed and are being practiced or applied. These would be important sources of information to draw upon during the drafting of a global framework, guidelines and standards for financial reporting and the valuation of extractive industries assets or properties.

The extractive industry stakeholders and all other institutions pursuing various initiatives in the development of guidelines or standards for financial reporting and the valuation of such assets should form a joint forum with one goal for the benefit of the profession and the industry at large. The forum should be committed in the harmonisation of national codes, standards and valuation guidelines in the extractive industry and one such forum has recently created the IMVAL template, however the accounting fraternity was not involved.

Challenges facing the globalisation of a VALMIN-type Code for the international Minerals Industry is the historical influence of real estate valuation and the USA jurisdictional idiosyncrasies. This is mainly due to a fixation on real property rights with a preference for using comparative sales techniques (Market Approach) to the exclusion of Income-based approaches, a regulatory reluctance in the US to accept that Mineral Resources have any value, and the IASB's preference for Historical, rather than Current Value, accounting.

A common issue with all these international standards and guidelines for mineral asset valuations is the fact that although the valuation approaches and methods are provided, guidance is restricted to the valuation approaches rather than being prescriptive in methodology application. They all assume that there is adequate market information and data available for each of the valuation methods to be used. In reality this is rarely the case in this particular industry sector.

The underlying reason for having a MAV code for the valuation of Mineral Assets is to provide consistency and minimum standards, as well as guidance, for MAV professionals, and this supports the importance of a global standard such as IMVAL template, in promoting global common understanding and interpretation of such valuations. This limits unscrupulous valuations, which could result in severely compromising the interests of investors and potential investors.

In conclusion it was established there exists significant common principles between the main national MAV codes and formed the basis of the IMVAL template that was published in 2016. The main issue is no jurisdiction has formally adopted the IMVAL template.

4. FINANCIAL REPORTING STANDARDS IN THE MINERAL INDUSTRY

4.1. Chapter Overview

Currently; financial reporting globally is governed by essentially two sets of accounting regulations or standards, namely (KPMG, 2012):-

- those applied in the United States and companies listed in the United States (US), through the use of the United States Generally Accepted Accounting Practice (US GAAP) created by Financial Accounting Standards Board (FASB), and
- those applied mainly outside the of the US, through the IASB, under the IFRS.

Many of the world's capital markets now require IFRS, or some form thereof, for financial statements of public-interest entities. The remaining major capital markets without an IFRS mandate are (KPMG, 2012):-

- the US, with no current plans to change;
- Japan, where voluntary adoption is allowed, but no mandatory transition date has been established;
- India, which announced its final roadmap in January 2015 requiring the use over the next several years of Indian accounting standards that are significantly similar to IFRS; and
- China, which intends to fully converge with IFRS at some undefined future date.

Continued global adoption affects US businesses, as additional countries permit or require IFRS for statutory reporting purposes and public filings. IFRS requirements elsewhere in the world also impact US companies through cross-border, merger and acquisition (M&A) activity, as well as the IFRS reporting demands of non-USA stakeholders. Accordingly, it is clear that being financially bilingual in the US (US GAAP and IFRS) is increasingly important. From an investor perspective, the need to understand IFRS is arguably even greater. US investors are viewing global companies outside the US as lucrative investment opportunities. Recent estimates suggest that over USD9 trillion of US capital is invested in foreign securities. The US markets also remain open to non-US companies that prepare their financial statements using IFRS. There are currently over 500 non-US filers with market capitalisation in the multiple of trillions of US dollars, who use IFRS without reconciliation to US GAAP. Given this background this thesis uses the IFRS compliant financial statements for all analysis, and it should be noted that the use of IFRS financial statements as opposed to the US GAAP financial statements does not affect the results documented herein.

In this chapter, the differences and similarities between the IFRS and US GAAP is discussed as a foundation for the financial statements that would form the basis of all financial analysis required when conducting equity valuations for minerals companies using financial ratios. The financial statements form the fundamentals on which to base the company's historical performance as a proxy for the expected future performance, when conducting a valuation on a mineral company.

The financial statements help the valuer to understand how the company and industry sector operates, and what factors affect its ability to generate free cash flow. Finally, due to the absence of a comprehensive accounting standard for the extractive industry, the single biggest asset for a mineral company, its mineral resources and mineral reserves, is not reflected anywhere in the financial statements, except in circumstances where the mineral asset was acquired through a purchase transaction. A value of the mineral resources and mineral reserves would be apportioned to these assets through the process of purchase price allocation (PPA), and the part value attributable to the mineral resources and mineral reserves would be recorded onto the balance sheet.

4.2. IFRS vs GAAP

The convergence of US GAAP and IFRS continues to be a priority on the agenda of both the US Financial Accounting Standards Board (FASB) and the IASB and there are still significant similarities and differences between the two frameworks. The differences in key areas of IFRS and US GAAP are the dissimilarities in accounting policies impacting the consolidated financial statements. Ernst and Young (2009, p3) noted that "*understanding the similarities and differences between US GAAP and IFRS on an industry basis can be challenging because while the principles and conceptual frameworks for US GAAP and IFRS are generally similar, US GAAP has more detailed, industry-based guidance than IFRS*". Reporting under the US GAAP is further complimented by SEC regulations, Federal Securities Laws and Acts and various SEC perspectives that provide detailed guidance on accounting and reporting. With regards to the extractive industries, the US GAAP provides detailed guidance on the accounting and reporting by oil and gas producing companies for expenditure before, during and after exploration and evaluation activities. US GAAP does not contain or provide extensive authoritative guidance for other extractive industries. Whereas the "*IFRS provides specialised extractive industry guidance only in respect of expenditures incurred on exploration for and evaluation of mineral resources after obtaining a legal right to explore and before achieving technical and commercial feasibilit*y". (KPMG, 2012, p89). Hence both the US GAAP and IFRS do not have a comprehensive standard or guidance on accounting and reporting, for entities in the minerals industry.

Ernst and Young (2009, p4) pointed out that "*under US GAAP, companies are allowed to follow either the full cost or successful efforts method of accounting for exploration and production activities*". The successful efforts method is governed by FAS 19 Financial Accounting and Reporting by Oil and Gas Producing Companies, and the full cost method is governed by SEC Regulation S-X Rule 4-10 Financial Accounting and Reporting for Oil and Gas Producing Activities. The US GAAP provide guidance that all exploration and evaluation expenditure should be expensed until mineral resources and mineral reserves are declared.

According to Ernst and Young (2009) interpretation, IFRS 6 suggests that entities could continue to use their existing practices of accounting for exploration and evaluation assets upon adoption of IFRS, provided that the requirements of paragraph 10 of IAS 8 are satisfied. However, IFRS 6 also stipulates the following (Ernst and Young, 2009, p4):-

- "*An entity must specify which expenditures are recognized as exploration and evaluation assets, and apply that accounting policy consistently;*
- *Expenditures related to the development of mineral resources should not be recognized as exploration and evaluation assets; and*
- *IAS 16 Property, Plant and Equipment, IAS 38 Intangible Assets and IAS 36 Impairment of Assets must be applied after the exploration and evaluation phase (which may affect the choice of accounting policies during the exploration and evaluation phase)"*.

Beyond the exploration and evaluation stage, there is no IFRS that specifically addresses development activities by mining companies. Therefore, an entity develops an accounting policy under the hierarchy for the selection of accounting policies under IFRS, considering both the guidance and requirements in standards and interpretations dealing with similar and related issues, and the IASB's conceptual framework (the Framework). An entity may also consider the pronouncements of other standard-setting bodies and accepted industry practice, but only to the extent that they do not conflict with the standards, interpretations and the Framework.

One other difference is that under the IFRS and US GAAP capitalised exploration and evaluation costs are classified as either tangible or intangible assets, according to their nature for extractive industries other than oil and gas producing industries. For oil and gas industries, all capitalised costs are classified as tangible assets.

Significant accounting issues include consideration of which costs should be capitalised, and the determination of when development ends and production begins. In practice this is further complicated, as development often continues once production has begun. It can be concluded that for mineral companies, there are significant accounting treatment differences between the IRFS and US GAAP on specific areas. These differences are not specific to the mineral industry but could have been borrowed from the regulators in the US from the oil and gas industry, and is being applied to the extractive industry in general. A further complication regarding the accounting and reporting by companies in the extractive industries is the peculiar issues that exist in either the minerals industry or the oil and gas industries that have not been addressed or resolved.

4.3. Financial Statements for Mineral Companies

Ongoing convergence of accounting standards around the world has helped to narrow some of the differences that exist in the mineral industry, for instance, in areas such as decommissioning obligations, impairment, exploration and evaluation expenditure and business combinations. Currently, globally, the primary financial statements are prepared on the basis of two accounting frameworks being IFRS and US GAAP as discussed in the previous section. Most countries have adopted the IFRS for financial reporting as the most widely used accounting standard, and due to globalisation. In this case, the financial statements for mineral companies are prepared and presented in the same way as any business, except for line items that are specific to the minerals industry. The only major difference is that mineral companies provide supplementary disclosures about mineral resources and mineral reserves. Generally, the most valuable asset of any mining company is its mineral resources and mineral reserves, and these are not disclosed on the balance sheet. Deloitte (2003, p6) further supported the argument that "*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*". While these mineral reserves are not reflected as an asset, the way a company estimates its mineral reserves is critical to most amortisation calculations, for addressing impairment, and comes into play in determining fair values in a business combination and purchase price allocations (Deloitte, 2003). Additionally, mineral reserves estimates impact a number of financial statement balances and operating costs, e.g., reserve estimates are used to calculate depreciation of mining assets on a unit-of-production basis. Importantly, IAS 1 Presentation of Financial Statements requires the disclosure of key assumptions and other major sources of estimation uncertainty. Hence the mineral reserves are fundamental in the preparation of the primary financial statements as disclosed in the annual reports, to the extent that these estimates need to be audited annually as part of the financial audits. This is further supported by the need for mining specialists as part of the mining audit teams. It is important to note that the discussion above suggests that financial accounting is more concerned with the mineral reserve whereas MAV included mineral resources as well.

It should be noted that mineral reserves estimates are not disclosed in the financial statements and are not addressed specifically by IFRS or the US GAAP. However, these estimates provide critical information in the evaluation of mining companies, preparation of the financial statements, and their disclosure is a key component of annual reports in the minerals industry. The purpose of resources and reserves statements is to make available information outside the financial statements, regarding the mineral resources and mineral reserves controlled by companies in the industry, which is important in assessing their current performance and future prospects.

It is now widely accepted that the task of interpreting and applying IFRS will be a continual challenge in the extractive industries, rather than a once-off issue arising on first-time adoption. It has become more apparent that the move to treating the mineral asset as an asset is being paid more attention in the mining and extractive industry.

Unlike other industries the mineral asset is finite and is a wasting asset over time. There are implications when treating the mineral asset as a balance sheet item and these include:-

- mineral deposit (mineral resources and mineral reserves) are finite and wasting assets;
- there is no single global standard for valuation of mineral resources and reserves;
- large up-front investment with low success rates on exploration expenses and long lead times on new projects;
- high back-end costs at mine closure, in terms of decommissioning the processing facilities and rehabilitating the sites;
- the issue of capitalisation being of major concern in the exploration for and evaluation of mineral resources and mineral reserves, because some mining entities capitalise all exploration and evaluation costs as in the case of junior mining companies whilst the major companies write off the costs as an expense until a decision is made to exploit the deposit;
- how revenues and costs incurred during the commissioning phase are accounted for;
- annual charge of depreciation and amortisation under IAS 36; and
- the use of USD as the determinant currency and the impact of exchange rate fluctuations.

The IASB (2001, p 93) discussed the arguments for recognising mineral reserve values in the primary financial statements as part of the extractive industries issues paper. The following issues were identified in support of recognising the mineral reserves values:-

- "*The most important economic asset for many enterprises in the extractive industries is its interest in mineral reserves, and the financial strength of the enterprise depends largely on the value of those mineral reserves. Mineral reserves represent the source of future cash inflows from sale of the minerals and they also provide the basis for acquiring funds through borrowings or additional equity financing. The use of mineral reserve values in the financial statements is sometimes advocated because the value of mineral reserves bears little, if any, relation to the historical costs of finding and developing those mineral reserves;*
- *For many enterprises in the extractive industries, the critical measure of success of upstream activities is the value of new mineral reserves discovered. Under historical cost accounting, the value of mineral reserves discovered is reflected in income only when the mineral reserves are produced and sold. As a result, historical cost accounting does not provide an effective basis for evaluating the success of efforts to find mineral reserves in the year in which the related costs are incurred; and*
- *Values of mineral reserves are an important predictor of the future cash flows, earnings, and share price of many extractive industries enterprises. Financial statements based on reserve values would be much more useful in making those predictions than statements based on historical costs".*

In addition to the arguments for recognising mineral reserves values in the primary financial statements as advocated in the section above, there are arguments against this concept. The IASB (2001, p94) also discussed the arguments against recognising mineral reserve values in the primary financial statements, which include:-

- "*Many who argue on one or more of the following bases against the use of reserve values as the basis of accounting in an enterprise's primary financial statements nonetheless believe that information about reserve quantities and values and changes in quantities and values is important to the users of the statements. Therefore they favour either preparing supplemental financial statements using value-based accounting or supplemental disclosures of this information.*
- *The estimated value of reserves lacks the quality of reliability necessary for recognition as an asset. Reserve estimates are subjective. Only after a mine or field has been producing for several years is it possible to develop highly reliable estimates of quantities and even then a degree of estimation remains. Assumptions about costs and prices that are inherent in value estimates are highly subjective.*
- *Use of varying discount rates in value measures reduces comparability across enterprises. If each enterprise were permitted to determine its own discount rate, value measures would not be comparable across enterprises. On the other hand, if a uniform rate were to be required of all enterprises, the result would not reflect economic reality for most enterprises.*
- *Mineral reserves in place have no ready market. Therefore, it is argued, such assets should be recorded on an historical cost basis. Even if value based accounting were to be used, it should apply only to those assets where value is easily measured and there is a ready market available for the enterprise to realise the recorded value. There is no such market for mineral reserves; and*
- *Reserve values and quantities are proprietary information and should not be disclosed to competitors*".

It should be noted that how you attempt to treat reserves may be entirely different to how you treat resources, if indeed you recognise resources as having value (considering that SEC only recognises reserves). The argument is that resources have "reasonable prospects for eventual economic extraction" which means that at the current time they are not adding any value to the company, whereas reserves that are being exploited are. Hence the discussion from an accounting perspective mainly focusses on mineral reserves only for financial reporting.

Based on both arguments for and against recognising mineral reserve values on the primary financial statements, it should be noted that both are valid, however, the middle ground is currently being implemented due to the complexity of the issues around the extractive industries. Hence financial statements are still reported based on the historical cost basis and supplemented by disclosure on mineral resources and mineral reserves.

4.4. Factors affecting the Value of Mining Shares

The primary factors that affect and influence share prices of companies in the minerals industry are commodity market prices, operational efficiency and marketing to investors. Deloitte (2012) pointed out that these factors are summarised as common value drivers for any business enterprise. The high level shareholder value map can be depicted as drivers for shareholder value as shown in Figure 4.1. According to Deloitte (2012, p3), regardless of the type of business, "*shareholders value a company that can grow revenue while delivering a healthy margin and efficiently using its assets. Since value is relative, more revenue growth is valued over less growth, larger margins are valued over smaller ones, and greater asset efficiency is favoured over lower efficiency. Furthermore, shareholders value the ability of management to sustain the continuing improvement of revenue, margin, and asset efficiency"*. In the minerals industry, growing the revenues is determined partly by factors outside the influence and control of the company (such as commodity price and exchange rate), and which can only influence profitability by controlling productivity and cost of production.

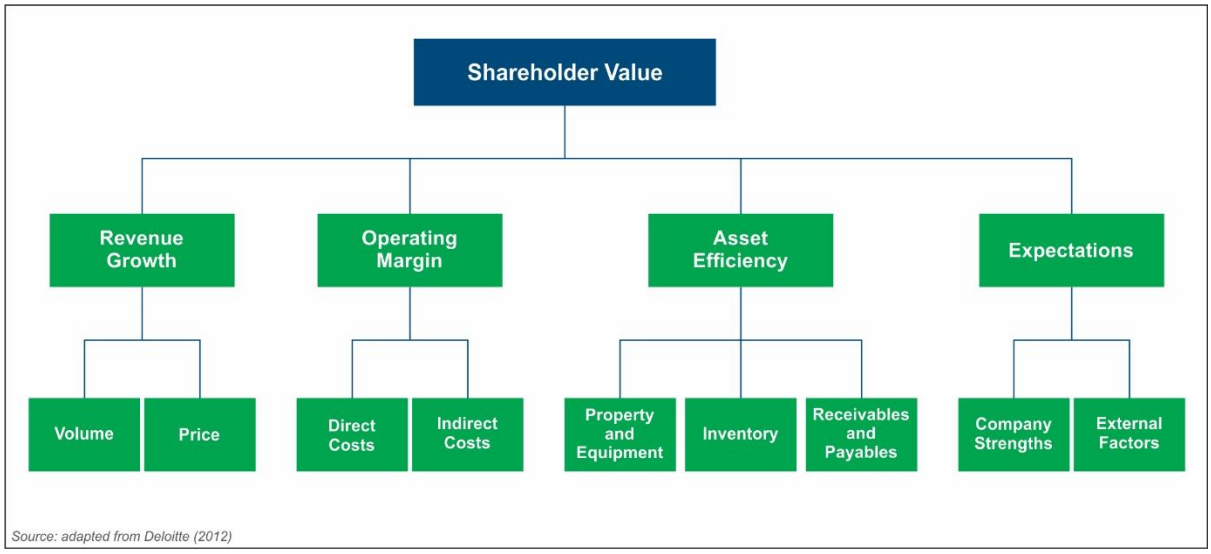


Figure 4.1: High-level Shareholder Value Map (Deloitte Methods) with value drivers

(Adapted from Deloitte, 2012)

In trying to understand these factors Maverick (2015) further identified that there are two tiers of companies in the mineral industry and these would have different factors influencing their share prices. These are the top tier and lower tier mining companies. Maverick (2015) defined the top tier mining companies as those that consist of a significant number of established, operating mines. For such companies, the factors driving share prices are the current commodity price for the metal or ore they produce and their operational efficiency in terms of lowering production costs as alluded to by Deloitte (2012). Maverick, (2015) further defined the lower tier, mining companies (junior miners), as companies that are still in the exploration and development phase and are yet to bring their mining products into production.

For these companies, share price is driven primarily by their ability to successfully market themselves to investors based on successful exploration results and the potential of discovering the ore deposit that is being explored for.

Maverick (2015, p1) further pointed out that "*current commodity market prices for the metals companies mine significantly affects share prices for productive, established mining companies. Once a mine is operational and producing, production costs are relatively fixed and do not tend to vary with the market price of the mined metal*". This is because the increase in the commodity price of mined ore does not usually increase production costs. The benefit of increased commodity prices commonly goes directly to a mining company's bottom line. Usually when the commodity price of metals rise, share prices of mining companies often rise exponentially. Maverick (2015, p1) provided an illustration that "*a 20% increase in the price of gold can translate to a 50% increase in share price for a gold mining company*".

Operational cost and productivity efficiency is key to a mining company's profitability, and ultimately to its share price. Mining companies have to make large capital expenditures to explore, evaluate, develop and construct a mine to production. This process normally takes 10 to 15 years. This requires careful planning and management of capital expenditure. Maverick (2015, p1) further explained that the "*costs involved in mining include hiring the right geologists to identify and assess ore deposits, building the necessary infrastructure to provide access to the mine site, negotiating with governments and negotiating labour costs*". Once a mine is in production, careful cost management is still required. The company may have to weather cyclical changes in commodity prices over which the company has little or no control. Maverick (2015, p1) concluded that "*mining companies must maintain operational mines even during downturns in commodity prices, since it is often cost prohibitive to go through the process of shutting down and then reopening a mine. Significant improvements in cost-efficient production can greatly increase a mining company's profitability*".

Marketing their stocks and attracting new investors is of prime importance for junior mining companies. The ability to accurately present the prospectivity of an area based on the exploration results, with a good management team with a proven track record is vital for such companies. Lastly, the capacity to effectively communicate to investors is critical to the survival of mining companies still in the exploration and development phase, because they depend almost entirely on investors to fund their operations. Another key component is a company's ability to obtain favourable long-term financing, and there is need for the company to be managed and controlled by mining professionals that have a sound track record of developing exploration projects into mining operations.

From a technical point of view the valuation of a mining company or mining shares would depend on four main factors which are:-

- Stage of Production: the stage of development of the mining company or mining project is discussed in detail in Section 1.4. In general, the higher in the stage of development the higher is the value attributed to the mining company or projects since the perception of risk is less compared to earlier stages. Quoting Wall Street, where, "*the market doesn't value uncertainty*", a mining company is worth more per ounce in production than in a development or exploration stage;
- Actual time to production: The closer to production the mining company is, the higher the company is valued per ounce by the investors, since cashflow is '*king*'. Even if two companies are in the same mining stage, the one that is closer to production, the market tends to attribute a higher value;
- Mineral Resource and Mineral Reserve estimates: The value of a company is not only dependent on mineral resource and reserve estimates, but also the classification categories of these estimates. In general higher value is ascribed where the geological confidence is greater in the definition of the mineral asset, and the quantity of measured and indicated resources, as shown in Figure 1.1. As mining company moves closer to production, the amount of proven and probable mineral reserves increases at the expense of indicated and inferred mineral resources. The market puts a higher per ounce valuation on proven and probable reserves compared to a company with only mineral resources.
- Price of resource (or commodity): The value of an asset is directly related to the current commodity price as well as the anticipated future and forecast prices, whether that be for the better or the worse. For example, if a mining company is not currently selling gold, its value would be directly proportional to the price of gold, as the market expects it to sell gold at a profit in the future based on the anticipated future and forecasted gold prices.

4.5. Equity valuation of mineral companies

The fundamental aspect in conducting a valuation on any company is to understand how the company and industry sector operates, and what factors affect their ability to generate free cash. The value of a company is driven by the potential future cash flows anticipated by the providers of capital, and these are used to determine a value of a company at a specified date. Investment analysts use specific multiples (i.e. factors) to analyse and value the mineral companies relative to their peers, and use the multiples to make investment decisions.

Market comparable valuations are widely used in the mining industry as addendums to the DCF technique. Given the basic nature of the minerals industry and low product differentiation, it is fairly simple to use multiples as a guiding valuation methodology albeit with some adjustments to cater for the peculiarities of different deposits and hence the mining operations. It should be noted that the multiples are only relevant when used for companies mining the same ore/mineral, on the assumptions that the companies in the same industry will face similar risks. Selection of the right peers when using trading or transaction multiples is important. Even within the same country and same commodity, there can be wide variations on operating costs, quality of the deposit, method of extraction and capital expenditure, therefore multiples should only be used as a guiding number. The most widely used multiples in the M&A environment are related to Enterprise Value (EV) and Earnings before Interest, Taxes, Depreciation and Amortisation (EBITDA) such as EV/resource, EV/reserve and EV/EBITDA. EV is also known as “firm value”, and was defined by Pignataro, (2013) “*as the value of the entire business including debt lenders and other obligations*”. Debt lenders and other obligations can include short-term debts, long-term debts, current portion of long-term debts, capital lease obligations, preferred securities, non-controlling interest and other non-operating liabilities such as unallocated pension funds. However, other multiples are also used widely in the equity valuation of companies in the mineral industries.

EV is summarised as EV = market value of common stock + market value of preferred equity + market value of debt + minority interest - cash and investments.

As is the norm with all multiples, one must be careful to match firm level results (EBITDA, resources, reserves, assets) with firm value and equity level results (Net Income, Cash Flow (to equity), Book Value) with equity value. The most common multiples utilised in the mineral industry are discussed in the next sub-sections.

4.5.1. Enterprise value to EBITDA (EV/EBITDA)

This multiple is commonly used in the investment fraternity across all industries and is commonly referred to as the enterprise multiple or Earnings before Interest, Depreciation and Amortisation (EBITDA) multiple. EBITDA measures profits before interest, and the non-cash expenses of depreciation and amortisation. This is often used to determine the value of a minerals company. One of the main advantages of the EV/EBITDA ratio over the price-earnings ratio (P/E), as the most popular valuation multiple, is that it is unaffected by a company's capital structure (Dumont, 2013). Drake (2015)

further supports the argument that most analysts look at a company's EBITDA because it enables comparison of the operating results among companies in the same line of business, that have a similar operating cost structure. This multiple is also not affected by the method a mining company chooses to spread the capital costs over the assets' useful life. If a company issues more shares, it would decrease the earnings per share, thus increasing the P/E ratio and make the company look more expensive, whereas the EV/EBITDA ratio would not change (Investopedia, n.d.). At the same time, if a company is highly leveraged, the price per cash flow (P/CF) ratio would be low, whereas the EV/EBITDA ratio would make the company look average. The EV/EBITDA ratio compares the minerals business, free of debt, to EBITDA.

The EV/EBITDA is an important metric as mineral companies typically have a lot of debt and the EV includes the settlement costs (Investopedia, n.d.). In times of low commodity prices multiples expand, and in times of strong commodity prices multiples contract. This is mainly because the cost required for exploration is usually significant and thus affects the multiples.

A low EV/EBITDA ratio indicates that the company might be undervalued. It is useful for transnational comparisons as it ignores the distorting effects of differing taxes for each country. It is also often used to find takeover candidates, which is common within the minerals sector. The lower the multiple the better, and in comparing the company to its peers it could be considered undervalued if the multiple is low. Additionally, enterprise multiples can vary depending on the industry. This is why it is important to only compare companies within the same industry.

Multiples like price/earnings ratio (or P/E ratio) or EV/EBITDA could be used to value a company based on its own historical multiples or peer companies' multiples (Investopedia, n.d.). One would apply a premium or a discount, based on the stage of development, quality of earnings, commodity price forecasts and leverage ratios. The EV/EBITDA multiple would be of better value for mining companies than EV/EBITA, because capital expenditure for these companies tends to be quite significant and depreciation, depends on the timing of the capital expenditure. However, one shortcoming in the earnings based multiple method is that it could be driven by the commodity price assumption taken in that particular year.

4.5.2. Enterprise value/Proved + Probable Reserves (EV/2P)

This multiple helps research analysts to understand how well mineral reserves will support the company's mining operations. Generally the EV/2P ratio should not be used in isolation, as not all mineral reserves are estimated using the same technical and economic parameters nor the timing for extraction. However, this multiple can still be an important metric to use for the valuation of mineral properties when little is known about the major cash flow assumptions, i.e. before the necessary engineering studies have been completed.

Mineral reserves can be proved or probable reserves depending on the jurisdiction. When the EV/2P multiple is high, the company of interest would be trading at a premium for a given amount of contained mineral in the ground. A low value would suggest a potentially undervalued company.

EV to reserve is also used for valuing mining companies because it is very difficult to assess the exact amount of contained mineral within a deposit at any particular point in time (geological risk), so valuations follow the market value of its reserves and companies with proven track records of successful exploration command a premium or higher valuations (Investopedia, n.d.).

4.5.3. EV/Resources

Mineral resources are the mineral deposits existing in the prospective area that have reasonable prospects for eventual economic extraction. In general the delineation of measured, indicated and inferred resources is dependent on the natural variability of the specific deposit and the amount of effort to upgrade from one category to another. The quantity, quality and continuity of the resource is estimated via geological evidence and knowledge. Mineral resources are divided based on decreasing geological confidence into Measured, Indicated and Inferred Resources (M+I+I) as illustrated in Figure 1.1. In general higher value is ascribed where the geological confidence is greater in the definition of the mineral asset. When the EV/Resource multiple is high, the company of interest would be trading at a premium for a given amount of contained mineral in the ground. A low value would suggest a potentially undervalued company.

4.5.4. EV/Reserves

Mineral reserves are the economically mineable part of the Measured and Indicated Resources. These can be determined only post a pre-feasibility study which has made assumptions on cost of mining and pricing of the product. They are divided into Proved and Probable Mineral Reserves as shown in Figure 1.1. Proved Reserves are the economically mineable part of Measured Resources and Probable Reserves from both Measured and Indicated Resources. Inferred resources cannot be converted to reserves according to the reporting codes, and therefore technically have no value, although small quantities are normally included in the mine plan for the purposes of practical mine layout. Inferred Resources cannot be converted to reserves, and therefore they have little or no value, even when small amounts are included in a mine plan for practical purposes. The issue comes because financial analysis does not differentiate between resource categories and ascribes the same commodity price to Proven, Probable and Inferred Resources in the Mine Plan. When the EV/Reserve multiple is high, the company of interest would be trading at a premium for a given amount of contained mineral in the ground. A low value would suggest a potentially undervalued company.

4.5.5. Price to cash flow: P/CF

Mining analysts will often use the price-to-cash-flow per share multiple. A few advantages of the price–to-cash-flow multiple is that in contrast to earnings, book value and the P/E ratio, cash flow is harder to manipulate (Investopedia, n.d.). Earnings can always be tweaked by aggressive accounting, and book value is calculated using subjective depreciation methods. One disadvantage is that while easily calculated, it can be a little misleading if there is a case of above average or below average financial leverage.

To calculate this, the price per share of the company that is trading is divided by the cash flow per share. In order to limit volatility in the price, a 30-day or 60-day weighted average price can be used to obtain a more stable value that is not influenced by random market movements (Investopedia, n.d.). The cash flow in this case is calculated as the operating cash flow less exploration expenses. This method adds back non-cash expenses, depreciation, amortisation, deferred taxes and depletion. For oil and gas companies in particular, due to their nature, this allows for better comparisons across the sector. Lastly, the share amount in calculating cash flow per share should be calculated using the fully diluted number of shares for most accurate results.

The P/CF Ratio is similar to the P/E ratio but uses cash flow which is more accurate because it removes the non-cash cost of depreciation and amortisation. When used for multiple years, a year of high capex can also distort results. Moreover, it is also important to note that in times of low commodity prices multiples expand, and during high commodity prices multiples contract.

4.5.6. Price earnings ratio - PER (Stock price/ Earnings per share)

The PER ratio is a standard valuation ratio used across all industries. It is defined as the number of years to recover the current share price estimated from the Current Share Price divided by the Earnings Per Share (net profit after tax divided by the number of shares on issue). This is the same as Market Capitalisation/Net Income and gives a measure of equity value as opposed to firm value or EV, as measured in the above two ratios (Investopedia, n.d.). A high PE ratio implies that an investor has to pay more per unit of earnings now. This could be due to higher volume growth prospects or improved margins expected in the near future. When used for valuations, a view of future earnings for a few years based on analyst forecasts and industry averages for a few years can be used to get a range of valuations. This helps to eliminate aberrations that may occur for a year or two of abnormal production or abnormal prices. It is important to ensure the sanctity of forecasted earnings' periods comparing January to December results of one company to July to June results of another company can cause errors due to cyclical effects. Using an EV/EBITDA multiple will be very dependent on what commodity prices are assumed in that year. It is more accurate to project a commodity price for a year or two but not into perpetuity.

4.5.7. Net asset value (NAV)

The ratios discussed earlier are occasionally used when discussing mining companies, but it is more likely for the net asset value (NAV) to be used.

NAV = (assets - liabilities) / number of outstanding shares

In this context, assets include total market value of the fund's investments (priced using the closing price of all the assets on the day the NAV is calculated), cash and cash equivalents, receivables and accrued income (Investopedia, n.d.). Liabilities equal total short-term and long-term liabilities, plus all accrued expenses, such as staff salaries, utilities and other operational expenses (Investopedia, n.d.). In other words, a company's NAV is calculated by adding the DCF produced from its mining operations, adding cash and subtracting any debt. There are a number of reasons why NAV, instead of price multiples, should be used when valuing mining companies. The main one is that NAV takes into consideration a company's debt position, as well as the cash flows over an entire life of mine (LoM), and the initial and sustaining capital required to build or operate a mine.

NAV has drawbacks. The first one is the sensitivity to commodity prices, and the method of determining the appropriate discount rate (analysts use a lower discount rate for gold mines than base metal mines) (Investopedia, n.d.). Another drawback is that the most popular method to calculate the discount rate is the Capital Asset Pricing Model (CAPM) which states that the cost of equity equals the risk-free rate plus beta (i.e., correlation to the market in general) times the market risk premium. Other drawbacks of NAV include the commodity price assumption. The analyst might make assumptions regarding the size of a deposit, thus penalising long-life assets, particularly when using higher discount rates. Despite these drawbacks, analysis by NAV is still more theoretically sound than price multiples.

4.5.8. EV/ annual production

The EV per unit of annual production compares companies in the same commodity against each other. The one with higher value means that it is performing well compared to the ones with a lower unit value.

4.6. Investment Banking Methodology

In finance, in order to properly estimate a value of a business based on the DCF, the valuer needs to first establish the appropriate cash flows to value i.e. the unlevered free cash flow (UFCF) (Pignataro, 2013). The terminal value is estimated as being the value of the business after the last projected year in the DCF. The cash flows and the terminal value are discounted using an appropriate discount rate that takes into account the riskiness of the cash flows and the time value of money. Those values are then added to get the net present value of the asset.

Extractive industries are unique in a number of aspects. Once a mineral deposit is sufficiently established from a technical perspective, and its economic viability is verified with a feasibility study, the processes to extract the ore and produce the commodity are known with a high level of confidence. Capital and operating costs, therefore, can be estimated with a reasonable degree of precision. Furthermore, the product usually has a ready end market (global or regional) so revenues can be forecasted using publically available forward pricing curves including the long term forecast price. These factors, estimates and forecasts form the basis of the DCF valuation models.

In the construction of a DCF model for investment banking purposes, there are two major components, namely the forecast period and the terminal value. The forecast period is typically 3-5 years for a normal business, but can be much longer in some types of businesses such as a mining operation. This is because this is a reasonable amount of time to make reasonable detailed assumptions. It should be noted that the forecast prices are best estimates of the future commodity price and are unlikely to be met in reality. The terminal value is estimated for periods beyond the forecasted period and is considered more uncertain. The DCF is the most widely used valuation methodology in finance especially when valuing mineral companies due to the complexity and interactions between the different value drivers, as discussed in more detail in the next chapter. This estimates the intrinsic value of an entity given a set of assumptions that drive future cash flows. Many financial professionals compare the DCF value per share to the market value per share to determine if the company is undervalued or overvalued, and then make trading decisions based on such information.

The high level methodology used in the construction of the DCF, using the financial statements, notes to the financial statements and any technical reports if available is summarised in the following steps:-

Step 1: Determine the type of cash flows to be discounted either unlevered or levered free cash flows (FCF). Are these enterprise value (before debt payments) or equity value (after debt payments) FCFs? Discounting unlevered FCFs will yield the EV, while discounting levered cash flows will yield equity value. However, there is a simple conversion from equity value to EV and vice versa, so both approaches theoretically lead to the same result. For the purposes of this thesis the EV was adopted and utilised in all analyses.

Step 2: Determine how many stages are required for the DCF. Most practitioners who value mature companies use a two-stage DCF model. In the first stage the valuer would forecast cash flows explicitly for a certain period of time (usually 5-10 years for mineral companies) and in the second stage the valuer would calculate the terminal value. The two staged DCF models are the most widely used by investment analysts.

In the minerals industry, the DCF analysis generally covers the period of the current mining plan, as this gives the period over which the mineral reserves are to be extracted and thus generate value. The

DCF may comprise an initial 3-5 year period where the forward commodity prices have been estimated with more confidence, followed by the remaining LoM years based on the long-term commodity price.

Step 3: For the first stage, determine how many years are required for the explicit forecasted period to be. Typically, 5-10 years is an accepted range, within the investment banking fraternity.

Step 4: Discount the stage 1 cash flows by an appropriate discount rate that reflects the riskiness of the various sources of capital. For unlevered DCF, use weighted average cost of capital (WACC) as the discount rate and for a levered DCF, use the cost of equity as the discount rate.

Step 5: Calculate stage 2 FCF using growth in perpetuity method or exit EBITDA multiple method. Terminal value is the estimated value of a business beyond the explicit forecast period (Pignataro, 2013). This is a critical part of the financial model as it typically makes up a large percentage of the total value of the business, depending on the expected LoM. There are two main approaches to calculating terminal value, either using the perpetual growth or the exit multiple.

The perpetual growth method of calculating a terminal value is the preferred method among academics as it has the mathematical theory behind it. This method assumes the business will continue to generate Free Cash Flow (FCF) at a normalised state forever (perpetuity). The formula for calculating the terminal value is:

$$TV = \left(\frac{FCFn * (1 + g)}{(WACC - g)} \right)$$

Equation 4.1

Where:-
TV = terminal value
FCF = free cash flow
g = perpetual growth rate of FCF
WACC = weighted average cost of capital
N= last year of the forecast

The exit multiple approach assumes the business is sold for a multiple of some metric (i.e. EV/EBITDA) based on currently observed comparable trading multiples for similar businesses. The formula for calculating the terminal value is:

TV = Financial metric (i.e. EBITDA) x trading multiple (i.e. 10x)

Equation 4.2

The exit multiple approach is more common among industry professionals as they prefer to compare the value of a business to something they can observe in the market. Academics prefer the perpetual growth model since it is based on theory that has been substantiated by proof. Some industry practitioners will take a hybrid approach and use an average of both.

Step 6: Discount stage 2 cash flows back to the present value, using the same discount rate established in Step 4.

Step 7: This being an enterprise value DCF, the enterprise value is the sum of stage 1 and stage 2 discounted cash flows.

Ryan (2008) noted that in estimating mark-to-model values, companies typically make a choice around which valuation model and inputs to use in applying the chosen model. This needs to be compliant to the current financial reporting standards and guidelines as they are applied in the mineral industry. All valuation models are limited, and various models capture the value-relevant aspects of positions differently. Companies often must apply valuation models using inputs derived from historical data that predict future cash flows or correspond to risk-adjusted discount rates. The financial period that the company chooses to analyse historical data in determining these inputs can have a significant effect on it's mark-to-model valuation results and the estimated values of the mining company.

4.7. Chapter Summary

This chapter has discussed that the IFRS and GAAP were prepared for general application to all industries and enterprises. These standards were not adapted or redesigned to suit the peculiar requirements for the extractive industries. As already alluded, the different accounting bodies have been conducting research to develop an accounting standard for the extractive industry for the last two decades. These gaps still exist and have been highlighted in the previous two chapters of this thesis.

Investment analysts use specific multiples (i.e. factors) to analyse and value mineral companies relative to their peers, and use the multiples to make investment decisions based on the published financial statements and additional research that the analysts would conduct in an effort to understand the important value drivers for the mining company to be valued. However, due to the complexities and peculiarities in the minerals industries the ratios cannot capture all these factors, hence Chapter 5 will discuss how the peculiarities are captured in a DCF.

5. MINERAL PROJECT EVALUATION AND MINERAL ASSET VALUATION

5.1. Chapter overview

This chapter discusses the two main valuation methodologies commonly used in the valuation of development projects and operating mines that were described in Section 1.3.4. These methodologies include the DCF analysis which falls under the income approach and the comparable transactions methods which falls under the market approach. The difference between mineral project evaluation and mineral asset valuation was discussed in detail in Section 1.3.3. It should be noted that both these two processes both utilise the DCF analysis. Hence this chapter will explore the inputs required in a comprehensive DCF analysis for either an evaluation or valuation process.

It is important to fully understand an extractive company's Mineral Resources and Mineral Reserves, because they are the single biggest assets held by these companies and the sale of the mineral is the only source of future cash flows (IASB, 2010). This assertion concurs with Ellis (2012, p 34) who argues that, *"a mineral resource estimate, if one exists, will be an important input in developing a valuation estimate of a mineral property, together with other extensive information such as geographical, environmental, regulatory and permitting, political and social, transport, products and product markets, cost estimates and details from transactions of mineral properties with similar characteristics*." The chapter will explore how the Mineral Resources and Mineral Reserves is the focal point for both of the processes because it is an integral part in establishing the links.

The chapter will also discuss the mineral project evaluation and MAV fundamentals and how these process are related. Lastly, the chapter will explore how the relationship between mineral project evaluation and MAV would assist in the development of a framework to link mineral asset valuation and financial reporting for mining companies and how this will be applied in the case study.

5.2. Discounted cash flow (DCF)

DCF analysis provides a way of comparing the amount of the expected future cash flows and the amount of the initial investment required to build the asset that will generate the cash flows. The DCF models, in the mineral industry are all based on the same foundation that simply involves calculating the NPV over the entire estimated LoM, accounting for the investment costs and the production free cash flows (FCF). Both the investment costs and production FCF are typically realised over more than one financial period, hence they have to be discounted back to the valuation date using an appropriate discount factor that best represents the risk associated with the project and the associated FCF. Lilford, (2011, p6) further noted that "*the DCF valuation method is based upon the principle that for any initial investment in a mining opportunity, the investor will look to the future cash flows to provide a minimum return over their hurdle rate on that investment*.

The hurdle rate represents the minimum return of a project below which the decision to invest or develop a new project will be negative, and above which the project may be developed with a certain probability of achieving minimum returns". Smith, (2011a, p204) defined the "*DCF analysis method of evaluation as a forward looking methodology which requires that forecasts be made with respect to technical and economic conditions which are likely to prevail in the future. All predictions of the future are inherently uncertain but the level of uncertainty will be materially reduced if adequate data is available from which to predict the future rates of production, costs (operating and capital) and commodity prices associated with exploitation of the mineral resource to the end of its estimated economically useful life*".

DCF analysis is often applied to companies in the mining industry because it is the only way that information from various disciplines can be converted into the same monetary units, and provides an accurate evaluation of a company's worth, which depends heavily on projected future earnings. In the minerals industry, profit is geared more to changes in revenue than costs. The operational costs of a producing mine tend to remain relatively fixed, while revenues from sales vary greatly depending on the market price for the mined ore. The most important figures for accurate DCF analyses of mining companies are the discount rate, operating costs (including capital expenditures) and projected future earnings. Projection of future earnings is further dependent on projections of commodity prices over the long term, and on the grade or quality of ore that the company's mines produce.

According to Smith (2000) the mathematical equation of the general law in mineral asset valuation or evaluation, shows that the IRR and NPV are inversely proportional to capital costs, and directly proportional to profit, as shown by Equation 5.1.

$$IRR\ \&\ NPV = Fn\left(\frac{\mathrm{Re}\,venue - Operating\ Costs}{Capital_Costs}\right)$$

Equation 5.1

The value of the mineral project is a function of revenue, operating costs and capital costs as illustrated in the Equation 5.1 and the Figure 5.1. On the revenue side the mining companies need to maximise the revenue through influencing factors that affect the revenue. Revenue is affected by the achieved commodity price and the volume of product produced. Mining companies are price takers, hence they have very little or no influence on the commodity prices. The only factors within their control is the volume of product produced, which can be adjusted through improving the processing recoveries, increasing labour productivity or increasing the operating window. This would mean that the company could produce more products using the same resources available. On the cost of production side, the mining company needs to optimise its cost of production through increasing the asset utilisation and increasing productivity. On both sides of the mining company's EBITDA there are factors that can be maximised or optimised, increasing the profitability and hence the value of the mineral project. Supporting this notion, Deloitte (2012) suggested that all common value drivers summarised in the high level shareholder value map can be depicted as drivers for shareholder value, as shown in Figure 4.1.

In addition, Smith (2000) advocated that for a mining company, revenue is usually the only positive component of the cash flow, and is determined by commodity prices and any production factors that influence the amount of product sold such as production rate, dilution, grade and recovery. All these will have a parallel effect. On the other side the cash flow is direct function of the margin between revenue and operating costs. Hence the operating costs exert a stronger impact on the cash flow and the return, whereas the capital is usually a relatively smaller number compared to any other estimates over the life of mine (LoM).

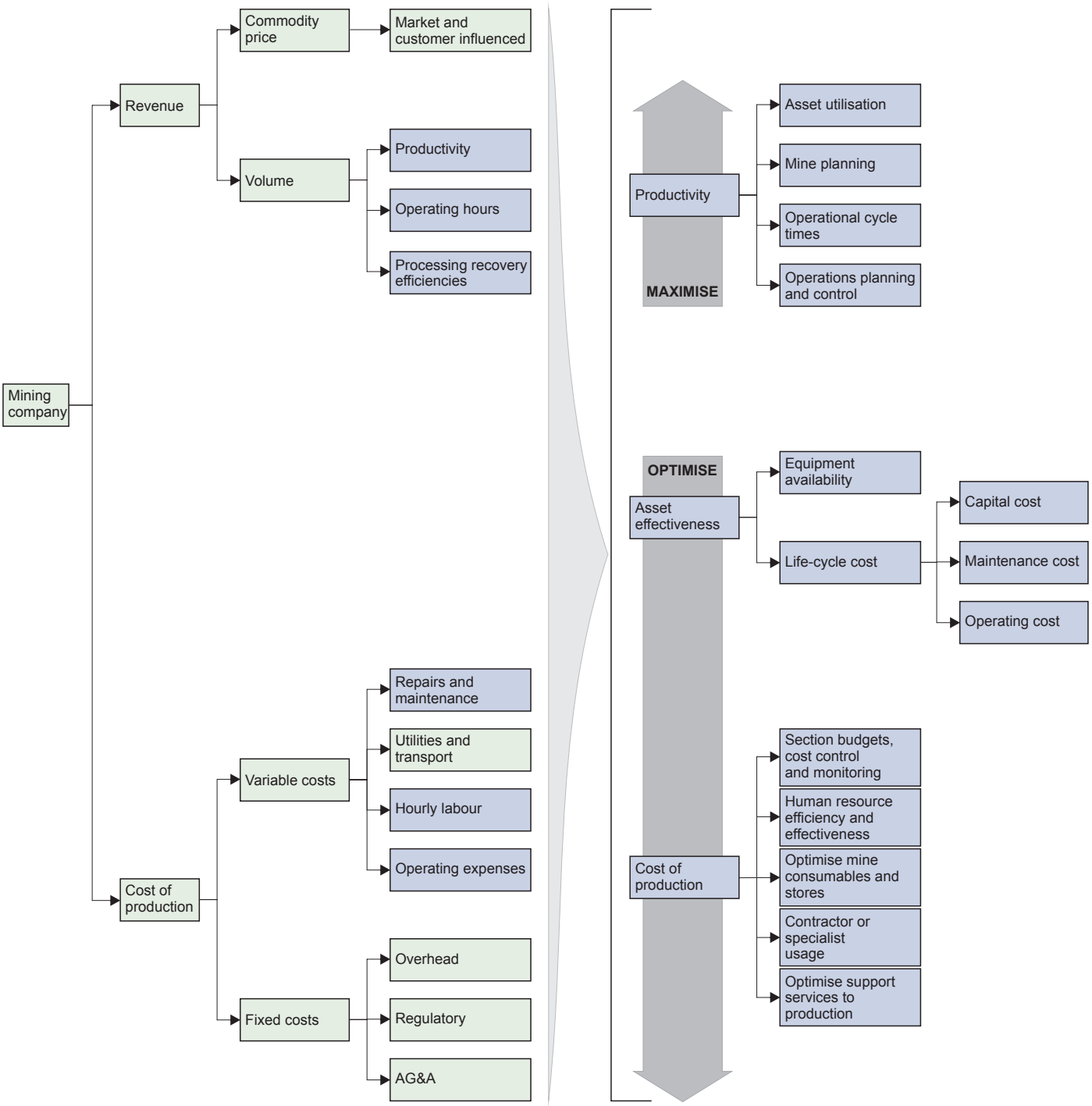
When preparing a DCF model for an established mining company, it is general practice that the valuer or analyst assumes that the mine will open on a specific date and continue to produce without cessation until the ore is exhausted. The price of the underlying commodity is assumed to be static, and to follow the futures curve or converge on some long-term forecast. To attain a more accurate discount rate, mining company evaluations must factor into the discount rate risks associated with specific mining projects, and country-associated risks dependent on mine location. Either of these risk factors can increase the discount rate.

In undertaking any DCF analysis, Lattanzi (2002, p1) emphasised that it is important to recognise certain fundamental attributes of the minerals industry which include:-

- *"The basis of any mineral development is the existence of an ore reserve;*
- *Costs are determined by the number of tonnes mined and processed, while revenues are determined by the number of pounds or ounces of metal produced. The two are related by the recovered grade of the ore;*
- *Profit is typically more sensitive to changes in revenue than it is to changes in cost; and*
- *Commodity price is a principal determinant of revenue, but it is also the factor with which is associated the greatest level of financial risk".*

Therefore, the most significant factors which must be considered in the DCF analysis or valuation of a mineral project are the reliability of the Mineral Reserve estimate (particularly with respect to recovered grade), the price at which the commodity is to be sold, the discount rate used to discount the estimated future cash flows and the risk of not maintaining the projected level of commodity price and cost of production. These factors provide the critical technical and financial inputs to a DCF analysis and are discussed in the next sections.

Figure 5.1: Mineral project economic value drivers



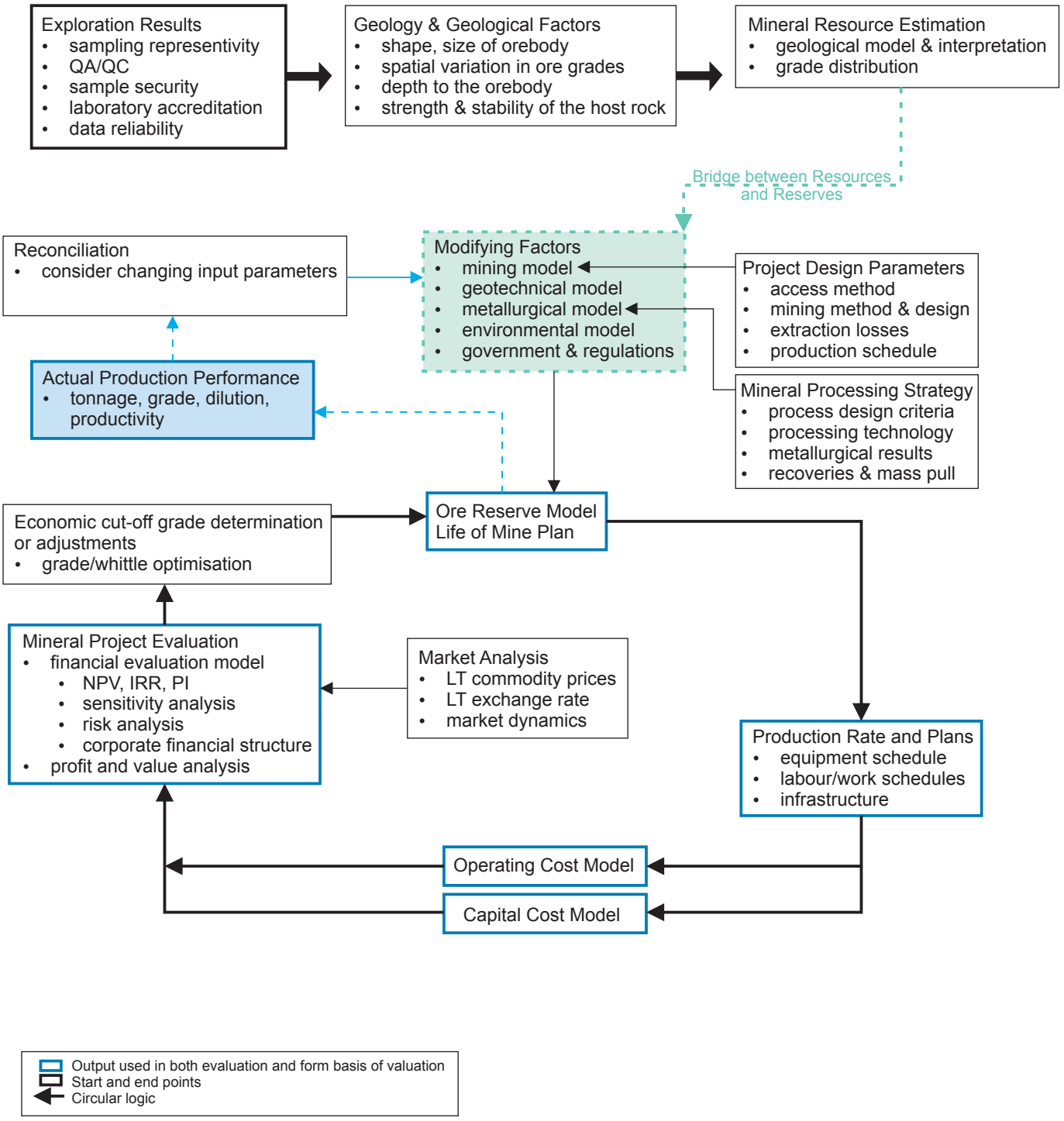
Source: adapted from "PWC, 2014"

5.2.1. Mineable Reserves and LOM

Lattanzi (2002, p 4) noted that "*the fundamental asset which underpins the value of any mining project is its mineral reserve, and a thorough understanding of the reserve is the first requirement of any DCF valuation*". SAMREC (2016) defined a Mineral Reserve as the economically mineable portion of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A Mineral Reserve includes diluting materials and allowances for losses that may occur when the material is mined. The relationship between Mineral Resources and Mineral Reserves is shown in Figure 1.1, and how these fit in a mining project development lifecycle. Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proved Mineral Reserves. Mineral Reserves are those parts of Mineral Resources which, after the application of all mining factors, are the basis of an economically viable project after taking account of all relevant processing, metallurgical, economic, marketing, legal, environmental, socio-economic and government factors. The link between the exploration results and the Mineral Reserves as part of the mineral project evaluation is illustrated in Figure 5.2.

The Mineral Reserves are estimated from a limited number of samples which constitute a very small proportion of the mineral deposit. Sampling is a statistical procedure utilised to estimate the Mineral Resources and Mineral Reserves, therefore, are subject to a greater or lesser degree of uncertainty. Two essential components in the estimation of a Mineral Resource is the contained tonnage and an estimate of average grade. With a sufficient number of samples to define the outline of the mineral deposit, the total tonnage of material contained within a mineral deposit can typically be estimated with a reasonable level of confidence. Estimates of average grade can be subject to significant error due to the variation of the contained mineral or metal. In MAV, the average grade is almost always a far more sensitive factor than the total tonnage. The tonnage and content of the recoverable Mineral Reserves are only known with certainty on permanent abandonment of the mineral asset after extracting all economically extractable minerals. By extension, at any other date of mineral asset valuation, the ultimate quantity and quality of Mineral Reserves is always uncertain, hence the productive life of the asset is estimated with some degree of uncertainty. The DCF analysis of any mineral asset is, therefore, highly dependent on certainty in Mineral Resource and Mineral Reserve estimation (Figure 5.2). It is of fundamental importance to understand the distribution of ore-grade material, when conducting a mineral valuation. AngloGold (2014) concluded that at a high level estimating the quantity and/or grade of the Mineral Reserve requires the size, shape and depth of orebodies to be determined by analysing geological data such as the logging and assaying of drill samples and mining face samples. This process may require complex and difficult geological judgements and calculations to interpret the data.

Figure 5.2: Mineral project evaluation framework linking exploratio results to LoM plan



When mining, it is unavoidable that some waste material or low grade material will be mined along with the ore. As a result of this mining dilution, the estimated grade of ore to be mined will invariably be lower than the grade of ore *in-situ*. Lattanzi, (2002, p 5) argued that "*it is fundamental to the economics of mining that costs are determined by the number of tonnes mined and processed, while revenues are determined by the number of pounds or ounces of metal produced. These two factors, cost and revenue, are related by the grade of the ore. Dilution by waste rock increases the tonnage of material mined and reduces the grade*".

Different mining methods and equipment used in the mining process determine the ability to minimise the amount of mining dilution through the selective mining of ore-grade material. Some level of dilution, however, will always occur in a mining operation. Generally, the cheapest or bulk mining methods would be the least selective in most cases. However, the added mining cost of a more expensive mining method is often outweighed by the added revenue benefit arising from the increased grade which results from improved selectivity. It is of paramount importance that the mining dilution is correctly reflected or accounted for in the Mineral Reserve estimate and/or in the DCF model (Figure 5.2). It is therefore indisputable that, the importance of the ore-grade factor in determining the value of a mining company should not be underestimated. A company with a lower grade of ore will have to process more material, possibly at greater cost and lower processing recoveries, in order to obtain the same amount of metal or valuable mineral.

The importance of a thorough understanding of the Mineral Reserve, in fundamentally underpinning any DCF analysis, cannot be over-emphasised. Most frequently, when mining projects fail, they do so because the mineable reserve has not been properly identified. The managing director of Mincon International, Bartlett (2016, p 1) also alluded to the fact that in their experience *"the single greatest cause of mine failure is inadequate study of the orebody. Recent improvements in the reporting requirements for exploration and mining projects, particularly the JORC Code, CIM standards and NI 43-101 all make perfectly clear the quality of exploration data required to define mineral resources"*. The most common error in this regard is inaccurate analysis of the distribution of ore-grade material, leading to an over-estimation of *in-situ* grade in the geological model, and an inadequate allowance for mining dilution, leading to a further over-estimation in the run-of mine (RoM) grade. This in turn, tends to an over-estimation of revenue. Typically, mechanical failures of mining or processing equipment can be rectified with time. An inherent over-estimation of RoM grade arising from exploration results, however, will have adverse economic effects throughout the life of the project, and all investment decisions would have been made based on inaccurate results. The link is clearly illustrated in Figure 5.2. In addition, Mineral Reserve and Mineral Resource estimates are dependent on forecasted commodity prices and the cost of recovering and processing minerals at the individual mine sites. This in turn affects the valuation of that mineral project or of the mining company.

The estimation of Mineral Reserves in an open pit environment requires the optimisation of the open pit mine planning process, which follows a circular logic (Musingwini, 2016), and as shown in Figure 5.2. According to Musingwini (2016, p 815) the main *"objective is to maximize the NPV of the pit, but the pit outline with the maximum NPV cannot be determined until the block values are known. In turn, the block values are not known until the mining sequence is determined; and the mining sequence cannot be determined unless the pit outline and cut-off grade are known……. In turn, the production costs and associated cut-off grade are not known until the mining layout and production scheduling have been determined; and the mining layout and scheduling cannot be determined unless the mining method and production capacity are available"*. Birch (2016, p 238) explained the concept of determining the cut-off grade and noted that "*mining companies calculate a cut-off grade to determine the portion of the mineral deposit that can be mined economically. This cut-off grade takes into account the forecast price of the commodity, the expected mine recovery factor, the cost to mine the ore and extract the commodity, as well as the fixed costs for the mine. By using the planned extraction rate, expected recovery factor, and total mineral extraction and sales costs, the variable factor in the break-even grade calculation then becomes the in-situ grade of the material being sold*". To estimate the optimal solution, several iterations have to be conducted changing the different assumptions and evaluating the results, until the company operating and economic objectives are met. The annual tonnage of ore mined and processed is a principal design criteria, chosen on the basis of the size of the Mineral Reserve, profitability and ability of the market to absorb the final product. The scenario that meets the objectives would be used as the basis to create the final mine design, production rates, operating costs, capital expenditure and cut-off grade for the estimation of the Mineral Reserves to be declared, and this would also form the basis of the mineral project evaluation.

The ultimate outcome of any Mineral Resource and Mineral Reserve process and feasibility study path is to secure funding to develop a technically and economically viable mine. The final feasibility study is referred to by some as a 'bankable' study because it can be used to support project financing by commercial bank loan facilities, or other forms of financing (Noppe, 2014). This supports the notion alluded to earlier, that for a mining project, the Mineral Reserve is the single biggest asset and drives the value in any mineral based company.

5.2.2. Determinants of Mining Revenue

Value is determined by the magnitude of the estimated future profits, and future profits are determined by the difference between revenues and operating costs in a DCF analysis. Generally in the minerals industry, the magnitude of profit is more sensitive to changes in revenue than it is to changes in operating costs because of the dependency on the prevailing commodity price. Therefore in estimating the future profits of a mining project, the most significant factors are those which influence revenue and are also identified as mineral project value drivers, as illustrated in Figure 5.1. Revenue, in a mining context, is the product of the following factors (Lattanzi, 2002, p 5):-

- "*The annual tonnage of ore mined and processed;*
- *The grade of that ore;*
- *The metallurgical recovery of saleable commodity; and*
- *The price of the saleable commodity".*

The ability to sell the commodities produced, especially the major precious and base metals, is generally not a concern, once they have been smelted and refined. Unlike most industrial minerals, bulk commodities and specialty metals, the annual rate of production will frequently be constrained by the level of demand for the product, and the commodity prices would be influenced by either an oversupply or undersupply of the mineral. A typical example of this phenomenon is in the iron ore industry, in which the prices tend to decrease when there is an oversupply of the product on the market and vice versa.

In conducting MAV of an existing operating mine, future rates of production can generally be reliably forecasted on the basis of historical operating experience, if the mining operation has reached steady state production levels. However, for a developmental project, there is no such body of historical production or experience, and MAV must be based on a design production rate. In this context, it must be recognised that few, if any, mining projects achieve their design rate of production immediately upon start-up. DCF analyses which fail to provide for a reasonable ramp-up of production during the first year of production, will typically overstate the cash flow to be achieved.

Once the annual production rates have been established as part of the mineral projects evaluation process (Figure 5.2), the next step in building the production profile is to estimate the amount of saleable metal or commodity. This is a function of the head grade and the achieved or estimated metallurgical recovery. Losses to process tailings have the effect of reducing recovered grade in the same way that waste dilution reduces RoM grade, and the application of the proper recovery factor is just as important as the application of the proper dilution factor (Lattanzi, 2002). Both of these factors act to reduce the quantity of saleable metal which will be produced from the *in-situ* ore.

Typically, metallurgical recovery is estimated on the basis of testwork. Lattanzi, (2002, p 6) noted that *"the most common sources of error in this regard are that the samples submitted for metallurgical testing are not fully representative of the design mill feed, and that realistic scale-up factors have not been applied to the process design in translating the results obtained under controlled laboratory conditions to those expected to be obtained in a full-scale commercial plant"*.

Ultimately, for a mine that has been in operation for some time, the throughput of ore, the mined grade of ore and the metallurgical recovery are reasonably well identified and to some extent controllable. The remaining determinant of mining revenue is the commodity price, which is normally beyond the control of the mining company. It is, nonetheless, not only the most important determinant of mining revenue, but also the most important determinant of overall value.

Whilst it is true that future commodity prices are extremely difficult to forecast accurately, especially over relatively long periods. This does not mean that no attempt should be made to do so. Lattanzi, (2002, p 6) proposed that, "*a thorough, well-reasoned forecast of supply, demand and price is an integral part of any valuation*" in the extractive industries. It is clear, however, that there is a great deal of uncertainty and risk inherent in any such commodity forecast, and any MAV conducted is inherently subject to such uncertainty. The need for a reasoned forecast of a commodity price, based on analysis of supply and demand, is a critical component of the valuation of an undeveloped industrial mineral project. A typical example of this happened in 2008, after the global financial crisis when the platinum price dropped to approximately USD820/oz. Fundamental analysis was conducted on the demand and supply and the industry cost curves, where the following observations were concluded as part of the MAV:-

- If the platinum price continued at the same level, more than 40% of the production would be halted, since the cost of production would be higher than the commodity price, resulting in mining at a loss; and
- If the demand for the metal was higher than what could potentially and sustainably be produced at that commodity price level, this will typically lead to an increase in the commodity prices.

Based on these two fundamentals, the platinum price was unlikely to persist at those levels over a long period of time and the price was bound to increase and achieve equilibrium. Within a month the commodity price had exceeded USD900/oz.

Hence a DCF valuation based on the simple assumption that the platinum price would hold at that level indefinitely, in constant dollar terms, would have yielded grossly erroneous results. This could have been avoided through careful market and economic analysis. Another recent example is the commodity prices that are being used for Mineral Reserves estimation in the copper and platinum industry. Almost all mining companies in this sector use commodity prices (USD3.05/lb and USD1, 300/oz respectively) that are higher than the current spot prices (USD2.3/lb and USD950/oz respectively), due to the market analysis that indicates that these commodity prices are going to increase in the short term. This is unlike the gold industry which uses commodity prices (USD900/oz) that are generally lower than the current spot prices (USD1200/oz).

5.2.3. Operating Costs

The operating costs are modelled around the major project design parameters and these would include the mining method, production rates, mining equipment schedules, work schedules, metallurgical process design and associated mining infrastructure (Figure 5.2). These parameters would form the basis of the operating costs estimation from first principles and as the major drivers of any mining operation.

At a higher level the cash operating costs will be incurred both on mine site, in extracting and processing the commodity which is shipped from the mine, and off mine site, in the transportation and downstream processing of that commodity into saleable end products is illustrated in Table 5.1. Generally, on-site operating costs are estimated under the functional sections of mining, processing, and general and administration. In these functional cost categories costs will then include estimates of the cost of labour, materials and supplies, and purchased services such as electric power, water and insurance. The estimation of site operating costs follows a fairly standard set of procedures based on a selected rate of production, a complement of mining and processing equipment capable of meeting that the production rate, and the ancillary and infrastructural facilities which are necessary to support the mineral project.

Table 5.1: Components of a typical Total Mine Operating Costs

Total operating costs	Total cash operating costs		On-mine cash operating costs			
comprise of:	comprise of:	components are:	comprise of:	components are:	components are attributable either:	Attributable components comprise of both:
Labour	Labour	On-mine	Shafthead	Direct	Directly	Fixed
					Apportioned	Variable
Stores	Stores		Concentrator	Direct	Directly	Fixed
					Apportioned	Variable
Contractors	Contractors		Central Services	Indirect	Directly	Fixed
					Apportioned	Variable
Utilities	Utilities	Off-mine	Smelting			
			BM Refining			
Sundries	Sundries		PM Refining			
			Other			
Amortisation						

Source : Smith (2011a)

For operating mines or even a project at a bankable feasibility study stage, the accuracy of operating cost estimates are generally considered within plus or minus 15% in accordance with Table 2 in the SME Guide (2014). Therefore, this is rarely an issue in DCF valuation. Estimates prepared at earlier stages in the development of a property will have even wider limits of precision. Table 2 in the SME Guide (2014) was drawn from the Mining Engineering Handbook to provide standards to be used by the Competent Person in preparing Technical Studies and it provides the study accuracy ranges for capital and operating costs estimates. It is imperative that sensitivity analyses be undertaken to determine the influence on value of more extensive variations on mine operating costs. The risk of materially underestimating site operating costs can be offset to some degree, by including a contingency allowance within the estimate.

Although contingency allowances are routinely applied to capital cost estimates, they are infrequently applied to estimates of operating cost. Most mining projects produce partially-processed products, such as doré bars or mineral concentrates. While these are saleable products in their own right, they require further processing at off-site facilities in order to render them suitable for industrial end use. The mining company bears the cost of downstream processing. One of the most common errors in DCF valuation is that these processing costs are not adequately reflected in the analysis. Where gold is recovered in a sulphide concentrate such as a copper concentrate, the costs of transportation, smelting and refining take on added significance. In these instances, the on-site processing plant is typically operated to maximise gold recovery, resulting in the copper grade of the concentrate being relatively low. Considerable care must be taken in determining the terms under which such concentrates can be sold, since copper smelters are likely to increase their charges for treating low-grade concentrates and these concentrates are associated with lower recoveries. Clearly, in such circumstances the cost of downstream processing of precious and base metal concentrates is a significant factor in DCF valuation, and it is imperative that these estimated costs be accurately identified and accounted for in the valuation model.

5.2.3.1. Productivity Improvements (Cost reductions)

The magnitude of the cash inflows and cash outflows are the only two factors affecting growth and profitability in a mining company. Increase in operational efficiencies and productivity improvements must accelerate to counteract negative price trends to some extent. Improving productivity is very difficult, because most mines operate at >95% availability on equipment and processing plant and there is very little capacity to increase production. Low commodity prices are generally offset by:-

- adjusting grade cut-offs, i.e. high-grading, which is clearly to the long-term detriment of the operation; and
- Expansionary capital and Stay in Business Capital (SIB capital) is deferred which is clearly a risk to the business.

Mining may remain a boom-and-bust industry, but companies do not have to depend on the commodity prices for success. It does not take a long period of declining prices to remind mining executives of the benefits of improved productivity and operational efficiencies (see Section 5.2.2). However, the industry has a decidedly mixed record when it comes to successfully implementing productivity improvements and operational efficiencies.

In many failed productivity initiatives, efforts stall because executives in charge lack a long-term vision, and fail to rally the rest of their team to the cause. Other frequent roadblocks include operational silos and engrained cultures that hamper productivity efforts. Successful productivity efforts incorporate a global view that aims at improving not only internal operations but also external relationships with suppliers and customers. Operational efficiencies' and productivity efforts must be continuous and sustained to have a lasting impact.

5.2.4. Capital Expenditure

Capital expenditure estimates are modelled upon the same design parameters as the operating costs, and will need to be prepared, firstly, for the initial pre-production cost of constructing the project (initial capital expenditure) and, secondly, for the on-going cost of replacing worn out mining equipment throughout the productive life of the operation also known as 'SIB capital'. Pre-production capital expenditures for a new mining project will typically be hundreds of millions of US dollars, and these expenditures will be incurred over the construction period, which is typically three to five years.

Globally, the approach used to develop a mineral project and activities that need to be completed along the project life cycle, is to a larger extent the same with local variations in the implementation strategy. Typically, initial capital expenditure is estimated and prepared by a recognised engineering firm, in conjunction with the compilation of a bankable feasibility study, based on a considerable amount of detailed engineering and cost estimation. The degree of accuracy applied for such estimates is normally in the region of plus or minus 15% (SME Guide, 2014). Lattanzi, (2002, p 8) noted that "*this estimate will be based on a comprehensive project scope, a detailed construction schedule, and a series of general arrangement drawings, single line electrical diagrams, and piping and instrumentation diagrams. These drawings will then be used to compile lists of the required mechanical and electrical equipment, and to estimate the required quantities of earthworks, concrete, structural steel, siding for buildings and similar items. Unit costs of major equipment and bulk materials will be based on budgetary quotations received from suppliers".* Contingency allowances of approximately 10% are typically applied to the estimates of surface capital expenditure and maybe a higher allowances applied to the estimated cost of capital mine development (SME Guide, 2014).

Capital expenditure estimates prepared at earlier stages of engineering studies will be subject to even wider limits of accuracy in the order of 30% to 50%. Similar to operating costs, it is again imperative that sensitivity analyses be performed to investigate the influence on value of wider variations in initial capital expenditure and SIB capital. Lattanzi (2002, p 8) noted that, "*the most common errors which occur in the estimation of preproduction capital expenditures, relate to over-optimism in the construction schedule and under-estimation of owner's cost"*. The owner's cost component of preproduction capital comprises those expenditures which will be incurred by the owner's team in supervising the work performed by the prime engineering, procurement and construction management contractor. In addition, the owner's capital account is also burdened by the costs of insurance, permits and licences, environmental baseline studies and impact assessments, associated public meetings, and like items. Owners typically begin with the view that they can manage the activities of their prime contractor with a very small team. As the project is developed, particularly in remote or foreign locations, it is frequently found that the owner has to allocate additional personnel and resources to this function than had been originally anticipated. In foreign locations, the owner's representatives may be mostly expatriates, and the cost of senior migrant staff in the field is usually very high.

Annual SIB capital expenditures will be lower, but since they are incurred at regular intervals, they can be quite significant in total over the LoM. It should be noted that the initial capital expenditure for the development of a mining complex would usually have an attached design and installed capacity in terms of mining production rates, milling and processing production rates and associated infrastructure, as illustrated in Figure 5.2. The SIB capital is the capital that is required to maintain the same design and installed production capacity over the estimated LoM. SIB capital expenditures required to sustain a project in operation can be estimated in detail on the basis of the assessed operating lives of the various components of stationary and mobile equipment. Otherwise, SIB capital expenditures can be estimated as a percentage of initial capital expenditure. Generally, DCF valuation is not sensitive to the annual allowances for sustaining capital, and approximate estimations may be acceptable.

With respect to capital expenditures, there is one area which historically has received minimal attention. It is the issue of environmental rehabilitation cost upon mine closure. Decades ago it was adequate to assume that the salvage value of the on-site equipment at the end of the mine life would be sufficient to cover the final cost of rehabilitation, and that there would be no net cash cost associated with mine closure. Under environmental regulations in most jurisdictions, and internationally accepted best practices, this assumption is no longer valid. Invariably, the cost of final reclamation of the site substantially outweighs the value of salvageable equipment. Many jurisdictions now require that a formal closure plan be prepared and costed prior to the commencement of production, and that financial assurances be put in place throughout the life of the operation, in order to ensure that funds are available to cover the costs of final rehabilitation or premature mine closure. The funding of final closure costs, however, is frequently overlooked in the valuation process, since they are of little significance in the DCF valuation of a mine with a projected LoM in excess of fifteen years, but can be important in the valuation of projects with LoM of ten years or less.

5.2.5. Mineral Resource Royalties and Taxes

All mining operations are subject to taxation, and many are subject to royalties in one form or another, payable to either private parties or government agencies. A mineral resource royalty is payment to the holder of mineral rights for the utilisation of the mineral resource. In South Africa, this payment is made to the State as holder of the mineral rights. Royalties based on either production or net smelter revenues represent an added cost to the operation, which must be fully reflected in the DCF valuation. It should be noted that the added costs associated with such royalties must be taken into account in determining the cut-off grade used in the estimation of Mineable Reserves (Figure 5.2). Birch (2016, p1) argued that "*an increase in cut-off grade due to an increase in costs (including the mineral resource royalty) leads to a reduction of available mineral reserves above the calculated cut-off grade*". Royalties based on revenue or production will tend to increase the break-even cut-off grade and, thus, will tend to turn ore into waste. Regulations governing the levels of taxation applicable to mining companies vary in each jurisdiction.

Different deductions may be applied in determining the income subject to each of these taxes, resulting in the calculation of cash tax liabilities becoming complex and time consuming. Nonetheless, since the cash taxes payable are invariably a significant component of the valuation, it is a task which must be undertaken with a degree of care.

It is important to also understand the nature of the tax regime in each jurisdiction. Most of the major mining jurisdictions in the western world allow for some form of accelerated depreciation of the cost of mining and processing assets when computing the income subject to tax. Accelerated depreciation does not reduce the total amount of tax payable over the life of the mine. It does, however, defer the payment of tax from the early years of mine life to the later years, thereby enhancing cash flow in the early years and increasing the value of the project as determined by DCF techniques. This leads to the creation of tax loss carry-forwards, and the utilisation of these losses would also depend on the jurisdictions and the future performance of the company. In some jurisdictions the losses expire after a regulated time. Changes in economic conditions, metal prices and other factors could result in revisions to the estimates of the benefits to be realised, or the timing of utilising the losses.

Some jurisdictions also allow additional tax deductions for depletion of the mineable reserve, further reducing the level of tax payable. The regulations governing the deductions for depreciation and depletion in a given jurisdiction can have a significant impact on the DCF analysis, and these regulations should always be fully reflected in the tax calculations which form an integral part of the valuation procedure. Inaccurate simplifications of tax regulations may lead to significant under-estimation or over-estimation of value, resulting in an inaccurate investment decision.

5.2.6. Discount Rate

Lattanzi, (2002, p12) suggested that, "*in the context of DCF analysis, it is important to distinguish between uncertainty and risk. Uncertainty is an attribute of any prediction of the future, but it carries with it the connotation that actual results may vary from the predicted results either positively or negatively, with a more or less equal probability of occurrence. Risk, on the other hand, refers principally to the probability that actual results will fall short of predicted results, and the use of the word tends to imply that actual results will vary negatively from the estimates more often than they will vary in the positive direction"*.

In the mining industry, because of intermittent contingent occurrences such as strikes or major equipment failures, Section 54 stoppages in terms of the Mine Health and Safety Act of 1996 in South Africa, actual rates of ore production fall short of design capacity more frequently than they exceed it. Similarly, experience indicates that, more often than not, the recovered grade of the ore is lower than predicted, and that both capital expenditures and operating costs are higher than estimated. Risk, then, is a word which is properly applied to the minerals industry, and it is a factor which must be considered in the valuation of mineral properties.

The variables that have the greatest impact on a DCF analysis are the Mineral Reserves, the commodity prices and the discount rate (Smith, 2000). Depending on the LoM of the mineral project, the different discount rates cause a variation of a more than 50% in the value placed on a project (Smith, 2000). Consequently, it is crucial to calculate an appropriate discount rate. Most literature and articles focus on the calculation of the corporate cost of capital. However, it is possible to determine a discount rate that is appropriate for an individual mineral project on the basis of industry expectations for project returns (Internal Rate of Return (IRR)), the risk factors associated with mineral projects in general, and the risks related to the specific project.

Smith (2000, p10) proposed that *"a discount rate for a mineral project comprises three principal components:-*

- *Risk-Free Interest Rate: The value of the long-term, risk-free, real (no inflation) interest rate is approximately 2.5%. Long term averages range from 2.3% to 2.6%. The 2.5% value is supported by numerous references in the literature and is set out in Ontario law.*
- *Mineral Project Risk includes risks associated with reserves (tonnage, mine life, grade), mining (mining method, mining recovery, dilution, mine layout), process (labour factors, plant availability, metallurgy, recoveries, material balances, reagent consumption), construction (costs, schedules, delays), environmental compliance, new technology, cost estimation (capital and operating), and price and market.*
- *Country Risk refers to risks that are related to country-specific social, economic, and political factors".*

Using these components, Smith (2000, p10) provided a framework to calculate a project specific discount rate:-

+ Real, risk-free, long-term interest rate	*2.5%*
+ Mining project risk (varies with level of knowledge)	*3.0%-16%*
+ Country risk	*0.0%-14%*
= Project specific discount rate (constant dollar, 100% equity)	*5%-32.5%*

Lilford (2006) argues that the discount rate should be the weighted rate reflecting the cost of capital of the various sources of capital applied to fund the company i.e. WACC. He further argues that fundamentally the discount rate excludes specific risks associated with the project being technical and economic but may include a small project risk component. His argument notes that after feasibility study has been completed the technical and economic risks are known to a 10% accuracy, therefore post feasibility study the discount rate should not vary. According to Lilford (2006, p141), the "*operating risks or the risk associated with not achieving a forecast plan must be factored into the asset or company's value through its cash flows using other valuation tools. These risk-mitigating tools include:-*

- *Sensitivity analyses incorporating weightings on probable outcomes;*
- *Real options;*
- *Binomial and polynomial tree analysis;*

- *Monte Carlo simulation; and*
- *Other available option pricing valuation methods, such as Black-Scholes's theories and formulae.*

Other different authors recognises these two different school of thoughts regarding the calculation of the appropriate discount rate and this debate is still on-going. According to Smith *et al*. (2007), real discount rates of 9-12% for mining projects are appropriate for mining projects in a stable country. For the purposes of this thesis, a WACC plus a specific project risk factor was considered the most applicable.

5.2.7. Sensitivity Analysis

Uncertainty can never be entirely removed from the evaluation and MAV process. Even the most thorough estimates of capital expenditure and operating costs are still subject to potential variations of, up to 15%, while metal prices have been subject to wide fluctuations, even over the short term. If all of these factors were simultaneously unfavourable, the economics of most mining projects would be seriously compromised. Conversely, if a number of factors were simultaneously favourable projects which appeared marginal at the feasibility study stage could be regarded as highly profitable.

The accepted procedure for analysing the effect of uncertainty in a deterministic DCF model is sensitivity analysis. Sensitivity analysis is required to evaluate the economics of a mineral project under various levels of sensitivity for the key project drivers. There are many forms of conducting sensitivity analyses that includes spider graphs, tornado diagrams, decision trees and Monte Carlo simulation to assess the probability of failure or success. Traditional sensitivity analysis involves varying one input parameter at a time, while keeping all other parameters constant at their base case levels. In this way, the effect upon value of each individual parameter can be determined separately.

However probabilistic DCF analysis utilise a different syntax, which takes into consideration all the possible permutations simultaneously. The reluctance of the financial community to adopt probability methods is the only reason that sensitivity analysis remains the "accepted" procedure.

5.2.8. Other Financial Considerations

In addition to the technical estimates of rate of production, revenue and cash cost discussed above, there are several considerations of a financial nature which must be considered in DCF analyses. The most important of these are:-

- The treatment of inflation: DCF analyses are most commonly conducted in terms of constant USD. This form of valuation makes no specific provision for future inflation. Rather, it implicitly assumes that revenues and expenditures are most likely to escalate at the same rate. In times

of high inflation, the use of constant USD will introduce inaccuracies in the calculation of tax liabilities and, potentially, also in the calculation of interest payments;

- The availability of debt finance: typically in the form of a bank loan, to fund a portion of the pre-production capital expenditure. From the standpoint of DCF analysis, the availability of bank financing will enhance the value of the project to the owner, provided that the effective after-tax interest rate payable on the loan is less than the discount rate used to reduce future cash flows to present value. The interest should note be considered in the DCF analysis, since this would have been considered in the WACC estimation; and
- The treatment of variances between currency exchange rates: The prices of most mineral commodities are quoted in terms of major currencies, such as USD or Pounds Sterling and, revenues are most commonly received in these currencies. Some components of cost, such as fuel oil, spare parts for heavy machinery and equipment, and many process reagents, are also commonly quoted and paid for in major currencies. A significant portion of cost, however, most notably labour cost, is incurred in the local currency of the country in which the project is located.

5.3. Comparable Market Transaction Methodologies

The market approach was defined by the IVSC (2013, p1) as, "*any approach to value based upon the use of data that reflect market transactions and reasoning that corresponds to the thinking of market participants. A general way of estimating a value indication for an asset using one or more methods that compare the subject to similar assets that have been sold."*

The Market Approach in MAV encompasses all of the methodologies that rely on databases of historical transactions of mineral assets (Lilford and Minnitt, 2005). These databases tabulate the prices at which all previous mineral asset transactions occurred. Such data provide a benchmark against which current mineral asset information and prices can be compared, in order to estimate the value of the mineral asset under consideration. The transactions include acquisitions, disposals and mergers, in addition to market capitalisations per unit of resource/reserve that are used as a sanity check for the transactions. Ideally, these transactions will to have been completed at arm's length, with the transacting parties being under no compulsion to transact.

The market approach may be considered subjective to the extent professional judgement is applied when comparing the mineral asset to be valued and the pool of mineral assets that have implied value from previous transactions. In the VALMIN and CIMVAL Codes, it is a requirement that the Competent Valuer should have a technical understanding of the issues being considered in the MAV. In applying the Market Approach, a Competent Valuer develops an indication of value for the mineral asset that is being valued by comparing similar mineral assets and making adjustments for the differences in the characteristics of the mineral assets that have been sold. It is difficult to ensure direct comparisons of different mineral assets because of technical idiosyncrasies that apply to almost every mineral asset.

The most appropriate approach to a valuation for developmental projects and operating mines would be the Income Approach to determine the fundamental value. However, if there are sufficient mineral asset transactions, these should be analysed and included in the MAV report to establish a reasonable range within which the value of the mineral asset should fall. Both the Income Approach and Market Approach should produce values within a reasonable value range, within the premises of the current market sentiments. Roberts (2006) also noted that the comparable transaction methodologies are key to ensuring that the fundamental valuations are congruent with what the market would actually pay. He emphasises that "*if the value estimated for a mining project using a discounted cash flow analysis differs significantly from the value implied using comparable market methods, the valuator may be using metal price or discount rate assumptions that differ significantly from those the market is currently willing to pay for"* (Roberts, 2006, p1).

The Market Approach valuation methodologies as discussed would be applied in the mineral industry, with the focus on mineral asset valuation of development projects and/or production assets either at project level or at a company level. This is relevant for the Oyu Tolgoi case study evaluated in Chapter 7. These methodologies are used to validate and support the DCF analyses results. It is industry best practice that at least two valuation methodologies should be used in estimating the value of the mineral asset.

5.3.1. Comparable Companies Transactions Methodology

Comparable companies' analysis is one of the primary methodologies used for valuing similar minerals companies or divisions. The analysis provides a market benchmark against which a Competent Valuer can establish valuation for a private minerals company or analyse the value of a public minerals company at any given point in time (Rosenbaum and Pearl, 2009). The comparable analysis has a broad range of applications in the MAV fraternity, particularly in M&A, initial public offerings (IPOs), company loan restructurings and project finance.

The foundation for comparable companies is built upon the premise that similar companies provide relevant reference points for valuing a given target company in the same business, due to the fact that they share key business and financial characteristics, performance drivers and, operational risks and challenges (Rosenbaum and Pearl, 2009). Comparable transactions analysis is designed to reflect "current" valuation based on the prevailing market conditions and sentiment. According to Rosenbaum and Pearl (2009), the comparable companies' analysis in many cases is more relevant than intrinsic valuation analysis such as DCF analysis. When conducting a comprehensive valuation, a DCF serves as an important alternative to market-based valuation techniques, such as comparable companies and precedent transactions, which can be distorted by a number of factors and sentiments such as the post-subprime credit crunch of 2008. As such, a DCF plays an important role as a verification of the prevailing market valuation for a publically traded company.

Roberts (2006, p1) concluded that "*market comparable and fundamental (e.g. DCF) approaches to mineral project valuation should not be viewed as alternative approaches to estimating project value, but rather can and should be integrated to derive a single value estimate based on both market and fundamental data*".

The Competent Valuer can establish valuation parameters for the target company by determining its relative positioning among similar or peer mining companies, taking into consideration the technical and operational key performance indicators of the individual mineral assets in the portfolio. The peer companies are benchmarked against one another, and the target mining company based on various technical, operational and financial statistics and ratios. At the same time, market trading volume levels may be subject to periods of irrational investor sentiment that skew valuations as either high or low.

Furthermore, no two mines or companies are exactly the same, so assigning a valuation based on the trading characteristics of similar companies may fail to accurately capture a given company's true value. The resulting trading comparison should be used in conjunction with the other valuation methodologies. A material disconnect between the derived valuation ranges from the various methodologies might be an indication that key assumptions or calculations need to be revisited.

5.3.2. Precedent Transactions Methodology

Precedent transaction analysis is similar to the comparable companies' analysis, as it employs a multiples-based approach using the historical transactions that have occurred in the industry, to derive an implied valuation range for a target mineral asset. This methodology is premised on multiples paid for comparable mineral assets or companies in prior M&A transactions. It is one of the primary methodologies used for valuing similar minerals companies or divisions. The selection of an appropriate universe of comparable acquisitions is the fundamental basis for performing precedent transactions, with the best transactions typically involving companies similar to the target company on a fundamental level, such as sharing key technical and financial characteristics.

However, when using this methodology, it is often challenging to obtain a robust set of truly comparable mineral assets or transactions. Naturally, there is no mineral deposit that is exactly the same as an adjacent mineral deposit in terms of structure, mineralogy and deposit. As a general rule, the most recent transactions are defined as the transactions that have occurred within the last three to four years, and are considered to be the most relevant, as they probably took place under similar market conditions to the contemplated transaction.

According to Rosenbaum and Pearl (2009, p71), "*under normal market conditions, precedent transactions comparable tend to provide a higher multiple range that the comparable companies for two principle reasons:-*

- *buyers generally pay a 'control premium' when purchasing another company and the acquirer would receive the right to control decisions regarding the business and its underlying cash flows; and*
- *strategic buyers often have the opportunity to realise synergies, which supports the ability to pay higher purchase prices. Synergies refer to the expected cost savings, growth opportunities and other financial benefits that occur as a result of the combination of two business (sic)".*

5.4. Mineral project evaluation

The mineral project evaluation process is a series of programmes, testwork and studies undertaken during the project life cycle by an enterprise in order to ensure that the mineral project is profitable, after taking into consideration reasonable and appropriate technical, economic and environmental parameters, and that the goals of the enterprise would be achieved. According to Nhung and Shtembari, (2008, p 4), general project evaluation is defined as *"a combination of a number of activities ranging from setting indicators, developing model, defining measurable outcomes, identifying key stakeholders and their interests, selecting methodology for evaluation, collecting information, analysing data and disseminating evaluation results*" for further learning or for investment decisions. The main objective of any mineral project evaluation process is to determine and demonstrate not only that the project is viable and that it will provide returns higher than the hurdle rate as determined by the mining companies management team on the basis of reasonable technical and economic assumptions, but that it can also be permitted and built as specified in the evaluation (Knight, 2016). Knight further notes that the latent project risks are manageable, and the management team has within its ranks the team, organisation, expertise and commitment to deliver the project as promoted in the evaluation. The art of mineral project evaluation involves understanding the key principles, parameters and project drivers in the complete mining value chain, as well as identifying and quantifying the level of risk to determine the viability of a mineral project. It should be noted by the nature of the mineral projects that they require huge capital investments to construct and develop, with very long payback periods. In addition, the evaluation methodology must anticipate both the future course of the project's operation based on the life of mine plan, and the future behaviour of the market, in order to yield accurate results. One step removed from this is the project for which a favourable bankable feasibility study has been prepared. According to Lattanzi (2002), such studies invariably use discounted cash flow techniques to assess the economic viability of the proposed mine development, based on the current reserve estimate, comprehensive engineering studies, detailed estimates of capital expenditure and operating cost, and rational projections of product revenues. Smith (2000) argued that the mineral project evaluation as the focal point of all the technical and economic data for a mineral project being developed by different discipline project team members, comes together in one place and the information represented in the same place in the same currency in US dollars. All the information converges when the economic evaluation is developed through the creation of the discounted cash flow analysis (also referred as the financial model).

The proposed mining operations represent an economic activity in which many decisions involve risk and uncertainty. There are many activities involved in any successful mining project. These activities include exploration, cut-off grade estimation, mineral resource calculation, mineral reserves estimation, human resource planning, environmental authorisation, mining activities, mineral processing, product transportation, marketing and mine closure. In each of these, the mining company must deal with local people, local and national governments, national and international standards or regulations and international organisations, both governmental and non-governmental. Torries (1998) espoused that the complexity of mineral projects leads to uncertainties caused by the very nature of the geological models, resource estimations, problems in forecasting commodity prices and production costs, extended evaluation periods during which economic and technological conditions can change, uncertain regulatory and environmental requirements and the longevity of mineral projects.

Torries (1998, p xi) summarised the mineral project evaluation process *"as the process of identifying the economic feasibility of a mineral project that requires a capital investment and making the investment decision*". Any misinterpretation of evaluation results would lead to incorrect investment decisions and inappropriate value being attached to the mineral project. The feasibility study is the principal result of the mineral project evaluation process, and the resulting document forms the basis upon which investment decisions are made (Knight, 2016). The project evaluation practices applied to mining investments have evolved considerably over time, since the 1900s, with the application of DCF analysis as the principal financial evaluation tool. In the extractive industry, the feasibility study is based on the Mineral Resources and Mineral Reserves statements. The preparation of these statements are codified and regulated in almost all major mining jurisdictions to comply with their respective international mineral reporting standards. The details of how all these activities, parameters and assumptions are linked together to form the basis of the mineral project evaluations is discussed in the next sub-sections.

5.4.1. Objective of mineral project evaluation

Mineral project evaluation methodologies are aimed at supporting the complex, interrelated and uncertain activities that make up the mining value chain in the investment decision making process. The projects generally tend to be larger and the scope of feasibility studies are much broader than in the past, so the trend towards complexity and rapidly escalating costs is hardly surprising (Knight, 2016). Due to these complexities, the failure of mineral projects due to flawed studies and poorly executed projects would end up being more expensive to rectify. The potential real value of the investment, coupled with the likelihood of successful and timeous delivery, on budget and to specification, is mainly dependent on the level of confidence and details attributable to the work conducted in support of the project evaluation.

To conduct a proper mineral project evaluation, the analyst must first recognise the purposes of the evaluation for whom it is to be done, the methods most suitable for specific needs or requirements,

appropriate decision criteria, and their expectations from the evaluation (Torries, 1998). Any project evaluation should address the fundamental objectives that Knight, (2016) identified namely:-

- To demonstrate the financial viability and strategic value of the mineral project both on a standalone basis and more broadly as a value-adding increment to the enterprise. Financial viability is a function not only of the characteristics of the project itself, as designed, but most particularly of the assumptions made for the external inputs such as commodity prices, inflation, escalations and foreign exchange rates. In a mineral project, since mining companies are commodity price-takers, these assumptions are commonly the principal variables and are the most difficult to predict or estimate;
- The selected evaluation model should be able to define, describe and model as closely as practicable to the overall commercial environment within which the project will be able to deliver the best returns for the investors. Given the uncertainties inherent in forecasting, project design must also be flexible and robust, and be able to respond to unforeseeable internal and external factors;
- The project evaluation commonly tends to devote more effort to matters of technical detail as the basis of any mineral project. This is important because it has a direct influence on what is designed, costed and built. The economics of the project is equally important. In most cases, though, not enough attention is given to these significant variables, generally because they are difficult to forecast with any confidence and these forecasts have a limited integrity. As the commodity prices and the associated volatilities cannot be predicted with confidence, assessment of future supply and demand has great value overall, including a detailed strengths, weaknesses, opportunities and threats (SWOT) analysis and market intelligence;
- Mineral projects have several uncertainties inherent not only in project design and execution, but also the commercial environment in which the investment must perform. Hence a risk assessment procedure should be completed as part of the evaluation process to understand the project risk profile and how these risk items can be mitigated during the mining operation; and
- Lastly, the project evaluation process should demonstrate that the project is viable and will be able to provide superior returns to shareholders on the basis of reasonable economic assumptions, that it can permitted and built as specified in the evaluation, and that the latent risks are manageable. In addition, the management has within its ranks, the team, organisation, expertise and commitment to deliver the project as promoted in the evaluation.

5.4.2. Mineral project evaluation process

The mineral project evaluation process is a series of studies, interspersed with decision points, leading to a point where the project is deemed by management to either be viable and worthy of investment or is rejected. The evaluation process varies in complexity, quality, rigour and the requirements of the current circumstances. How this evaluation process is executed is ultimately a function of skills, experience and commitment of the owner's team.

A mining project typically evolves from exploration, Mineral Resources definition, economic assessment, Mineral Reserves declaration, mine development, production and rehabilitation. Each of these project development phases require an escalating level of economic and technical assessment with increasing levels of confidence for the project design, scheduling, costs and risks, to justify progression of the project to the next investment level.

The feasibility study is the principal result of the evaluation process. The document that encompasses a feasibility study is a technical and economic assessment that serves as the basis for making a decision about whether to develop the mine or not. The SAMREC code (2016, p31) defined a feasibility study as *"a comprehensive technical and economic study of the selected development option for a mineral project that includes appropriately detailed assessments of applicable modifying factors together with any other relevant operational factors and detailed financial analysis that are necessary to demonstrate at the time of reporting that extraction is reasonably justified (economically mineable). The results of the study may reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or financing the development of the project*". A feasibility study includes reserve estimates, mine and plant designs, detailed cost estimates, full technical and economic assessments, and details of possible financing arrangements. A so-called "bankable" feasibility study is a type of feasibility study that a company would take to a bank or other entity in its search of financing. Feasibility studies come in myriad forms and, as projects move forward through the evaluation process, are prepared to ever-greater levels of detail and at least purportedly, greater levels of accuracy. For example, the preliminary evaluation process would start just after early exploration, which would be a Scoping Study as defined in the SME Guide (2014), in advance of detailed exploration so that the team in the field has a general appreciation of what constitutes an economic target, and what constitutes simply technical success of no immediate economic interest (Knight, 2016).

For a mineral project, the feasibility study is based on the Mineral Resources and Mineral Reserves statement, the preparation of which is codified and regulated to comply with the International Mineral Reporting Codes applicable in its jurisdiction. In South Africa, this entails compliance with the SAMREC Code, regulated by the Johannesburg Stock Exchange (JSE Limited). Compliance with the SAMREC Code ensures that the estimation of the Mineral Resources and Mineral Reserves has been done by a recognised Competent Person and has been subject to prescribed standards.

Funding for mineral projects can take up to five years to finalise and to complete the mine construction and, where practicable, should be subject to ongoing evaluation, refinement and optimisation as additional information becomes available. In the mineral sector, the factors that influence expected revenues, costs, and risks can be grouped into four categories (Figure 5.2):-

- **Geological factors**: Does a mineral resource exist in a region, in what quantities, and of what quality? Geological risk is the likelihood of and degree to which actual mineralisation (its quantity and quality) differs from what is anticipated at the point a decision is made, to undertake exploration or development. For example, what is the likelihood that a mineral deposit exists in a region undergoing initial geological investigation? Or during mining, what is the likelihood that the grade and quality of ore differs from what was expected at the time the mine was initially developed?
- **Technical factors**: Can a known resource be extracted and processed with existing or likely future technologies? Technical factors such as cut-off parameters, mine design criteria, equipment efficiencies, mining infrastructure, mining methods, geotechnical, mine planning and scheduling and metallurgical assumptions directly affect the project economics. Technical risk can be thought of as the likelihood and degree to which actual recovery of a mineral during mining and processing differs from what was anticipated. In other words, are there unanticipated technical problems or complications associated with mining, mineral processing and extractive metallurgy?
- **Environmental, social, and political (Governmental) factors**: Can a resource be extracted in ways that are consistent with a country's preferences and policies for environmental protection and general governmental regulatory frameworks? Can it be extracted in ways consistent with the preferences and policies of the government and local communities? Risks in this category can be thought of as the likelihood and degree to which actual environmental degradation or impacts on local communities differ from what was expected. Or does the likelihood and degree to which public attitudes, public policies, and the overall business environment differ from what was expected at the time of initial investment.
- **Economic Factors**: Overall, can a mineral resource be extracted at a profit? Can economic risk can be thought of as the likelihood and degree to which actual revenues and costs differ from what was anticipated at the time of investment? Economic risk is an overarching type of risk because it incorporates and reflects the three other categories of risk cited above. It incorporates the purely economic risks that actual mineral prices and production costs differ from those anticipated at the time of initial investment.

In general management, these factors are considered as the political, economic, social, technical, legal and environmental (PESTLE) factors. For a mineral project, one has to consider the factors that will influence and drive its value. This would enable the mining company to make the right investment decisions.

5.4.3. Major factors in mineral project evaluation

The literature on mineral project evaluation has placed a significant focus on providing various financial techniques that support the process, using the principles established in general project management profession. Traditional methods used in project appraisal such as net present value (NPV), internal rate of return (IRR), Payback period derived from the DCF have been analysed by many authors (Ballantine and Stray, 1998; Small, 1998; Müller, 2003). Small (1998) showed the role of these financial key performance indicators and methods in evaluating projects, in particular those carefully considered during the evaluation process in evaluating projects, in particular the cost and benefit analysis. The trade-off between accrued cost and future benefits related to all stakeholders should be carefully considered during the evaluation process. Müller (2003) explained how those investment appraisal techniques support, accept or reject decisions in relation to projects through some simple examples. He also proposed some key investment factors that project managers should identify to ensure the financial gain of the projects. However, (Akalu, 2001) criticised these methods due to some weaknesses or problems identified below:-

- the disconformity in the measurement techniques before and after the project;
- the dynamic characteristics of the project are not considered, as changes during project implementation are not accommodated;
- some good projects are dropped as intangible long term benefits of projects may not be considered; and
- do not consider the strategic importance of projects.

Notwithstanding the weaknesses identified above, the key performance indicators and methodologies are still widely used in the mineral industry with different levels of sophistication, and are regarded as the industry norm. These analyses are conducted in spreadsheets in most cases. To contribute to this, Gardiner,(2005) observed that not only financial and economic aspects, but also other factors such as environmental impacts, employment effects, etc, should be taken into account to assist organisations to decide whether a project concept is worth turning into reality.

The mineral project evaluations are often commonly based on a deterministic DCF methodology. A cash flow is designed to capture all cash inflows (being mining revenues) and outflows (namely capex, taxes, royalties and operating costs) over the whole life of a project and to avoid inclusion of non-cash accruals (Pires, 2012). The cash flow model must recognise the time-value of money by discounting at an appropriate discount rate to obtain their present value and other DCF criteria values such as the following as defined by Pires (2012, p4):-

- "*Gross profit as defined by revenue minus the cost of product sold;*
- *Earnings Before Interest, Taxes, Depreciation and Amortisation (EBITDA) is a measure of a company's operating performance without taking into account taxation, financing and accounting decisions and simplistically is the gross profit minus the cash operating expenses;*

- *Earnings Before Interest and Taxes (EBIT) = EBITDA adjusted for depreciation and amortisation;*
- *Net Present value (NPV) is an indicator of how much value an investment or project adds to the firm and indicates the maximum value that a firm should pay for a project at year 0 (sic);*
- *Internal Rate of Return (IRR) is a financial indicator used to measure and compare the profitability of investments. It is important to note that the IRR of a project cannot be evaluated in isolation as it does not account for the magnitude of the cash flows, just profitability on a per-dollar-invested basis; and*
- *Payback Period (PYP) is the period of time required to payback the initial investment from future cashflow. Although the method does not account for time value of money, it is a useful evaluation parameter because it provides an indication of how long the company has to wait to get its return on investment".*

In other words, the NPV of a mineral project merely provides a value around which negotiations may take place to stipulate an agreeable price, possibly higher but generally lower than that NPV. Assessment of mineral projects includes all processes of the mining value chain from "Mine to Mill to Port to Customer", and evaluation of market supply and demand has to be assessed on economic, social and environmental merit, to make a mineral project both financially successful and sustainable. Typically, a mining company would prefer the mineral project to be in the first quartile producer on the industry cost curve to maximise value to the shareholders. It is important to note that value includes managing the company's new investments and current operations to achieve sustainability, profitability, solvency, liquidity, and growth (by adding value) and survival.

In mineral project evaluation several factors affect the technical and financial viability of the project. The following section discusses some of the major factors considered in mineral project evaluation, and the interaction with the framework that links the exploration results, the LoM schedule and the declared Mineral Reserves (Figure 5.2).

5.4.3.1. Long Term Commodity Price Forecast

In most cases, mining companies are commodity price-takers and have little influence in determining the price of the commodities that they produce, except through influencing the supply dynamics. Commodity prices therefore, are the single most sensitive input assumption in the technical and economic assumptions required in the determination of the quantum of Mineral Reserves available, and the resulting LoM (see Figure 5.2 and Figure 5.3) and, finally, the MAV of the project or mining company.

It is a widely held belief that commodity prices must decline in real terms over time, but this has been refuted a number of times. The Prebisch-Singer hypothesis states that owing to the low income elasticity of demand for commodities and because total factor productivity increases have been smaller for

manufactured goods than for primary commodities, the price of commodities relative to manufactured goods should decrease over time, Prebisch (1950). If this hypothesis were true, then the long-term outlook for commodity-exporting countries would be unfavourable. Few ideas in development economics have been studied more intensively, yet remain so controversial. Prebisch (1950) and Singer (1950) originally observed a downward trend in real commodity prices, while later work by Grilli and Yang (1988), using data from 1900–1988, noted that this downward trend had accelerated in 1921. Several papers had failed to detect such an adverse trend movement (Cuddington and Liang, 1999). Accordingly, much of the empirical debate around the Prebisch-Singer hypothesis has focussed on whether the non-stationarity of real commodity prices takes the form of either a deterministic or stochastic trend, or whether there are structural breaks in the trend.

While there were also credible reasons why long-term prices were revised higher over the recent past (structural alterations to costs and demand, etc), present market dynamics, specifically the direction and level of spot prices, seem to have an undue influence on analysts' expectations of the long-term future. Commodity prices are likely to increase because of structural alterations to costs, demand and supply, and the depletion of less complex orebodies. This is the premise that mining analysts in our generation tend to rely on.

The forecasting of long-term real commodity prices is one of the important economic inputs considered in annual mine planning, business budgeting and Mineral Reserves declaration processes, as well as in mineral project evaluation and mineral asset valuation. As part of the annual reporting process in company reports, the Competent Person would need to assess the validity of the Mineral Reserve, especially in the current economic climate where commodity prices continue to be depressed.

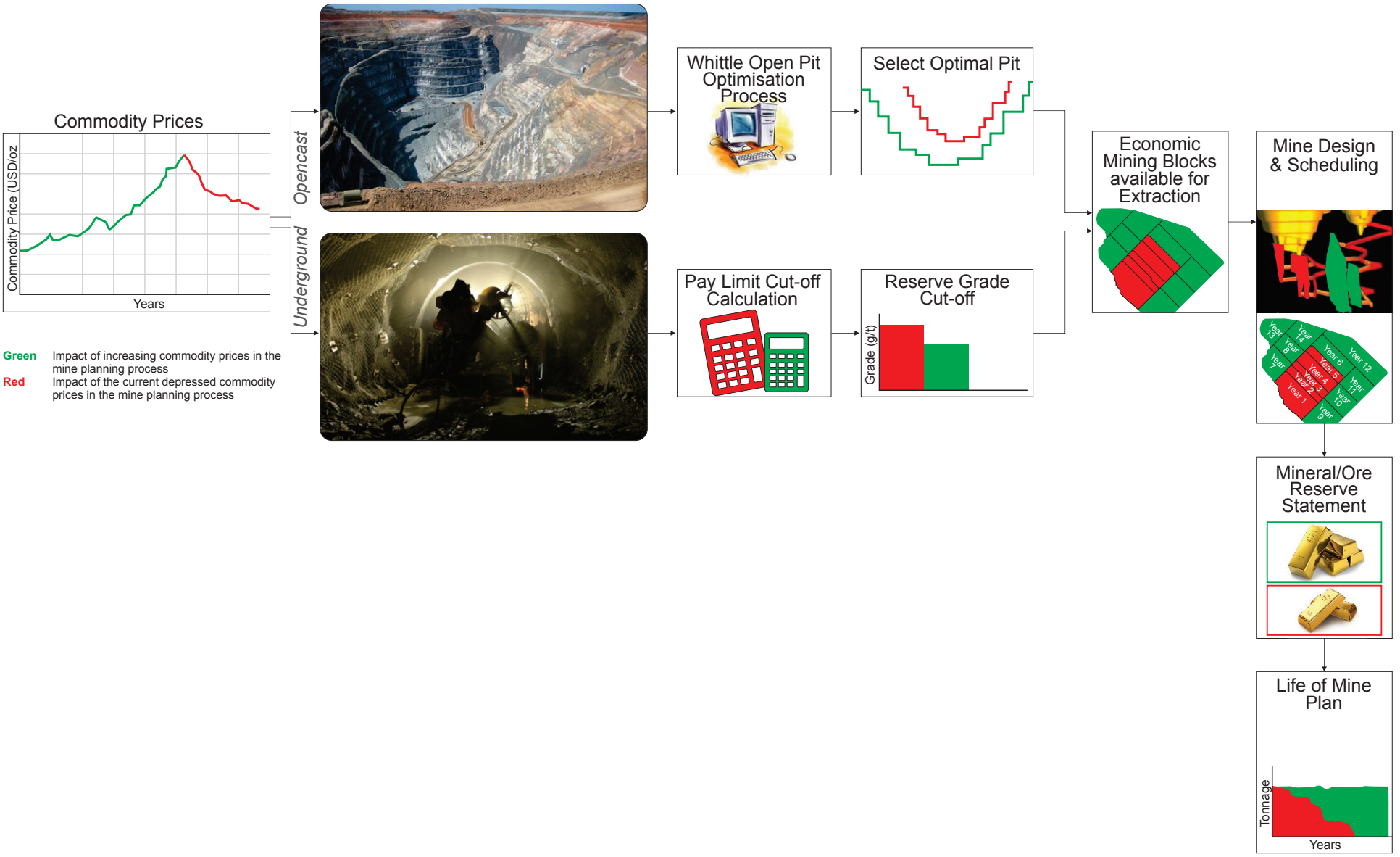
One of the issues is that current industry practice involves a wide range of stakeholders that influence and/or provide inputs in the selection of modifying factors, including the commodity prices used in the Mineral Resources and Mineral Reserves estimation process. The Competent Person takes overall responsibility of the result. It should be noted that neither the international mineral reporting codes such as JORC, SAMREC, NI 43-101 Codes or PERC standard, nor their guidelines, provide any guidance on how to estimate the commodity prices in this process. The SAMREC Code (2016) requires that, for commodities traded on metal exchanges, reasonable forward-looking prices should be used and such prices should be based on historic full-cycle price averages, and should be disclosed. However, for commodities not traded on metal exchanges, it is recognised that disclosure of a specific price may put a company at a competitive disadvantage, and as such need not be disclosed in the public domain (SAMREC Code, 2016). All the CRIRSCO-type codes require some form of statement on how the commodity prices have been derived, but SAMREC is the only one to mandate the use of historical full cycle price averages. In general, other reporting codes do not require the actual prices to be reported publicly, but they do require an explanation of the method by which they have been derived.

The PERC (2013, p18) standard is the best-worded in this regard, and states that "*the Competent Person should wherever possible disclose commodity prices and exchange rates used for Mineral Reserve estimation. If commodity prices are not disclosed the reasons for this should be given; e.g. where disclosure of a specific price may put a company at a competitive disadvantage. In such cases where possible, reference should be made to "current or anticipated prices" or "prices known to apply in the area". Commodity prices should be based on supportable forward looking estimates, short term and long term as appropriate. Overly optimistic or pessimistic price forecasts could result in significant over or under estimates. Where commodities are sold under existing contracts, reserves should be determined using these contract prices. When commodity prices are disclosed, disclosure can be as a single price estimate equal to that used for reserve determination, or as a range of prices within which no material change in reserves would occur. Whether or not the commodity prices used to estimate reserves are published, the overall methodology used to determine those prices should be disclosed. Such disclosure should be in a manner which helps investors determine whether, in their own opinion, prices used represent reasonable views of future prices. Documentation supporting price forecasts might include comparisons with historical and current prices, forward projections, market considerations, exchange rates or any other relevant information. If there is doubt about what should be reported, it is better to err on the side of providing too much information rather than too little*".

The exception is the regulator at the New York Securities Exchange (NYSE), which has provided some guidelines on which commodity prices to utilise in these annual processes. For example, Sibanye Gold Limited (2016) stated that, "*the cut-off grades have been calculated in accordance with the SEC Guidelines and approximate the historic two to three year average commodity prices*" for the estimation of 2016 Mineral Resources and Mineral Reserves declaration. Figure 5.3 shows the influence of selected commodity prices on the mine planning process, mining schedule, the resultant LoM plan and the declared Mineral Reserves, if the commodity prices used increase or decrease significantly.

For most commodities, as a general rule, the long-term real commodity price and exchange rate used in the mine planning processes and Mineral Reserves estimation process, should be a reasonable and realistic forecast at any given point in time. However, an exception is circumstances where the commodity prices and exchange rates are expected to change based on detailed market analysis, e.g. copper and platinum as discussed in earlier sections. In such cases, companies would use commodity prices that are well above the current spot prices, because the market analysis shows that commodity prices will recover in the short-term. One point of view when using a lower commodity price compared to the forecasted long term commodity price, is that the company should be seen as a going concern and continue economic mining operations, even during very low commodity price periods. This would also avoid instances where one may be required to develop a new mine plan during the financial reporting period due to a significant decrease in the commodity price, or changes to any modifying factors. Using high commodity prices in determining the Mineral Reserves might mean that the mine would be designed to make an operating loss, at least in the short-medium term.

Figure 5.3: Influence of commodity prices on the Life of Mine plan and Mineral Reserves - a technical perspective



Source: Venmyn Deloitte, 2016

A Framework to Harmonise Mineral Asset Valuation Methodologies with Existing and Emerging Financial Reporting Requirements

by Godknows Njowa, 2017

Due to fluctuations in commodity prices over the past few years, some mines have closed despite companies still reporting a Mineral Reserve. This is contrary to the original intentions of the International Mineral Reporting Codes to declare Mineral Reserves determined by a mine plan that is technically achievable and economically viable, and that material modifying factors have been considered at the time of reporting. In the SAMREC code 2016 edition, the term 'economically mineable' implies that "*extraction of the Mineral Reserve has been demonstrated as viable and justifiable under a defined set of realistically assumed modifying factors"*. In most of these cases of mine closure, the commodity price used in the Mineral Reserve declaration would have been inappropriate.

It is important to understand that a re-estimation of the Mineral Reserve with a different commodity price, exchange rate or change in the modifying factors would take significant time, i.e. approximately three-to-six months depending on the complexity of the mining operation. Industry best-practice recommends that appropriate sensitivity testing be done during the mining-study level, and in each annual revision of the Mineral Reserve estimation on the commodity price forecast, along with all modifying factors. It is proposed that the company director or CEO can then inform the market of the valid ranges, and when a new Mineral Reserve estimate may be required. Commodity price variations may trigger modifications, and reductions or increases in other areas of the mining operations, including production rates, waste stripping, operating costs, on-going capital costs and/or cut-off grades. All these, combined, can negatively affect the Mineral Reserves declared, the business plan and the financial performance of the mining company.

Market fluctuations in the commodity price of minerals, or increases in the costs to recover metals from the company's mining projects, may render mining of Mineral Reserves uneconomical and affect the company's operations in a materially adverse manner. The mining operational fundamentals are directly linked to the performance of that mining company, and hence the financial reporting, as illustrated in Figure 5.4. The business plan implemented by a mining company at the beginning of each financial year guides the mine operation during the year, with a futuristic perspective whilst the financial statements report the mining company's performance in a historical perspective. Moreover, various short-term operating factors may cause a mining operation to be unprofitable in a particular accounting period. Hence, the selection of the long-term commodity price used in the Mineral Reserves declaration should be carefully considered and supported by detailed market analysis.

5.4.3.2. Understanding Geology and Grade Distribution

The fundamental asset which underpins the value of any mineral project is its Mineral Reserve, and a thorough understanding of the Mineral Reserve is the first requirement for the application of any DCF technique for either mineral project evaluation or MAV (See Figure 5.2 and Figure 5.4). The size and grade distribution of any Mineral Reserve is estimated from a limited number of samples which constitute a very small proportion of the total mineral deposit as explained in Section 5.2.1.

Estimates of average grade, on the other hand, can be subject to significant variations. However, in terms of the valuation of mineral deposits, the average grade is almost always far more significant than the total tonnage mined. During actual mining operations, it is inevitable that some waste material will be mined along with the ore. As a result of this dilution, the grade of ore mined will invariably be lower than the grade of ore *in-situ*. These factors would significantly affect the results of any DCF analysis being conducted, since both the grade distribution and tonnages are the primary drivers of the revenue estimation process.

It is fundamental to the economics of mining that costs are determined by the number of tonnes mined and processed, while revenues are determined by the number of pounds or ounces of metal produced, and this drives the revenue reported on the financial statements for a mining company (Figure 5.4). These two factors, cost and revenue, are related by the grade of the ore.

Mining projects are complex businesses that demand a constant assessment of risk. This is because the value of a mineral project (Figure 5.4) is typically influenced by many underlying economic and physical uncertainties.

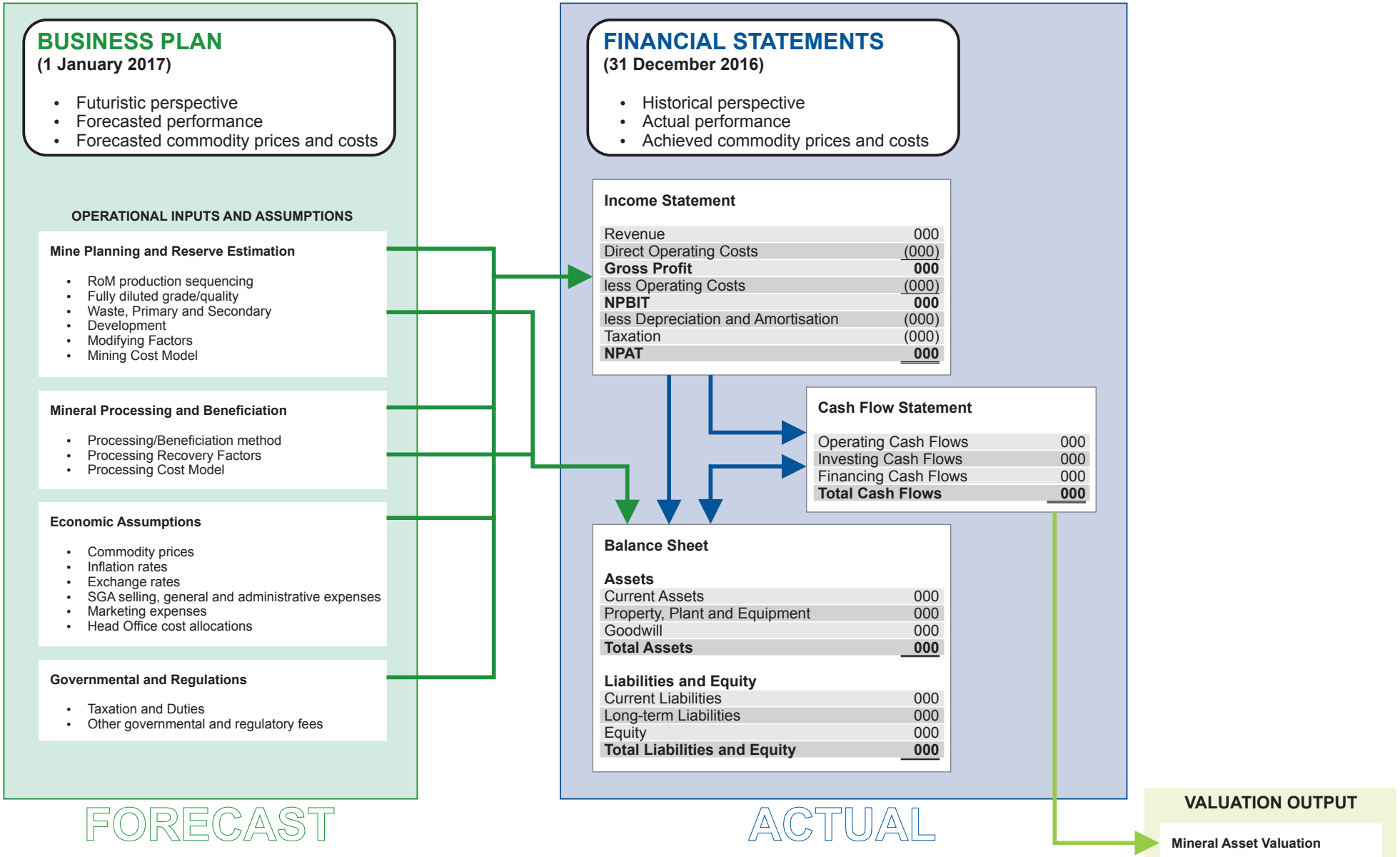
5.4.3.3. Optimal Ore Extraction Methodology and Systems

Mining methods vary in their ability to minimise dilution through the selective mining of ore-grade material. Generally, the cheapest mining method is also the least selective, but it may be false economy to choose a mining method simply because it is the cheapest. The added cost of a more expensive mining method is often offset by the added revenue arising from the increased grade which results from improved selectivity. Some level of dilution, however, will always occur and it is of paramount importance that it be reflected appropriately in the DCF valuation.

Most frequently, when mining projects fail, they do so because the predicted Mineral Reserve estimates for tonnage and (especially) grade do not reflect the real variability of the deposit, and inappropriate modifying factors have then been applied to mining. The most common sources of error in this regard are inaccurate estimation on the distribution of ore-grade material, leading to over-estimation of in-situ grade, and inadequate allowance for dilution, leading to a further over-estimation in RoM grade.

The issue is generally that the actual variability of the deposit exceeds expectations, and particularly predicted values of grade which are normally over-optimistic. The level of geological confidence is a direct reflection of the heterogeneity of the deposit. A completely uniform deposit will require only one borehole to determine the overall grade, and thus provide a very high degree of confidence, whereas a completely heterogeneous deposit will require many boreholes but the natural grade variability can never be estimated with high confidence.

Figure 5.4: The interrelationship between mining operational fundamentals and financial reporting



A Framework to Harmonise Mineral Asset Valuation Methodologies with Existing and Emerging Financial Reporting Requirements

by Godknows Njowa, 2017

5.4.4. Main Sources of Uncertainty in Mineral Project Evaluation

There are two sets of uncertainty in mineral project evaluation that need to be considered and these are either internal or external. "*Internal uncertainties are those where the project owner has the ability to reduce and/or manage uncertainty and these include orebody knowledge and the associated processing performance, environmental and social impacts of the development alternative"* (Logan and Jackson, 2016, p125). External uncertainties are those that are predominately outside the management's control, such as commodity prices, exchange rates, government regulations and political factors (Logan and Jackson, 2016).

The main sources of uncertainty in mineral project evaluation can be broadly explained in four areas. These are orebody modelling, commodity prices, production costs and mine design. These sources are now briefly explained below.

Uncertainty in orebody modelling: The geology of the mineral deposit represents one of the most critical sources of technical uncertainty in a mining operation. Uncertainty in orebody modelling arises because the information obtained from the drill-hole samples is not representative of the entire mineral deposit. One consequence of this limited information is the misclassification of reserves, where economic ore can be dispatched to the waste dump and non-economic ore can be sent to the mill. Another consequence is that the size of the deposit can be overestimated or underestimated depending on how the drillhole information is interpreted. According to Bartlett (2016) the single greatest cause of mineral project failure is inadequate study of the orebody. Recent developments in the reporting requirements for exploration and mining projects, particularly the JORC Code, CIM standards and NI 43-101 all make perfectly clear the quality of exploration data required to define mineral resources.

Uncertainty in commodity prices: Another important source of uncertainty which has a critical impact on mine project evaluation is that associated with future commodity prices. Uncertainty of future commodity prices arises because of two main factors:-

- the lack of exact knowledge of those factors leading to the increase/decrease in metal supply and demand, and
- the practices that producers or consumers perform in the face of powerful speculative and political motives.

Advanced models based on stochastic processes, are normally used to quantify future price uncertainty, enabling mine planners and managers to assess their effect on project economics.

Uncertainty in production costs: Production costs are another source of uncertainty when evaluating mineral projects. The reason for this is that the economic evaluation component of the feasibility study is based on information that provides an answer to the question, 'What is it going to cost?' Since estimation of capital and operating costs is an important requirement for mine evaluation, uncertainty in these cost estimates arises due to the lack of engineering or economic information at the beginning of the mineral project.

The estimated capital and operating costs are driven by mining method, anticipated RoM production, mineral processing and the general size of the facilities. Simply put, mining companies do not know with absolute certainty today how much they will be able to spend tomorrow, let alone next month, or even next year.

Uncertainty and risk in mine planning and design: Since both the ultimate mine design and the production scheduling limits depend directly on the orebody model and future commodity price and costs, uncertainty and risk in mine planning and design arise due to the uncertain nature of the underlying variables that take part in the designing and planning process, (Smith, 2000). In this context, the allocation of the physical limits of both the ultimate mine design and long-term production sequence on the orebody model turns into a complex and uncertain process.

Mining has long been perceived as a risky business and with good reason. Risks that are difficult to calculate precisely include regulatory hurdles (such as the time and cost of procuring approvals and producing the necessary documentation to commence exploration, development and operations of a mine) and other market and project risks that may affect cash flows.

Uncertainty and errors in Mineral Resource and Mineral Reserve estimates remain a major reason for the economic failure of mining projects globally (Noppe, 2014). The appreciation and consideration of this uncertainty is critical for realistic project reporting, planning, successful project execution and operation. "*Current common approaches to the assessment of these uncertainties tend to focus on orebody grade uncertainty (internal), sensitivity analysis (internal or external) or Monte Carlo simulations (internal or external) and are only static assessments of a single development alternative*" (Logan and Jackson, 2016, p125). A comprehensive multi-criteria assessment of these uncertainties would provide a better understanding on how to mitigate the impact of these uncertainties in mineral projects.

5.5. Mineral Asset Valuation

Traditionally, mining organisations use various types of quantitative methods to estimate profit and loss associated with a proposed mine project. Among all these measures of profitability, the NPV which is based on the DCF technique is the most widely used in the mining industry. In practice, the cash flows generated at each production period are estimated using anticipated values for the underlying variables. Smith *et al*. (2007, p37) explained the DCF analysis as a technique that *"provides a means of relating the magnitude of all expected future cash flows to the magnitude of the initial cash investment required to purchase the asset and develop it for commercial purposes*". The objective of discounted cash flow analysis is to determine:-

- the NPV of a stream of expected future cash flows over the LoM; and
- the IRR which the expected future cash flows will yield on the original cash investment.

Within this context NPV was initially applied to capital investment decisions with later application as a guiding principle throughout the mine planning and Mineral Reserves declaration process as the principal determinant of value assessment. Smith *et al*. (2007, p37) pointed out that "*value accretion from an investment option occurs when the NPV > 0 and the IRR > selected hurdle rate, where the hurdle rate is determined by considering a minimum rate of return in conjunction with a variety of risk premiums operational, project and country"*. In general larger NPV and IRR values indicate better returns and inherently lower risk of value destruction.

Preparing a cash flow model to be used in project evaluation is not just an exercise in manipulating numbers in spreadsheets. There are numerous complexities in compiling such a model which require a thorough understanding of the project and the commodity, from geology, to mining, to processing, to logistics and to marketing the finished product. There are technical matters specific to product and commodity to be considered. Further, the terms of any off-take / marketing agreement or toll-treating agreement need to be used accurately and properly modelled.

In most mining projects, month zero (marking the start of the project construction), is different to the start of mining and the processing components. The mining ramp-up to steady-state production invariably takes much longer than that of the processing plant. The time when the first ore can be fed into the plant needs to be carefully assessed, so the size of the run-of-mine (RoM) stockpile during construction does not get too large, compared to a plant that is brought on-stream too early, only to be starved of RoM ore (reducing revenue and increasing unit costs).

5.5.1. Estimation of cash flows

To estimate the value of a minerals company, as discussed in Section 1.4 or conduct a mineral project evaluation on a mineral project, as laid out in Section 5.4, both require an estimation of future cash flows to providers of capital in a DCF analysis, and discounting these to determine the value of the company. Section 5.4.1 supports the notion that the DCF analysis is aimed to support the complex interrelated uncertain activities and assumptions involved in the mining value chain, which need to be evaluated or valued in any general investment decision making process. These cash flows are estimated in different ways, which adds to the confusion around which cash flows are used, and how are they estimated in an integrated financial statement. The simplest form of cash flow, when conducting an assessment of any kind of value for a mining company, is to consider the cash flows available to all the providers of capital i.e. creditors and owners. This is referred to as EBITDA. EBITDA is defined in Equation 5.2.

EBITDA = Net Income + Interest + Depreciation + Amortisation.

Equation 5.2

It should be noted that the interest expenses arising from all interest-bearing loans would have been subtracted in the calculation of the net income. For this calculation, cash flow, before any interest, is required. This provides an estimate of cash flows that could be paid to both the creditors and owners. Drake (2015) pointed out that EBITDA, though useful in some applications, does not fully reflect the cash flows of a minerals company because it doesn't consider the changes in working capital, SIB Capital and expansionary capital requirement of the business going forward.

As part of the general financial statements described in detail in Section 1.6.1, minerals companies publish a statement of cash flow as part of the financial statements, regardless of whether they publish under GAAP or IFRS. This provides useful information to help in financial analysis and valuation. This statement requires the segregation of cash flows by operations, financing and investment activities. However, the key cash flow in both analyses is the cash flow for/from operating activities. This cash flow is calculated by adjusting net income for non-cash expenses, and income as well changes in working capital accounts. This adjustment converts the accrual-based accounting into cash-based accounting, utilising information from both the income statement and the balance sheet. This cash flow from operations (CFO) is defined in Equation 5.3.

CFO = Net Income + Depreciation + Amortisation + Other non-cash charges (income) – Increase in net working capital.

Equation 5.3

Cash flow from operations is a key indicator of a company's financial health, because without the ability to generate cash flow from its mining operations, a mining company may not be able to survive. Cash flow is the lifeblood of any business. When analysing these mining companies it is important to understand the stage of development, (Section 1.4) of the mineral asset under review.

5.5.2. Estimation of free cash flows

It should be recognised that cash flow, no matter how its calculated, does not fully reflect what will be available for the providers of capital. There is an additional consideration required to fully appreciate what cash flows will be available for the providers of capital, this being the SIB capital required to maintain the current production or growth levels. This type of free cash flow (FCF) is defined as "*a measure of a company's financial performance, calculated as operating cash flow minus capital expenditures. FCF represents the cash that a company is able to generate after spending the money required to maintain or expand its asset base. FCF is important because it allows a company to pursue opportunities that enhance shareholder value*" (Investopedia, (n.d.) (a)). The reason these cash flows are regarded as 'free' is that the company directors are at liberty to utilise these cash flows without negatively affecting the mining operations or the future production levels.

FCF is a useful measure of cash flows because the mining company must invest such capital (also known as sustaining capital expenditure) in order to maintain the current production levels and to grow at the planned production rates, and FCF considers the capital expenditures. In financial analysis and mineral asset valuation, the FCF is expressed as cash flow from operations less any capital expenditure necessary to maintain the current production rates, as summarised in Equation 5.4.

FCF = CFO - Net Capital Expenditure (SIB)

Equation 5.4

As an industry norm, the mining company's financial statement does not necessarily disclose the capital expenditure necessary to maintain its current production levels. Therefore, many analysts revert to using the simplified FCF calculation, where the entire capital expenditure for the period is utilised in the calculation. In the minerals industry, this could be misleading in circumstances where the company is mining in one section and developing another area for future extraction. Drake (2015) defined the FCF as representing the financial flexibility of the company, in that these funds represent the ability that the company has to take advantage of other investment opportunities or projects over and above what has been planned, and it varies from year to year.

5.5.2.1. Free Cash Flow to Equity (FCFE)

When considering the valuation of the equity of a mining company, the free cash flow to the equity shareholders, as the residual claimants, is affected by the level of the debt financing of the company. Therefore the free cash flow to equity (FCFE) is defined as "*a measure of how much cash can be paid to the equity shareholders of a company after all expenses, reinvestment and debt are paid. FCFE is a measure of equity capital usage"* (Investopedia, (n.d.) (a)). The FCF adjusted for the debt cash flows (both the new debt financing and the debt repayments), and is defined in Equation 5.5.

FCFE = CFO - Net Capital Expenditure - Change in Net Working Capital + New Debt - Debt Repayment.

Equation 5.5

Another form of the calculation is to start with net income and then add non-cash charges (or subtract non-cash income), such as depreciation, amortisation, charges for the write-down of assets, and deferred income taxes. When conducting a valuation of equity the cost of capital is the cost of equity and the free cash flow is the free cash flow to equity.

5.5.2.2. Free Cash Flow to Firm (FCFF)

When considering the valuation of the firm or mining company, the free cash flow to the firm is affected by the level of the debt financing of that company. Therefore the free cash flow to firm (FCFF) is defined as "*a measure of financial performance that expresses the net amount of cash that is generated for a firm after expenses, taxes and changes in net working capital and investments are deducted. FCFF is essentially a measurement of a company's profitability after all expenses and reinvestments*" (Investopedia, (n.d.) (a)). FCFF is the FCF adjusted for the interest payable to interest-bearing debt, after being adjusted for the tax implications, and is defined in Equation 5.6.

FCFF = CFO - Net Capital Expenditure + interest (1-Tax rate).

Equation 5.6

Another form of the calculation is to start with earnings before interest and tax (EBIT) adjusting for the tax implications, then add non-cash charges (or subtract non-cash income) such as depreciation, amortisation, charges for the write-down of assets, and deferred income taxes, less the capital expenditure and less increases in working capital. The FCFF is often referred to as the unlevered free cash flow because it is the cash flow before interest on debt is considered. When conducting a valuation of the firm the cost of capital is the weighted average cost of capital (WACC) and the free cash flow is the free cash flow to the firm.

5.6. Chapter Summary

This chapter discusses the two main MAV methodologies considered to be the most appropriate for development projects and operating mines, being the DCF analysis and comparable transactions method. The fundamental factors and information required to conduct the MAV using these methodologies is discussed in detail and how this information is utilised in the mineral project evaluation, Mineral Reserves estimation and finally the MAV. In this chapter it was established that there is strong foundation for linking mineral project evaluation, Mineral Reserves estimation, MAV and financial reporting. This forms a fundamental basis for the development of a framework to link the MAV methodologies and financial reporting for mineral companies. Similar information and results from these processes is fundamental in the preparation of primary financial statements disclosed in the integrated annual reports for financial reporting purposes, to be discussed in Chapter 6.

The DCF analysis is the most widely used methodology in mineral project evaluation and MAVs globally despite inherent weaknesses and shortcomings. For example, uncertainty can never be entirely removed from the MAV process because even the most thorough estimates of capital expenditure and operating cost are still subject to potential variations, while commodity prices are subject historically to wide fluctuations, even over the short term.

If all of these factors were simultaneously to move in an unfavourable direction, the economics of most mining projects would be seriously compromised. Conversely, if a number of factors move simultaneously in a favourable direction, projects which appeared marginal at the feasibility study stage can suddenly become highly profitable.

It has been established that the mining company's performance, as depicted in the annual financial statements, is driven by the mining technical operational fundamentals, as illustrated in Figure 5.4. However, it should be noted that the mining operational fundamentals, budgeted productivity and forecasted economic assumptions in the business plan provides a benchmark guidance on what is expected from that particular mining operation, whereas the financial statement reports on the actual performance of the operation at the end of the financial period. Financial reporting considers a historical perspective. The mining operational fundamentals influence the results reported in the annual financial statements, thereby establishing the link between the mining operational fundamentals and financial reporting to be discussed in detail in Chapter 6, where the framework for linking the MAV and financial reporting is established. In Chapter 7, the proposed framework is validated by applying the case study to a real life case study on Turquoise Hill Resources.

In conclusion, there are a number of issues that arise in calculating and using free cash flows in MAV. These issues include:-

- The use of different free cash flows, such as the FCF, FCFE and FCFF. As highlighted in the discussion there are different calculations to represent these cash flows and, to add to the confusion, many are simply referred to as free cash flow;
- Estimating free cash flow for future periods using current financial information presumes that the current performance is representative of the company and its ability to generate cash flows. In most cases this is not true due to difficulty in forecasting commodity prices with a high degree of confidence, and their cyclical nature;
- Variation in capital expenditure from year to year, combined with the typical variability in net income, suggests that a better benchmark may use some type of averaging for cash flows from several periods, not just one fiscal period;
- The benefit of using free cash flow is still debatable. While FCF provides financial flexibility, it also creates temptation to invest in non-value adding projects; and
- The value estimated using FCF should be evaluated with respect to the sensitivity of the estimate to the specific calculation of FCF, the assumptions regarding growth rates, and the assumptions embedded in the calculation of the appropriate cost of capital.

Market comparable valuations are widely used in the mining industry as an addendum to the DCF technique. Given the basic nature of the minerals industry and low product differentiation, it is fairly easy to use multiples as a guiding valuation methodology albeit with some adjustments to cater for the peculiarities of each mineral deposit and hence the mining operation.

It should be noted that the multiples are only relevant when used for companies mining the same commodity/mineral, on the assumptions that the companies in the same industry will face similar risks and operating circumstances. Selection of the right peers when using trading or transaction multiples is important. Even within the same country and same commodity, there can be wide variations on operating costs, quality of the deposit, method of extraction and capital expenditure so, multiples should only be used as a guiding number.

6. LINKING MAV AND FINANCIAL REPORTING

6.1. Chapter Overview

The chapter discusses how the existing and emerging financial reporting requirements in the mineral industry discussed in Chapter 4, mineral project evaluation, Mineral Reserve estimation and MAV discussed in Chapter 5 provide a solid foundation for linking MAVs and financial reporting. As established in these previous chapters, there are links between mineral project evaluation, Mineral Reserve estimation, MAVs and financial reporting. This chapter considers how these are all linked. In this thesis a framework to harmonise MAV methodologies and financial reporting requirements has been developed and is discussed in detail in this section. In addition, the developed framework will be validated using a real life case study as detailed in Chapter 7.

In this chapter, the emerging trends by mineral companies to compile integrated annual reports in an effort to provide the stakeholders with more information is examined. The information that is peculiar to mineral companies reported on the primary financial statements is also discussed and lastly the proposed framework is discussed.

6.2. Mining Integrated Financial Statements

Mineral Resources and especially Mineral Reserves are at the heart of a mining company's value, and the KPMG (2009) survey highlighted the difficulties that mining companies have in communicating clearly to the stakeholders the impact that Mineral Resources and Mineral Reserves have on their financial reporting, as well as the significant uncertainties that mining companies face in their operations. The difficulty is in finding a transparent method to reflect the value of the mineral asset. Most companies do not place any value on their Mineral Resources as far as financial reporting is concerned. Integrated reporting provides a means to address the issue through greater transparency and hence provide a potential solution to mining companies. The primary purpose of an integrated annual report is to communicate information and explain to providers of capital (shareholders) how an organisation creates value over time (Integrated Reporting, 2013). An integrated annual report benefits all stakeholders interested in the mining company's ability to create value through the extraction of the mineral reserves over time, including employees, customers, suppliers, business partners, local communities, legislators, regulators and policy-makers.

In 2013 the International Integrated Reporting Council developed the International Integrated Reporting Framework which provides principles-based guidance for companies and other organisations wishing to prepare an integrated annual report. It was hoped that this initiative would provide impetus for companies to standardise global reporting and thus create value for shareholders. The framework *"applies principles and concepts that are focused on bringing greater cohesion and efficiency to the reporting process, and adopting 'integrated thinking' as a way of breaking down internal silos and*

reducing duplication. It improves the quality of information available to providers of financial capital to enable a more efficient and productive allocation of capital" (Integrated Reporting, 2013, p2). Its primary focus is on value creation, and the capital invested in the business to create value over time, contributes towards a more financially stable global economy.

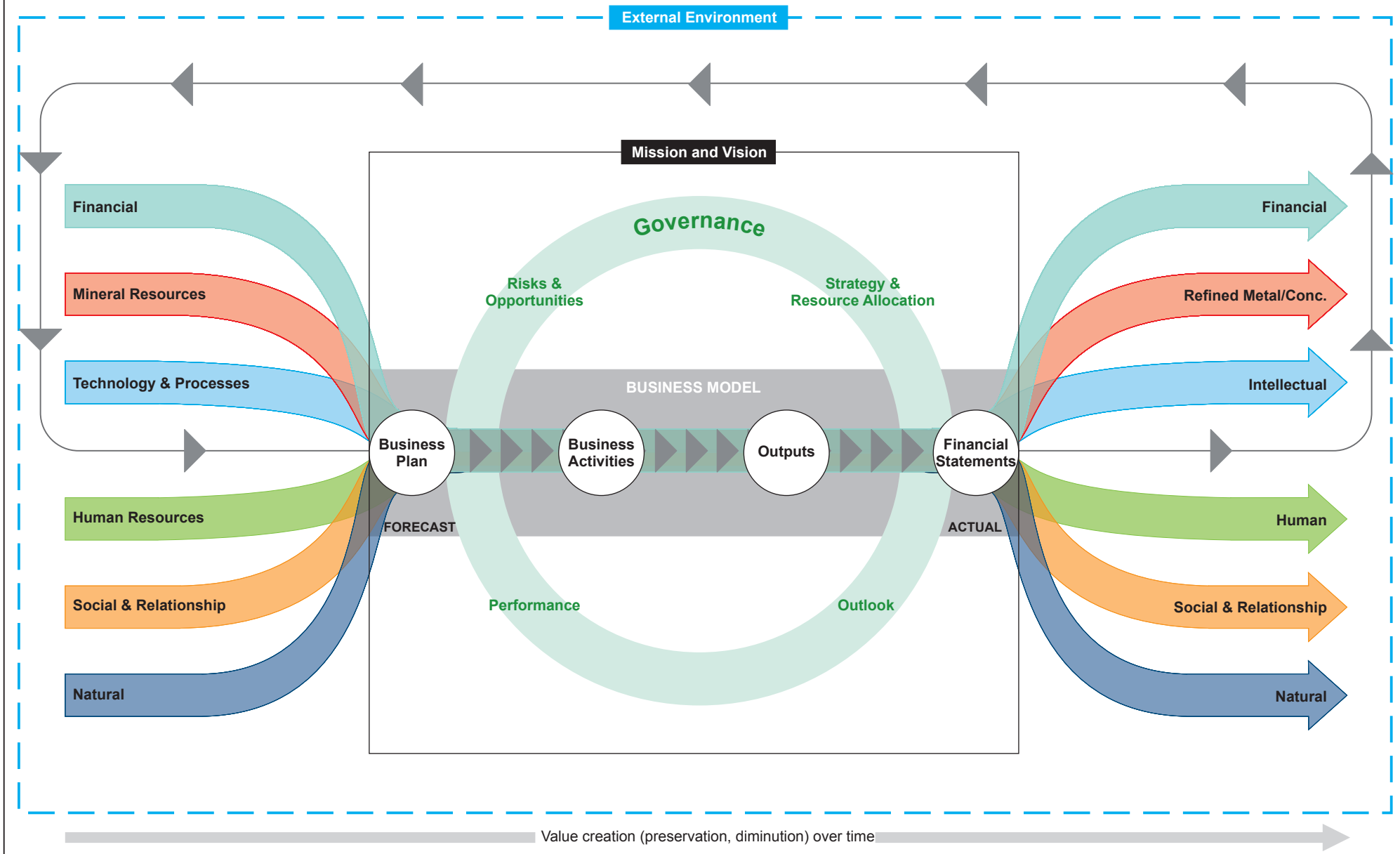
The process of integrated thinking and reporting over time would result in an efficient and productive capital allocation and would affect financial stability and sustainability. Integrated annual reporting aims to (Integrated Reporting, 2013, p2):-

- *"Improve the quality of information available to providers of financial capital to enable a more efficient and productive allocation of capital (sic);*
- *Promote a more cohesive and efficient approach to corporate reporting that draws on different reporting strands and communicates the full range of factors that materially affect the ability of an organization to create value over time;*
- *Enhance accountability and stewardship for the broad base of capitals (financial, mineral resources 'manufactured', intellectual, human, social and relationship, and natural) and promote understanding of their interdependencies (*Figure 6.1*); and*
- *Support integrated thinking, decision-making and actions that focus on the creation of value over the short, medium and long term".*

The Integrated Reporting (2013) defined a Business model as "*an organization's system of transforming inputs through its business activities into outputs and outcomes that aims to fulfil the organization's strategic purposes and create value over the short, medium and long term*" as illustrated in Figure 6.1. As already established in the preceding chapter, a mining company's business plan and the associated LoM plan form the basis of the inputs into the mining business model and the financial statements provide a basis to evaluate whether the company's financial targets and objectives have been met. The business plan has a futuristic perspective of the business model, whereas the integrated annual report measures the performance of the business model from a historic perspective. All these factors interact with the external environment which is not limited to economic conditions, technological changes, social issues and environmental challenges, during the execution of the business activities. This sets the context within which the organisation operates and the mining company should identify risks and opportunities and devise strategies of how to deal with these challenges in order to create value for the shareholders in the short, medium and long term.

As already alluded to in the previous chapter the single most important asset for a minerals company is the Mineral Reserves, yet these are not reflected on the financial statements, except where the mineral assets were purchased as a going concern. However, the importance of integrated reporting was established in the Extractive Industries 2001 Discussion Document that first pointed out the problem and suggested that the additional information can be provided to the stakeholders in the form of accompanying notes in the annual report and financial statements.

Figure 6.1: The generalised mining value creation over time



Adapted from: Integrated Reporting (2013)

A Framework to Harmonise Mineral Asset Valuation Methodologies with Existing and Emerging Financial Reporting Requirements

by Godknows Njowa, 2017

Since then mining companies have started reporting mineral resources and mineral reserves statements as part of their annual declarations. This was the introduction of integrated reporting in the extractive industries and at present day it is considered as the industry best practice. This fact bears testimony that mineral resources and mineral reserves, environmental issues, communities and social issues are factors that could materially affect the ability of a mining company to create value through the extraction of mineral reserves over time. In addition, this also indicates that there is a link between mineral reserves and the results presented in the financial statements. The size of the integrated annual reports are growing year after year as companies strive to provide the stakeholders with more information both internal and external to the mining company. This information has a potential impact to affect the mining company's ability to create value for the stakeholders, through increased transparency.

Financial statements are designed to report on business performance in the last financial period. Globally it has been established that companies would report their financial results annually as the major component of the integrated annual report. In addition, in the minerals industry a trend has been established that companies prepare their annual business plans that form the basis of the annual mineral reserves declaration, also declared in the integrated annual report. Major mining houses such as Rio Tinto Limited, Anglo American plc, BHP Billiton Limited, Vale SA, Newmont Mining Corporation, Barrick Gold Corporation and Gold Fields Limited, all have embraced the concept of integrated reporting. The Mineral Reserves declaration and annual business plan cycle achieve the following objectives as elaborated by Smith (2011a, p.148):-

- *"To enable integration between Corporate and Operations, both mines and process operations, and between MRM / Finance / Business Development / Projects;*
- *To improve the quality of product in long and short term planning by better balance of effort between the two;*
- *To create a planning process that is routine but sufficiently adaptable, and which allows for planning flexibility;*
- *To facilitate communication between stakeholders (Corporate, Operations, Services, Projects);*
- *To define the process, its components and inter-dependencies;*
- *To produce a defined product which is aligned to expectations; and*
- *To define clear accountability, roles and responsibilities".*

6.2.1. Mining Income Statements

Extraction and processing of Mineral Reserves is the only major source of the revenue generated by a mining company. Hence the Mineral Reserves are the most important economic asset for a mining company. Its financial strength depends largely on the scale and quality of its Mineral Reserves. Resources and reserves are also the source of future cash inflows from sale of minerals and they provide the basis for acquiring funds through borrowings and additional equity financing.

Minerals can be sold either as the refined metals, concentrates or as ore and the income statements show the profitability of the mining company and how the profit or loss are shared between the major shareholders and the minority shareholders.

The income statement also summarises the revenue and cost incurred in the extraction of the Mineral Reserves in a financial period. In addition, the income statement also shows the proportions that each group of shareholders have on the profit or loss made. The operating costs are categorised into different sections:-

- Cost of Sales: being the direct cost of mining, processing and other costs directly related to the ore, to the point of a saleable product;
- Operating Expenses: all the other costs incurred on the mining operation as support services and activities to the extraction of Mineral Reserves;
- Exploration and evaluation costs;
- Selling, General and Administration Expenses: all other non-production expenses incurred on marketing the saleable mineral ore, the general management and administration of the mine;
- Finance Costs: this relates to the interest paid and/or earned during the financial year. This is mainly affected by the amount of cash available or amount of debt that has been borrowed to finance the mining operations; and
- Income Taxes: relate to the corporate taxes that the company pays to the Government mainly based on profitability and are based on certain taxation regulations.

The non-operating items also affect the reported income taxes, hence they must be adjusted to an all-equity, operational level, since the interest expense is tax deductible in most of the mining jurisdictions globally. Theoretically, highly leveraged companies will have smaller tax burdens, which would lead to a higher valuation.

The historical and forecasted income statement is the heart of the MAV for a minerals company that is either at a developmental stage or operating mine. A mineral company's value at these stages of development is solely driven by the potential profitability of the mining operation. The more profitable the mining operation is the higher the value attributable to the mineral project and or the mining company. This further supports the idea that there is a link between the financial reporting and MAV as established in the next chapter when looking at a real life case study.

To maintain competitiveness, a mining company needs to focus on cost and capital discipline to deliver competitive all-in sustaining costs, all-in operating costs; and continue to target sustainable free cash flow generation. Sometimes in times where commodity prices continue to be depressed, significant cost reductions initiatives are included in the annual business plans to maintain profitability.

6.2.2. Mining Balance Sheet

A balance sheet is a financial statement that summarises a mining company's assets, liabilities and shareholders' equity at a specific point in time and give an analyst an idea as to what the mining company owns and owes, as well as the amount invested by shareholders. A balance sheet of a mining company would be the same as a balance sheet of any other business entity, except for the additional mineral asset categories.

It was established, that Mineral Reserves are the single biggest asset for a minerals company. However, this asset is not recognised on the balance sheet unless the mineral asset has been acquired from a third party and a value has been ascribed to the mineral asset as part of PPA. In the case where the mineral asset was developed by the mining company, the capital cost used to develop and construct the mine and associated infrastructure would be recognised on the balance sheet. However, the capital costs used to develop the mine, would not have a resemblance with the estimated value of the mineral asset because, for the mining company to make the investment decision to spend that capital in the construction of a mine and the associated infrastructure they would have conducted a mineral project evaluation at a definitive feasibility study level. The DCF analysis is developed as part of the mineral project evaluation of the proposed mining operation where the mineral reserve has been well defined and extraction has been scheduled over LoM. From a cost basis, there should be established capital infrastructure accompanied by stable cash operating costs. The results of such analysis should have shown that execution of the project would give a suitable return to the providers of capital over and above paying for capital spend, operating costs and all other regulatory costs. Hence the capital costs on the balance sheet would only be a proportion of the estimated MAV for implementing such a project.

AngloGold Ashanti (2014, p.58) defined capitalised mine development costs as the "*expenditure incurred to develop new orebodies, to define further mineralisation in existing orebodies and, to expand the capacity of a mine*". Capitalised mine development costs in an open pit mining environment as defined by AngloGold Ashanti (2014, p.57) would include "*stripping activity assets relating to production stripping activities incurred in the production phase of a surface mine. Once determined that any portion of the production stripping costs should be capitalised, the group uses the average stripping ratio and the average mine costs per tonne of the component to which the production stripping costs relate to determine the amount of the production stripping costs that should be capitalised*". Mine development costs would also generally include acquired proved and probable Mineral Reserves. These costs are then amortised from the date on which commercial production commences on the basis of units of production relative to the total units expected to be produced according to the LoM and the declared Mineral Reserves statement. Depreciation, depletion and amortisation of mine development costs are computed by the units-of-production depreciation method. The proved and probable Mineral Reserve reflects estimated quantities of reserves which can be recovered economically in the future from known mineral deposits.

In an open pit environment, the average mine stripping ratio and the average mine cost per tonne of the component to which the stripping activity asset relates are recalculated annually in the light of additional knowledge and changes in estimates that an auditor would need to test these estimates annually (AngloGold Ashanti, 2014). Mine infrastructure and plant facilities, including decommissioning assets, are amortised using the lesser of their useful life or units-of-production method based on estimated Mineral Reserves.

Mining companies need to strengthen their balance sheets in the medium term, so as to create a prudent buffer for volatility. In the normal course of their business activities, the mining companies are exposed to uncertainty in commodity price, foreign exchange, interest rate, liquidity, equity price and credit risks. In order to manage these risks, the mining companies may enter into transactions which make use of both on- and off-balance sheet derivatives and funding to weather the unfavourable commodity price cycles. Hedging, a form of security against falling future commodity prices, is a process whereby miners and other suppliers of metal can guarantee the future profitability of their operations by locking in currently prevailing prices. The forward price is normally very close to the currently prevailing price; if prices rise by much, a miner would still have to deliver at the agreed rate, foregoing the increased profit margin.

The argument here is that the first step would be recognising the value of Mineral Reserves on the balance sheet. Mineral Resources are a whole different issue since they are potential future mineral reserves. The position taken by the USA is that “if a mineral resource has not been converted into a mineral reserve, then why not, and therefore what value does it have?”

6.2.3. Mining Cash Flow Statement

A cash flow statement, also known as statement of cash flows, is a financial statement that reports the cash generated and used during the reported time interval and in addition it shows how changes in balance sheet accounts and income statements affect cash and cash equivalents, and breakdowns the analysis in to:-

- Operating activities: these are the company's core business activities in this case mining activities and generally provide the majority of a company's cash flow and largely determine whether a company is profitable;
- Investing activities: report the net cash flows from buying and selling long-term assets and other investments; and
- Financing activities: that account for external activities that allow a firm to raise capital and repay investors, such as issuing cash dividends, adding or changing loans or issuing more stock.

It has been established that the ability to generate free cash flow would determine the fundamental value of the mining company. Theoretically, if the commodity price increases the difference should flow straight to free cash flow line *ceteris paribus* and the value of the mining company should increase.

This is because it increases the profitability of the mining business, assuming that the cost base remains the same. Mining cash flow statement forms the basis of any mineral asset valuation for a mineral property in production, the different ways to calculate the free cash flows for valuation purposes were discussed in detail in Section 5.5.1 and the outcome would be similar valuation results.

6.2.3.1. Dynamic Cash Flow Modelling

The development of a dynamic cash balancing model would start by modelling the business activities as they occur and the model should then calculate the end of period cash balance as derived from the beginning of period cash plus cash from operations, cash from investing activities and cash from financing activities. A good cash flow model should have a changing cash balance as the business activities generate or deplete cash during each period being analysed. When building the forward-looking cash flow model, the cash balance fed from the statement of cash flows should be available.

Operating Cash Flows should be fed from the Net Income line on the Income Statement, and non-cash adjustments to Net Income (e.g., depreciation and amortisation) would be added back and the working capital adjustments made and this would result in a net positive or negative cash flow from the operations of the business. For growth businesses it is not uncommon to first have negative cash balances prior to the company being cash flow positive - in which case either debt or equity financing may be acquired to bridge this cash shortfall.

Investing Cash Flows are cash flows involved with the business's investments, including investments in securities or cash investments (which should interact with current assets in the balance sheet), investing in non-expensed assets, which would interact with property, plant and equipment in the balance sheet. These are typical cash outflows. Any asset disposals or maturing investments would represent the cash inflows.

Financing Cash Flows are cash flows involved with the business' interactions with its investors and creditors and it should be noted that interest expenses are considered in the operating cash flows) and should not be included in the financing cash flows section. The analyst needs to understand what the business is doing as far as issuing short- and long-term debt, or equity (cash inflows) or redeeming debt or buy back shares (cash outflows).

Finally using the Beginning of Period cash balance (prior month's cash balance), the net cash flows from these three sections (operating, investing and financing) of the cash flow statement are used to calculate the End of Period cash balance. This would then be fed into the cash balance on the balance sheet.

When developing an integrated financial statements and valuation model, the business needs to maintain a fixed level of cash resources to cover its working costs and this could be achieved through a cash sweep modelling. A cash sweep is the obligatory use of excess free cash flows to pay down outstanding debt rather than paying dividends to its shareholders. In the financial modelling the amount of cash sweep is the difference between the fixed cash balance assumption from the beginning of period balance, adjusted for the forecasted cash from operations, cash from investment and mandatory financing repayments according to debt schedule and financing agreements. Shortfalls may be mitigated through revolver facilities which will be drawn down to get the cash balance to be at the required level. A cash sweep does diminish cash on hand and cash flows, as a cash sweep is an earlier redemption mechanism included in term sheets with lenders, due to mining and cash flow risk. Excess cash is swept by the lender to redeem debt earlier, and unless there's a draw-down facility with the lender, this cash cannot be accessed. Therefore the cash swept pays the lender and does not sit on the balance sheet as retained cash.

Other companies would also have a cash sweep for dividends to equity and the way this is effected in the financial model will depend on the types of equity in capital structure. When there is a cash surplus, then one needs to model for the revolver to be paid down first such that the fixed balance is maintained, if there is a residual surplus after revolver repayment then one needs to model this surplus as a dividend payment.

6.3. Relationship between Mineral Reserves and Financial Reporting

In order to calculate the Mineral Reserve, estimates and assumptions are required about a range of geological, technical and economic factors, including quantities, grades, production techniques, recovery rates, production costs, transport costs, commodity demand, commodity prices and exchange rates.

Any of the economic and technical assumptions used in the estimation of the Mineral Reserve from period to period as illustrated in Figure 5.2, are subject to change during the LoM, different commodity cycles and because additional geological data is generated during the course of operations, estimates of the Mineral Reserve may change from period to period. It is certain that these assumptions are "bound" to change, however most financial models blindly assume they will not. This is part of the problem of linking Mineral Reserves estimate to the actual historical company performance being reported in the financial statements. Changes in the reported Mineral Reserves estimate may affect the mining company's financial results and financial position in a number of ways, including the following:-

- mining company's profitability maybe affected due to changes in the depreciation, depletion and amortisation charges;
- asset carrying values may be affected due to changes in estimated future cash flows;

- depreciation, depletion and amortisation charged in the income statement may change where such charges are determined by the units-of-production method, or where the useful economic lives of assets change;
- overburden removal costs, including production stripping activities, recorded on the statement of financial position or charged in the income statement may change due to changes in stripping ratios or the units-of-production method of depreciation;
- decommissioning site restoration and environmental provisions may change where changes in the estimated Mineral Reserve affect expectations about the timing or cost of these activities; and
- the carrying value of deferred tax assets may change due to changes in estimates of the likely recovery of the tax benefits.

The relationship between the Mineral Reserves and financial statements as highlighted above is based on a historical perspective, aimed at reporting on the company's historical performance during the financial period under review. The changes in the estimated Mineral Reserves would have a direct impact on the financial statements being reported. It should also be noted that the application of these changes are only considered at the balance sheet date, only considering how the business activities were conducted in the financial period that is being reported on. Therefore financial reporting is mainly focused on the historical performance of a mining organisation within that specified financial period, with a very limited or short view of the business activities. However, with the adoption of integrated annual reporting in the last decade, mining companies now include information that is pertinent to the continuation of these mining operations, with a relatively longer perspective for the investors to consider for investment decisions.

The relationship is further supported by research conducted by Sergeeva and Lebedevaa (2016) to investigate how Mineral Reserves and Mineral Resources are evaluated and represented in financial statements of mining companies, and what kind of influence do these mineral assets exert on the market value of a company. They concluded that mining companies as characterised by specificity conditioned by the nature of their key production asset (Mineral Reserves) and evaluating the so called accounting and managerial approaches to estimate value of the mineral resources base gave completely different results. Despite this, Mineral Reserves and Mineral Resources are not recognized in the annual financial statements. This leads to occurrence of difference between market and book value of a mining company, which should be taken into account in business combinations, signifying that there is a relationship between the Mineral Reserves and financial reporting in the minerals industry (Sergeeva and Lebedevaa, 2016).

6.3.1. Linking Mineral Project Evaluation and Mineral Asset Valuation

Understanding the differences and the links between mineral project evaluation and MAV is fundamental in the development of a framework linking the MAV's and the current trends in financial reporting. Mineral project evaluation is usually conducted at the beginning of a mineral project either a greenfield or a brownfield project to establish an investment case or justification before implementation. A greenfield project has no historical (or established) mining activity nor unproven mineral belt and a brownfield projects is near existing mining operation or in an established mineral belt.

The evaluation would be aimed to determine whether the project will create value for the providers of capital. This would involve the comparison of the total capital requirements (investment) and all the future economic benefits expected over the LoM. The future economic benefits should be greater than the initial investment. During assessment different scenarios are considered and analysed and if the proposed project is viable an optimal scenario is selected for final engineering design and implementation. The valuation of a mineral project can be conducted at any time of the mining project life cycle and is aimed at estimating how much the mineral project can be sold or bought for at that particular point in time based on the prevailing market conditions and known information. This is mainly focussed on the future cash flows rather than a historical perspective i.e. selling the future cash flows of the business. Usually the sunk costs are excluded from such calculations, since they are historical and would not affect the future earning potential or cash flows for the business. Smith (2011a, p.209) further provided clarification that the "*distinction is made between the capital investment decision in which consideration of historic / sunk cash flows is excluded, as it has no bearing on the future viability of the investment, and assessment of overall business performance where it is necessary to include all prior cash flows viz. the business performance evaluation should include all sunk or historic cash flows (including revenues and spent capital expenditure and costs)*".

However, it should be noted that mineral project evaluation is closely linked to the MAV, fundamentally because both processes mainly focus on the potential future ability of the mineral project to generate free cash flows. Secondly, the optimal mining scenario selected based on the results of the mineral project evaluation form the basis for the final LoM plan and the declared Mineral Reserves. The LoM plan and declared Mineral Reserves are the fundamental backbone input in the business planning and MAV process.

6.4. Proposed Framework

The fundamental asset that underpins the value of a mining project or mining company is its Mineral Reserves. A thorough understanding of the Mineral Reserves as the single most important item that drives the value and any financial performance of a mining company is required. For developmental projects and operating mines, the existence of Mineral Reserves forms the foundation of the mineral asset and the value attributed to it depends on the profitability of the business plan developed to extract the Mineral Reserves. The link between mineral project evaluations, declared Mineral Reserves

statement, Business plan, financial reporting and the resultant MAV are all premised on the profitability of the business plan. These links are summarised in Figure 6.2. For a mining company, the establishment of a continuous feedback loop of business investment performance relative to original investment criteria (technical, capital and otherwise) or business plan is essential if investment decision making and value maximisation are to be continuously improved over the LoM (Smith, 2011a).

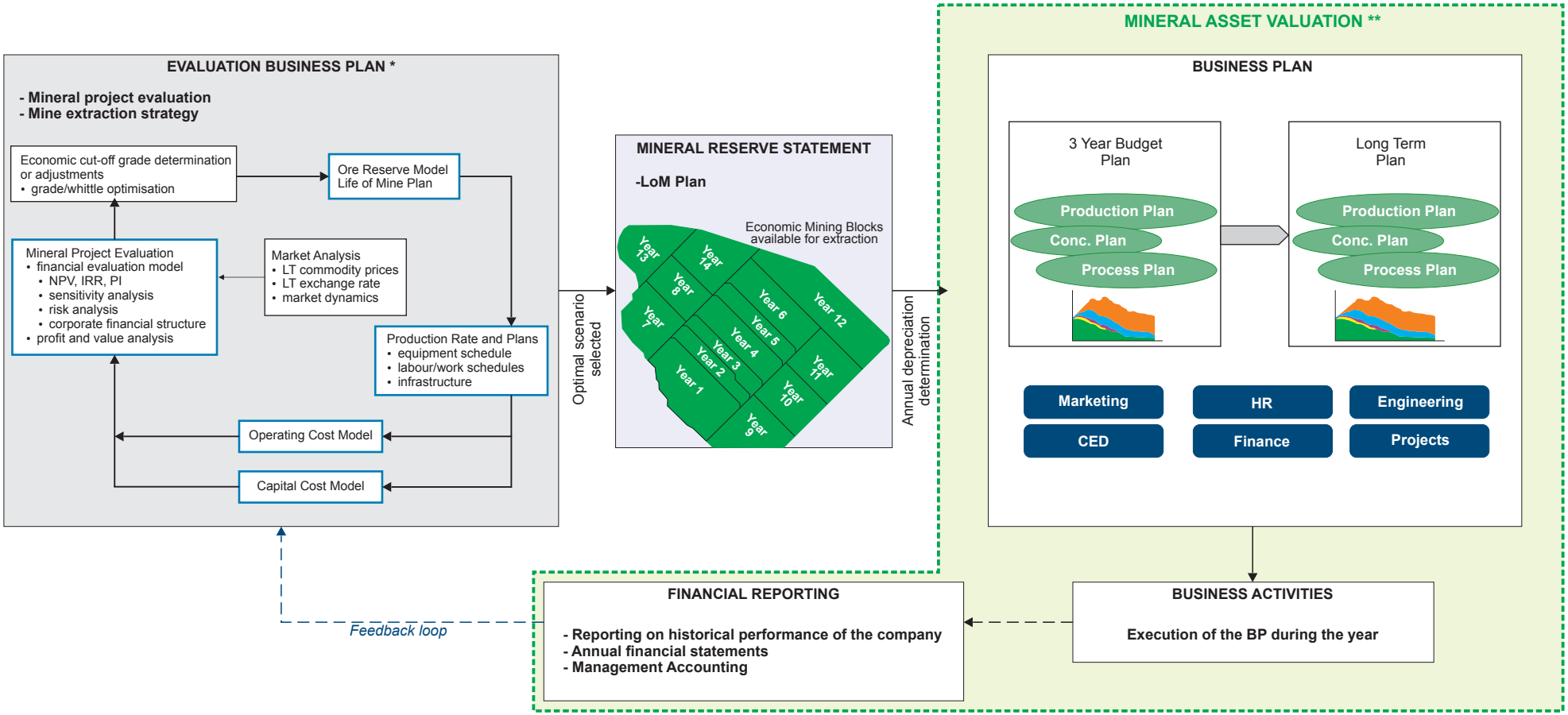
A key characteristic of commodity companies is their dependence on the price of the commodity for their cash flow and value. Multinational commodity companies are generally price takers, regardless of their size, because the global market is so large and the products created cannot be differentiated. Therefore, commodity company revenues are vulnerable to price trends and to volatility that account for most of their variance in revenues. However, other key value drivers of a mining property may include:-

- The extent and quality of its Mineral Reserves;
- Sales arrangements;
- Productivities and efficiencies during extraction of the ore;
- Operating capital and extraction costs; and
- Applicable royalties, taxes and duties.

The DCF analysis method for the evaluation or valuation of a mineral asset is a forward looking methodology that requires forecasts to be made with respect to technical and economic conditions which are predicted in the future to be able to estimate the value of the mineral asset under review (Smith, 2011a). In addition, Smith (2011a, p.204) further explained that the DCF analysis can also "*be used to assess the economic viability of a proposed mineral project based on a mineral reserve estimate, a comprehensive engineering study, detailed estimates of capital investment requirements and rational projections of operating costs and revenues. Since DCF analysis can be applied to assess the value associated with differing levels of expansion, increases in operating life and changes in mineral resource, it remains the preferred method for valuing various options available to the business*". Ultimately, as long as a mineral reserve has been identified with a high level of geological confidence and it is possible to make a reasoned estimation of production rate, associated costs and revenues, DCF analysis can be applied.

Financial reporting primarily focusses on reporting on historical performance and how well the business activities performed against the business plan. The MAV focusses on the forecasted and perceived future performance of the mining organisation and utilises this basis to estimate the value of the minerals company. It should also be noted that the historical performance provides some insight into what would likely to be the future performance of the mining company and also models the future changes that are planned in the business plan. Figure 6.3 illustrates the proposed framework, linking financial reporting to MAV as it applies to developmental projects and operating mines. One fundamental aspect is the commodity prices which are cyclical and if forecasting is wrong, then the MAV is going to be wrong as well.

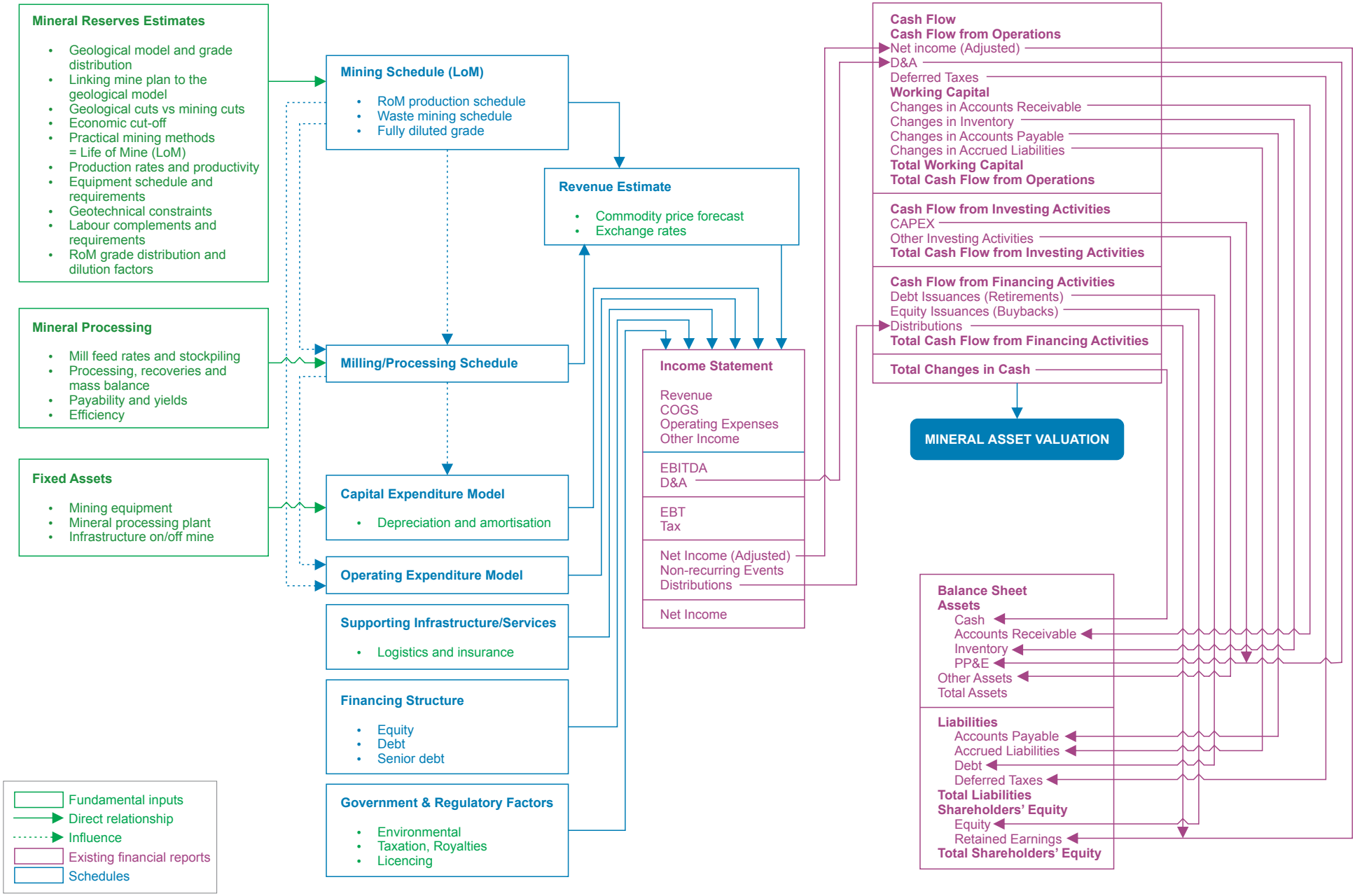
Figure 6.2: High level links between Mineral Project Evaluation, Mineral Reserves, Business Plan, Financial Reporting and Mineral Asset Valuation



* Chapter 5
** Chapter 1, 4 and 5

Adapted from: Smith 2011(a), Njowa and Clay 2016

Figure 6.3: The proposed financial reporting and mineral asset valuation framework for developmental and producing mineral projects



A Framework to Harmonise Mineral Asset Valuation Methodologies with Existing and Emerging Financial Reporting Requirements

by Godknows Njowa, 2017

The effect of including and excluding historical cash flows on the value of the project, i.e. a comparison of project value between the present perspective and the future view is done in both in nominal and real money terms. Eliminating historical cash flows, which include sunk capital expenditure, operating costs and any revenues derived from historical production, plus tax effects (if applicable), will leave only the current forward looking cash flow of the project.

At present, there are few specific regulations and standards on financial reporting of mineral assets. Development and validation of the complex international financial reporting standard covering all kinds of extractive activities from exploration to minerals processing and environmental remediation will provide interested users with complete information on the current mineral reserve base and its prospective development. The inclusion of Mineral Reserves value in the financial statements could also assist in making decisions on deals with mineral assets and mining business. (Sergeeva and Lebedevaa, 2016).

6.5. Summary

This chapter discussed the emerging integrated financial reporting requirements for companies in the extractive industries, emanating from the fact that in most cases Mineral Reserves are not recorded on the primary financial statements. This is further reinforced by the lack of a specific accounting standard for the extractive industries, as discussed in Chapters 2 and 4. Integrated annual reports provides interested and affected parties with more information about the mineral asset, internal factors, external factors and their interaction during the course of business activities. This chapter further explored the specific information required from the mining operations as an input to the preparation of financial statements as opposed to a general business enterprise. This additional information is disclosed in the integrated annual report. This further supports the fact that the extraction of the mineral asset drives the value of a mining company, establishing the strong links between the mineral asset and financial reporting.

The linkages between the mineral project evaluation, Mineral Reserves declaration, financial reporting and finally the financial valuation of the mineral asset or mineral companies was established. These linkages formed the basis of the framework proposed in this chapter to harmonise MAV methodologies, with existing and emerging financial reporting requirements for developmental projects and operating mines. The proposed framework was applied on a real life case study, the Turquoise Hill Resources, which owns Oyu Tolgoi copper-gold mine in Mongolia, as detailed in the next chapter.

7. LINKING MAV AND FINANCIAL REPORTING: OYU TOLGOI CASE STUDY

7.1. Chapter Overview

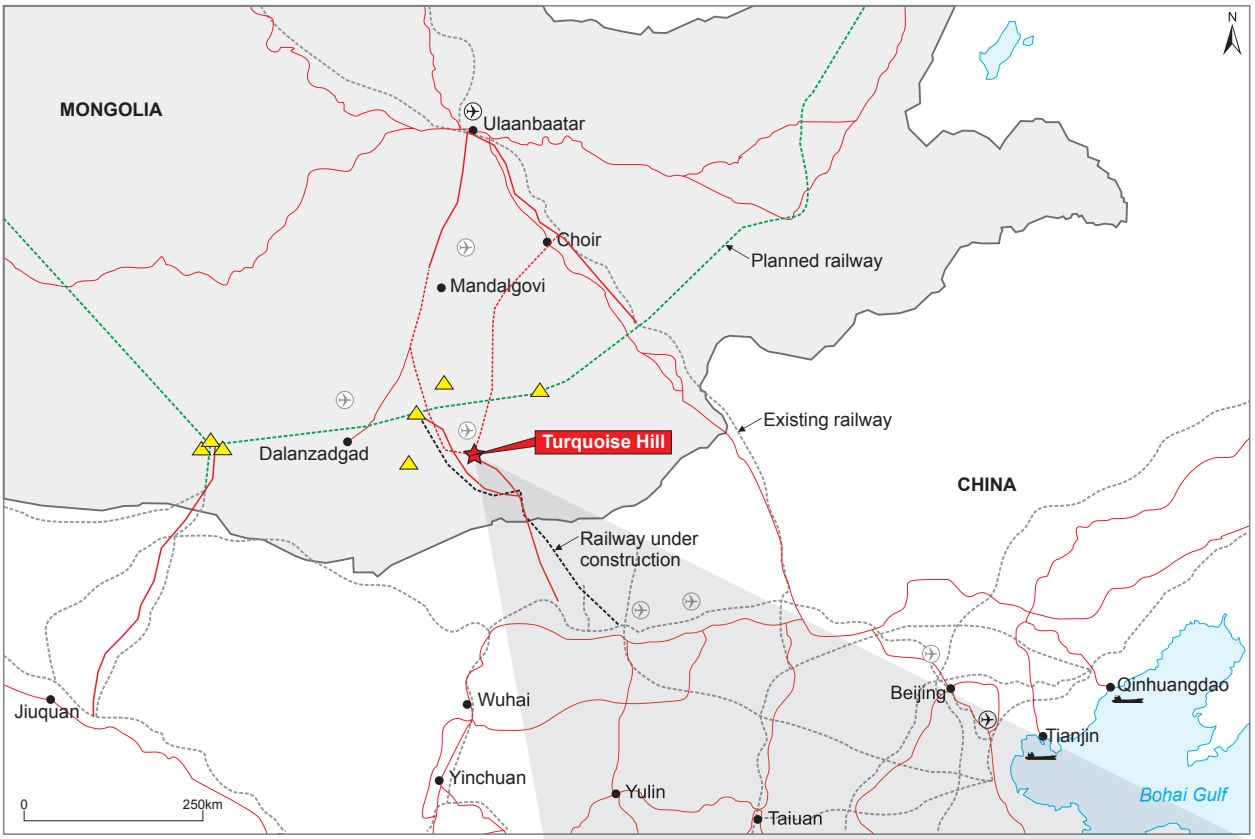
This chapter uses the developed framework linking the financial reporting requirements and mineral asset valuation methodologies to estimate the value of a mineral asset and comparing it to the market value of the mining company that holds the asset. DCF analysis will be used as the primary valuation methodology as it remains the most widely accepted technique. Despite the increasing use of probabilistic methods, deterministic DCF analysis remains the most widely accepted methodology despite its drawbacks.

The use of DCF analysis is considered a primary methodology for project valuation and investment decision making for developmental projects and operating mines. Turquoise Hill Resources (Turquoise or The Company), which owns Oyu Tolgoi copper-gold mine in Mongolia was found to be a suitable case study, because Turquoise owns and operates this single multi-commodity mineral asset, with information that is available in the public domain. Hence the value of the Turquoise on the stock exchange is driven by the fundamental value of the mineral asset. As part of the validation, this case study considers the factors that Turquoise is considering on several investments into Oyu Tolgoi copper-gold mining project and the expected future returns. This chapter discusses the technical and financial factors that the company considered before investment and what the value attributable to this company is. Comparison of the project's NPV, IRR, estimated project value based on assumptions on commodity prices outlook and discount rate and operating costs is done. It will show how the market attributed value to the mining company is ultimately based on the mining project.

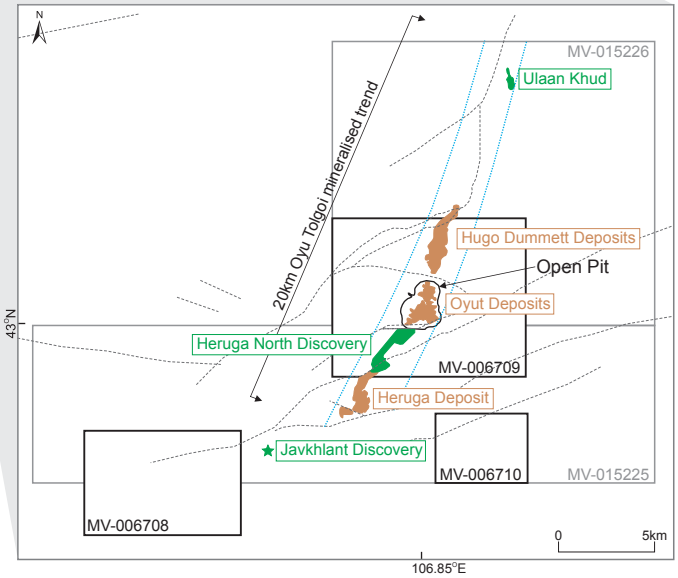
7.2. Oyu Tolgoi Copper-Gold Mine

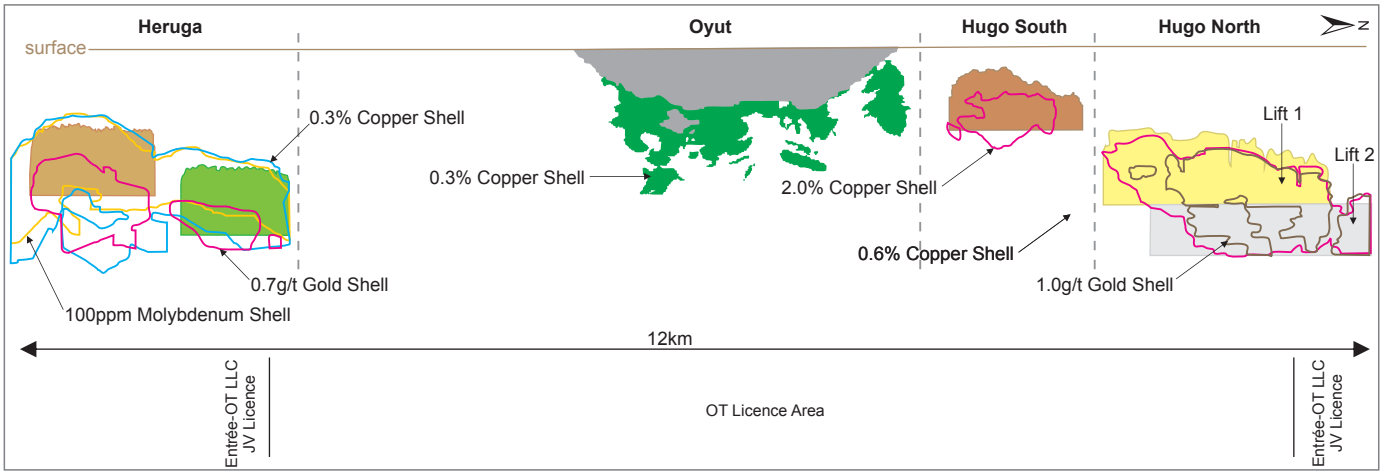
Turquoise has its primary listing in Canada on the TSX, and secondary listings in the United States of America on the NYSE and the NASDAQ under the code TRQ. The company is focused on copper-gold mining in Mongolia, with its primary operation as its 66% interest in Oyu Tolgoi copper and gold project (Oyu Tolgoi), which also produces silver and molybdenum. Oyu Tolgoi is one of the world's largest new copper-gold mines that went into production in early 2013 and is located in the South Gobi region of Mongolia, approximately 550 kilometres (km) south of the capital, Ulaanbaatar, and 80km north of the Mongolia-China border. Turquoise currently utilises road transport for the copper, gold, silver concentrates produced, to be delivered to customers in China.

Figure 7.1: Locality of the Turquoise Hill projects and a cross-section along the 12km strike length of the mineral asset









Source: Oyu Tolgoi (2016), Oyu Tolgoi (2014)

On October 6, 2009, Turquoise and Rio Tinto plc (Rio Tinto) signed a long-term, comprehensive Oyu Tolgoi Investment Agreement with the Government of Mongolia for the construction and operation of the Oyu Tolgoi copper-gold mining complex. The agreement created a public-private partnership between the Mongolian Government which acquired a 34% interest in the project through a state-owned company Erdenes Oyu Tolgoi LLC to represent its interest and Turquoise, which retained a controlling 66% interest in Oyu Tolgoi. Global miner Rio Tinto, joined Turquoise as a strategic partner in October 2006, to manage the development of Oyu Tolgoi. Rio Tinto indirectly owns approximately a 50.8% interest in Turquoise.

Erdenes Oyu Tolgoi LLC has the right to appoint three members to the Board of Directors of Oyu Tolgoi LLC. Together with the members of the Board appointed by Turquoise and Rio Tinto, their responsibility is to guide and oversee the management team to maximise the value of the project and Oyu Tolgoi LLC. Rio Tinto is a leading international mining group, combining Rio Tinto plc, a London listed public company headquartered in the UK, and Rio Tinto Limited, which is listed on the Australian Securities Exchange, with executive offices in Melbourne. The two companies are joined in a dual listed company structure as a single economic entity, called the Rio Tinto Group.

Rio Tinto's business is finding, mining, and processing mineral resources. Its interests are diverse both in geography and products. Major products are aluminium, copper, diamonds, energy (coal and uranium), gold, industrial minerals (borax, titanium dioxide, salt) and iron ore. Activities span the world but are strongly represented in Australia and North America with significant businesses in South America, Asia, Europe and Africa.

7.2.1. Summary of Oyu Tolgoi Project Development

The Oyu Tolgoi project is located in the Southern Gobi region of Mongolia and is being developed by Oyu Tolgoi LLC. Mineralization on the property consists of porphyry- style copper, gold, silver and molybdenum contained in a linear structural trend (the Oyu Tolgoi Trend) that has a strike length extending over 26km. Mineral resources have been identified in a series of deposits throughout this trend. The Oyu Tolgoi deposits stretch over 12km, from the Hugo North deposit in the north through the adjacent Hugo South, down to the Southern Oyu Tolgoi ('SOT') deposit and extending to the Heruga deposit in the south as shown in the Figure 7.1. The series of deposits contain an estimated Measured and Indicated mineral resource of 46.8billion pounds (blb) of contained copper and 25.3 million ounces (Moz) of contained gold and an estimated Inferred mineral resource of 51.5 billion pounds of contained copper and 36.0Moz of contained gold as summarised in Figure 7.2. The Oyu Tolgoi trend is still open to the north and south and the deposits have not been closed off at depth. Arsenic (As) is a deleterious element, which is also found in the Oyu Tolgoi deposit and contributes to the operating costs due to penalties charged depending on the amount of contained As in the concentrate.

Figure 7.2: Oyu Tolgoi Mineral Resource and Mineral Reserve Statement as at 31 December 2015

Mineral Resources

CLASSIFICATION	DEPOSIT	TONNAGE (Mt)	Cu (%)	Au (g/t)	Ag (g/t)	Mo (ppm)	CuEq (%)	CONTAINED METAL Cu (Mlb)	Au (koz)	Ag (koz)	Mo (Mlb)	CuEq (Mlb)
Oyutu Deposit - Open Pit (0.22% CuEq Cut-off) (Excludes material mined up to 31 December 2015)												
Measured		377	0.52	0.35	1.35	53.90	0.72	4 335	4 038	15 804	45	5 947
Indicated		715	0.38	0.23	1.11	56.40	0.51	6 039	5 082	24 705	89	8 110
Measured + Indicated		1 092	0.43	0.27	1.19	55.50	0.58	10 374	9 120	40 509	134	14 057
Inferred		389	0.29	0.16	0.86	44.20	0.38	2 461	1 888	10 381	37	3 247
Oyutu Deposit - Underground (0.37% CuEq Cut-off) (Unchanged since 2014 Oyu Tolgoi Technical Report (OTTR))												
Measured		14	0.40	0.78	1.15	38.80	0.83	121	342	509	1	250
Indicated		93	0.35	0.59	1.19	34.30	0.67	713	1 766	3 562	7	1 386
Measured + Indicated		107	0.35	0.61	1.18	34.80	0.69	833	2 108	4 072	8	1 636
Inferred		159	0.39	0.32	0.85	25.40	0.56	1 354	1 638	4 382	9	1 985
Hugo Dummett Deposits (0.37% CuEq Cut-off) (Unchanged since 2014 OTTR)												
Measured	OT LLC	98	1.97	0.46	4.48	30.30	2.26	4 231	1 446	14 046	7	4 865
	EJV	1	1.43	0.12	2.86	39.40	1.52	35	4	103	0	38
	All Hugo North	99	1.96	0.46	4.46	30.40	2.25	4 267	1 450	14 149	7	4 902
Indicated	OT LLC	749	1.56	0.34	0.35	34.30	1.78	25 737	8 268	80 718	57	29 362
	EJV	128	1.65	0.55	4.12	33.60	1.99	4 663	2 271	16 988	10	5 633
	All Hugo North	877	1.57	0.37	3.46	34.20	1.81	30 400	10 539	97 707	66	34 994
Measured + Indicated	OT LLC	847	1.61	0.36	3.48	33.85	1.83	29 968	9 714	94 764	63	34 226
	EJV	129	1.65	0.55	4.11	33.70	1.99	4 698	2 276	17 091	10	5 670
	All Hugo North	976	1.61	0.38	3.56	33.83	1.85	34 667	11 989	111 856	73	39 897
Inferred	OT LLC	811	0.77	0.27	2.34	34.80	0.94	13 807	7 058	60 964	62	16 851
	EJV	179	0.99	0.34	2.68	25.40	1.20	3 887	1 963	15 418	10	4 730
	All Hugo North	990	0.81	0.28	2.40	33.10	0.99	17 695	9 021	76 382	72	21 581
Inferred	Hugo South	845	0.77	0.07	1.78	66.40	0.83	14	1 861	48 406	124	15 384
Hegura Deposit (0.37% CuEq Cut-off) (Unchanged since 2014 OTTR)												
Inferred Hegura EJV		1 700	0.39	0.37	1.39	113.20	0.64	14 610	20 428	75 955	424	24 061
Inferred Hegura TRQ		116	0.41	0.29	1.56	109.80	0.61	1 037	1 080	5 819	28	1 565
Inferred (All Hegura)		1 816	0.39	0.37	1.40	113.00	0.64	15 647	21 508	81 774	453	25 626
Oyu Tolgoi All Deposits Grand Total (Excludes material mined up to 31 Decemeber 2015)												
Measured		489	0.81	0.38	1.97	48.70	1.03	8 722	5 971	30 996	53	11 098
Indicated		1 686	1.00	0.32	2.34	43.60	1.20	37 152	17 572	126 797	162	44 486
Measured + Indicated		2 175	0.96	0.34	2.26	44.80	1.16	45 875	23 543	157 792	215	55 584
Inferred		4 200	0.56	0.27	1.64	75.10	0.73	51 531	35 980	221 670	695	67 821
Total Resources		**6 375**						**97 406**	**59 523**	**379 462**	**910**	**123 405**

Notes:-

1. The Mineral Resources include Mineral Reserves.
2. The contained gold and copper estimates in the table have not been adjusted for metallurgical recoveries.
3. The 0.22% for CuEq cut-off is equivalent to the open pit Mineral Reserve cut-off determined by OT LLC.
4. The 0.37% for CuEq cut-off is equivalent to the underground Mineral Reserve cut-off determined by OT LLC.
5. Oyut open pit Mineral Resources exclude material mined in the open pit as at 31 December 2015.

Mineral Reserves

CLASSIFICATION	DEPOSIT	ORE (Mt)	Cu (%)	Au (g/t)	Ag (g/t)	RECOVERED METAL Cu (Mlb)	Au (koz)	Ag (koz)
Oyut Mineral Reserve								
Proven		353	0.54	0.35	1.40	3 266	2 775	11 837
Probable		598	0.39	0.23	1.11	4 058	3 103	15 977
Oyut Total (Proven and Probable)		951	0.45	0.28	1.22	7 325	5 878	27 814
Hugo North Mineral Reserve								
Probable (OT LLC)		464	1.66	0.34	3.37	15 592	4 199	43 479
Probable (EJV)		35	1.59	0.55	3.72	1 121	519	3 591
Hugo North Total (Probable)		499	1.66	0.35	3.40	16 713	4 717	47 070
Total Mineral Reserve								
Proven		353	0.54	0.35	1.40	3 266	2 775	11 837
Probable		1 097	0.97	0.29	2.15	20 771	7 820	63 047
Total (Proven and Probable)		**1 450**	**0.86**	**0.30**	**1.97**	**24 037**	**10 595**	**74 884**

Notes:-

1. Commodity prices copper at USD3.02/lb, gold at USD1 300/oz and silver at USD19.00/oz.
2. Mineral Reserves do not include stockpile as at that date.
3. Mineral Reserves reported above are not additive to the Mineral Resources.

Source: Oyu Tolgoi 2016, Oyu Tolgoi 2014

Over time, the company will need to make multiple investment decisions on Oyu Tolgoi based on potential development options, to ensure the optimum use of capital. An initial investment decision made in 2010 was to construct the SOT Open Pit mine, a nominal 100ktpd concentrator and supporting infrastructure. These facilities are complete processing operations that began in December 2012, while commercial production started in September 2013, and first concentrate was exported in October 2013.

The initial investment decision included continued investment into the development of the Hugo North underground mine in parallel with mining the open pit. Lift 1 of Hugo North is the most significant value driver for the project and plans for its development are now at a feasibility stage and has been included as part of the current LoM plan. Oyu Tolgoi LLC, was funded by a group of international banks, through Rio Tinto plc.

Oyu Tolgoi mine was initially developed as an open-pit operation, with a copper concentrator plant and necessary infrastructure to support an initial throughput of 100,000 tonnes of ore per day (tpd). The main focus was to process ore mined from the Southern Oyu open pit. Future plans for Oyu Tolgoi envisage a 95,000tpd underground block-cave mine. In August 2013, development of the underground mine was halted due to outstanding issues with the Government of Mongolia. Upon successful resolution, development of the underground mine recommenced. The signing of the Underground Plan in May 2015 as part of addressing outstanding shareholder matters provided the final approval to implement the project. The underground development is currently underway, with first production from underground operations expected in 2020.

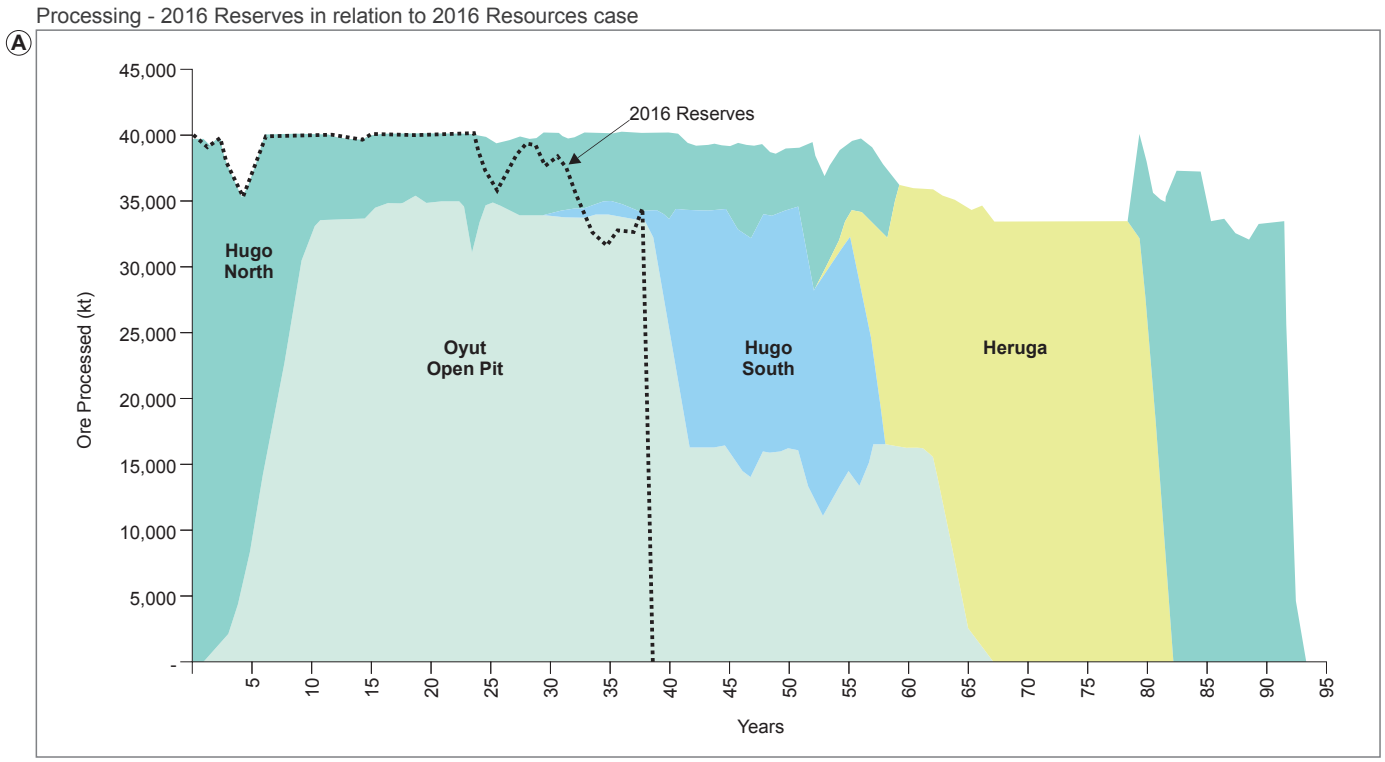
7.3. Oyu Tolgoi Mining Business Model

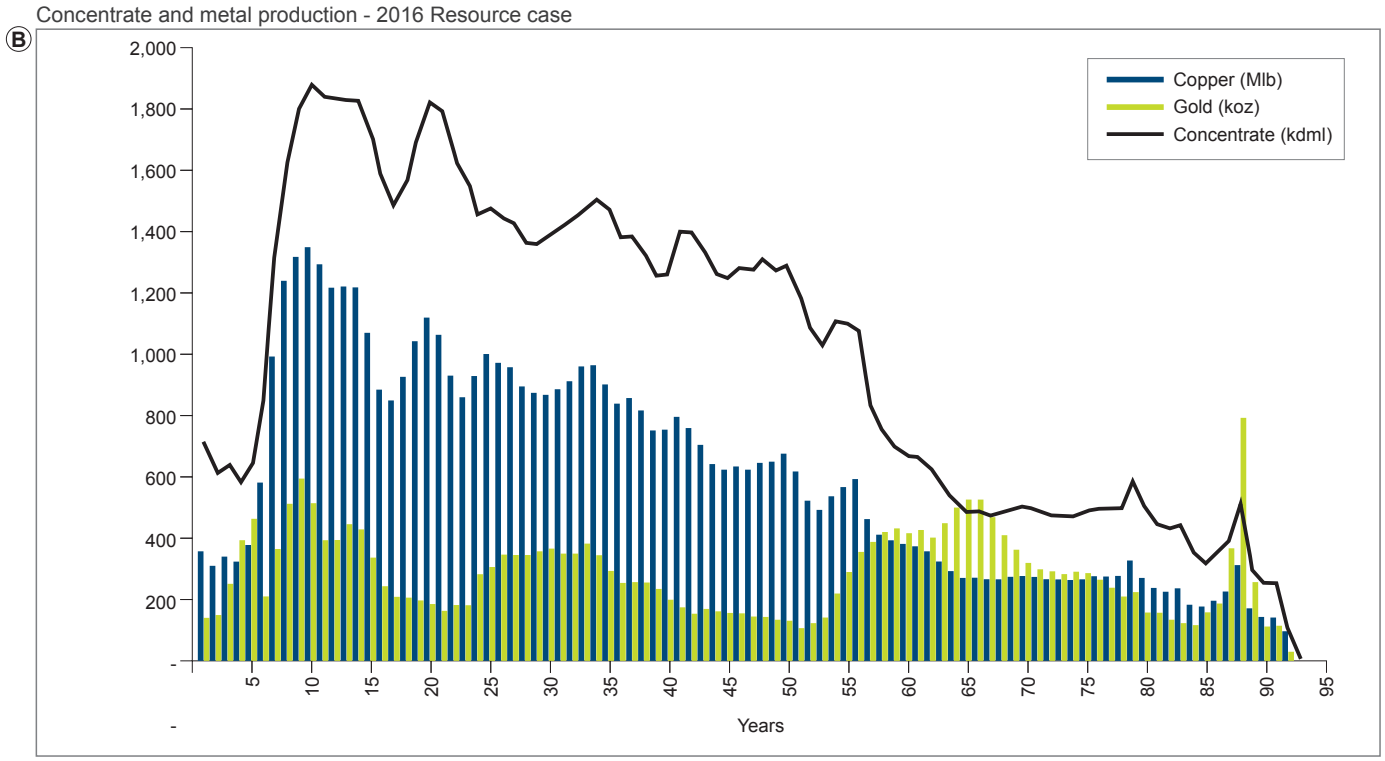
Oyu Tolgoi has been producing and exporting copper and gold concentrate since 2013. In the copper-gold concentrate, there are some minor elements such as silver and molybdenum. In the valuation models only credits for the silver have been included and the molybdenum has been allocated a value of zero. Good progress continued during 2016 on underground development and approximately USD106m was spend during the year and an additional USD750m committed for this project, including ongoing contractor mobilization and the signing of an additional contract for the sinking of Shafts 2 and 5 (Oyu Tolgoi, 2016).

7.3.1. Mining Production Schedule

For the purposes on validating the framework proposed in Chapter 6, all the financial modelling conducted utilised the 2016 Reserve Case (Base Case) , which is a baseline of the expansion analysis, that assumes that the plant capacity remains at the planned average production rate of 110,000tpd (40 Mtpa) for the LoM of 38 years as illustrated in Figure 7.3 A. This is based on the extraction of Oyut open pit and Hugo North lift 1 and 2 underground.

Figure 7.3: An example of Production Plans and Metal Production for the different cases with 2016 Reserves (Base Case)





Source: Oyu Tolgoi (2016)

The rest of the conceptual production plans include the extraction of the rest of the deposit, where Turquoise has several options that still needs to be evaluated. These options include increasing the production in a stepwise fashion from the current 40Mtpa, to 50Mtpa, then 100Mtpa and finally 120Mtpa, thereby shortening the LoM currently estimated to be 93 at the current production rates.

7.3.2. Mineral Processing Schedule

The development of the design criteria is an iterative process in which process assumptions must match and keep pace with test results, mine plans, economic constraints and vendor data. Grinding test work and preliminary mill selection provide the key capacity input to the mine, resulting in a production plan. In many cases, increments are determined by the largest available equipment or the size of the equipment already installed to minimize holding costs for insurance spares. Flotation recoveries and concentrate analyses provide the head grade-related capacity and product quality constraints used to tune the mine plan to maximize NSR while still producing a readily marketable product. The production plan is incorporated into the design criteria and ultimately drives the next mass balance.

Based on the Base Case, the processing plant will be fed consistently at the rate of 40Mtpa, based on the current declared Mineral Reserves of 1,450Mt of ore at a grade of 0.86% Cu as illustrated in Figure 7.3 A. However is should be noted that concentrate and metal production shows a different profile as shown in Figure 7.3 B from which it is evident that the metal production decreases over time due to the optimisation of extraction strategy in order to optimise the project NPV. This results from mining blocks with higher grades before those with a lower grade. This optimisation achieved the following two goals:-

- To cushion the profitability of the Turquoise, during this period where the commodity prices continue to be depressed, with the hope that by the time they would mine the lower grades the commodity prices would have recovered; and
- To enable early payback of the capital or debt spent for the construction of the mine and minimise the interest charges.

7.3.3. Commodity Price Forecast and Revenue Model

The financial modelling for the Oyu Tolgoi Project is based on projected future commodity prices. The prices used reflected stockbrokers consensus pricing views and opinions. It should be expected that actual prices will be potentially significant different than the prices used for such modelling. The commodity price forecasts used in the different financial models (the proposed framework model and banking model), were sourced from consensus forecasts prepared by Rand Merchant Bank (RMB) as summarised in Table 7.1. The base case forecast prices are the same commodity prices used by the company for their project evaluation. The same source was used as the basis of the commodity price forecasts, so that no bias would be introduced in these estimates which may affect the results of this work.

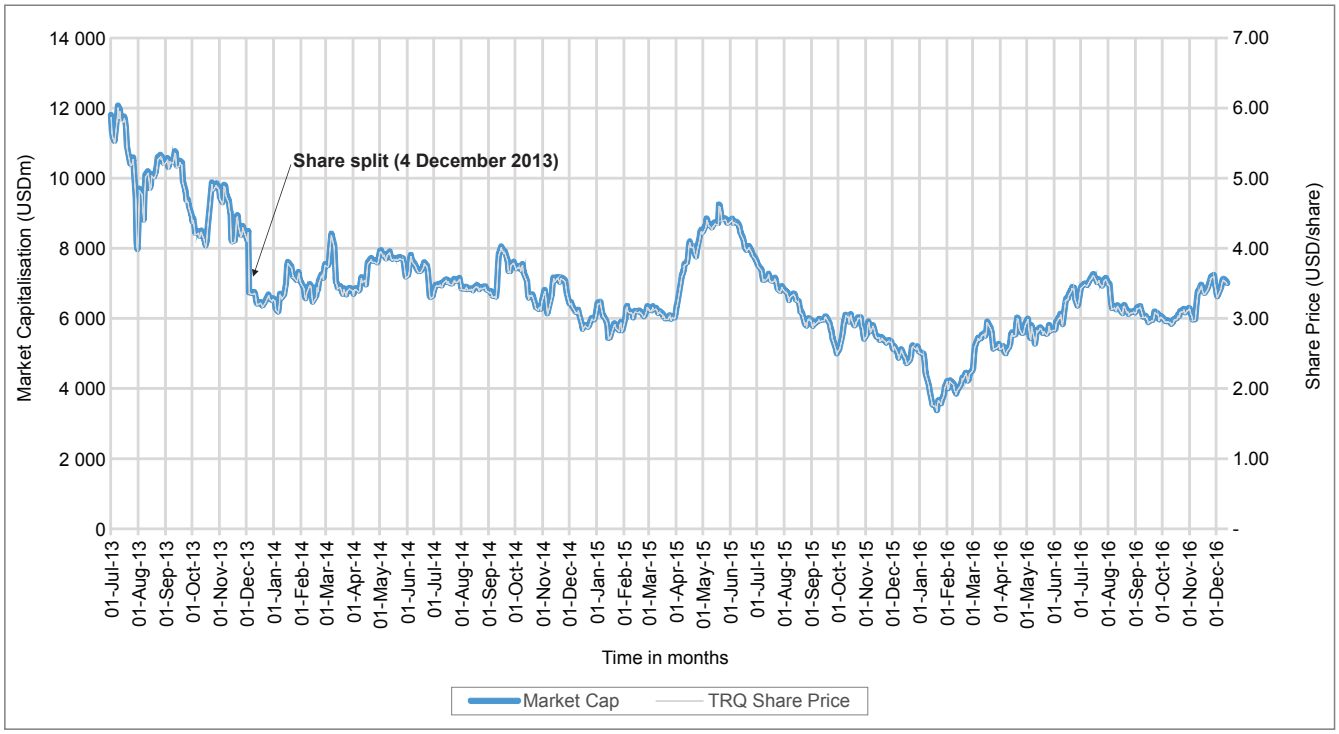
Table 7.1: 2014 - 2016 Consensus Commodity Prices and Base Case Prices

COPPER PRICE (USD/lb)	1	2	3	4	5	6	LT - real
Base Case	2.15	2.36	2.58	2.79	3.02	3.02	3.02
Sep-16	2.12	2.11	2.31	2.50	2.66	2.76	2.95
Jun-16	2.14	2.10	2.23	2.39	2.45	2.51	2.80
Mar-16	2.19	2.22	2.44	2.64	2.73	2.80	2.81
Dec-15	2.53	2.34	2.42	2.68	2.78	2.86	2.99
Sep-15	2.72	2.66	2.85	2.95	2.95	2.99	2.99
Jun-15	2.78	2.80	2.88	2.90	2.87	2.89	2.91
Mar-15	2.85	2.87	2.95	2.95	2.91	2.94	3.03
Dec-14	3.12	2.97	2.92	2.94	2.92	2.91	2.91
Sep-14	3.13	3.08	3.02	3.03	2.98	2.97	2.97
GOLD PRICE (USD/oz)	**1**	**2**	**3**	**4**	**5**	**6**	**LT - real**
Base Case	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Sep-16	1,285	1,325	1,271	1,246	1,244	1,244	1,220
Jun-16	1,185	1,173	1,169	1,168	1,172	1,178	1,167
Mar-16	1,205	1,152	1,154	1,159	1,151	1,147	1,147
Dec-15	1,169	1,126	1,113	1,112	1,113	1,118	1,089
Sep-15	1,194	1,166	1,152	1,150	1,137	1,141	1,170
Jun-15	1,200	1,178	1,161	1,154	1,151	1,161	1,167
Mar-15	1,226	1,192	1,167	1,169	1,171	1,177	1,210
Dec-14	1,268	1,174	1,161	1,141	1,147	1,180	1,182
Sep-14	1,285	1,249	1,241	1,216	1,203	1,214	1,209
SILVER PRICE (USD/oz)	**1**	**2**	**3**	**4**	**5**	**6**	**LT - real**
Base Case	19	19	19	19	19	19	19
Sep-16	19	19	19	19	19	19	19
Jun-16	16	16	16	16	16	17	17
Mar-16	16	16	16	16	16	16	16
Dec-15	16	16	16	16	17	17	17
Sep-15	17	17	17	17	17	18	19
Jun-15	17	17	17	17	17	18	19
Mar-15	18	18	18	18	18	18	20
Dec-14	19	18	18	19	19	20	21
Sep-14	21	20	20	20	20	20	20

Source: RMB (2016), Oyu Tolgoi (2016)

The long-term viability of the Oyu Tolgoi Project depends in large part on the world market prices of copper and gold. The market prices for these metals are volatile and are affected by numerous factors beyond the company's control. These factors include international economic and political trends, expectations of inflation, global and regional demand, currency exchange fluctuations, interest rates and global or regional consumption patterns, speculative activities, increased production due to improved mining and production methods and economic events, including the performance of Asia's economies.

Figure 7.4: The relationship between the historical market capitalisation, copper and gold prices







Adapted from: Kitco (2016), Yahoo Finance (2016)

Proxy for Company Valuation in the Market

The market capitalisation of Turquoise, was used as a proxy for the value of the company. Given the fact that Turquoise only has this mineral asset (Oyu Tolgoi copper-gold mine), as can be supported by the trend illustrated in Figure 7.4, the market capitalisation follows the copper and the gold prices very closely. The starting proposition for this thesis is that the value of Turquoise on the stock market should approximately equal the value of the mineral asset (Oyu Tolgoi). It should be noted that there was a share split in December 2013 and market capitalisation before this date was not considered in this evaluation. Therefore the banking model and proposed framework were compared to the market capitalisation to test validity in estimating the MAV for the mineral asset.

7.3.4. Operating Cost Model

The operating cash costs excludes: depreciation and depletion; exploration and evaluation; charges for asset write-down (including write-down of materials and supplies inventory), and includes management services payments to Rio Tinto, and management services payments to Turquoise which are eliminated in the consolidated financial statements.

The all-in sustaining costs is an extended cash based cost metric, providing further information on the aggregate cash, capital and overhead outlay per unit of production. This reflects the total costs of producing the copper-gold concentrate product in both the short term and over the life-cycle of its operations; as a result, sustaining capital expenditure on a cash basis is included rather than depreciation. This was used as the basis for the financial modelling cases considered in this these and summarised in Figure 7.5.

Mining operations are subject to extensive laws and regulations. These relate to production, development, exploration, exports, imports, taxes and royalties, labour standards, occupational health, waste disposal, protection and remediation of the environment, mine decommissioning and reclamation, mine safety, toxic substances, transportation safety and emergency response and other matters. These laws and regulations will affect the profitability of the mining operation and are were considered in the financial modelling considered in this thesis.

7.3.5. Capital Expenditure Model

The Project Financing package closure was completed in 2016 with 100% of project finance net proceeds and operating cash flow from the Oyut open pit used to fund underground development projected to be completed mid-2020's and is estimated at a cost of USD4.4bn to be spend in the next 5 years as summarised in Figure 7.5. In addition to the initial capital of USD4.4bn, approximately USD6.0bn would be spend on SIB capital over the Mineral Reserves LoM of 38 years. All project finance debt is forecast to be repaid by 2030.

Figure 7.5: Summarised Input Sheet for Financial Modelling (Technical and Economic Schedules for the Proposed Framework)

DESCRIPTION /YEARS	UNITS	1	2	3	4	5	6	7	8	9	10	11-20	21-30	31-40	TOTAL
Mining Schedule		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2040	
Open Pit ROM Feed	kt	39 980	39 169	38 818	35 161	30 518	27 842	24 901	19 936	14 456	9 180	70 468	326 251	272 289	948 969
Waste Tonnages	kt	65 788	46 565	43 109	75 153	54 397	60 194	46 786	23 343	23 362	48 171	571 594	516 711	116 278	1 691 451
Total Material Moved	kt	105768	85734	81927	110314	84915	88036	71687	43279	37818	57351	642062	842962	388567	2 640 420
Underground ROM Feed	kt	0	0	881	1 905	4 527	10 046	15 101	20 177	25 547	30 823	329 890	60 269		499 166
Plant ROM Feed	**kt**	**39 980**	**39 169**	**39 699**	**37 066**	**35 045**	**37 888**	**40 002**	**40 113**	**40 003**	**40 003**	**400 358**	**386 520**	**272 289**	**1 448 135**
Processing Schedule															
Plant ROM Feed	Mt	39 980	39 169	39 699	37 066	35 045	37 888	40 002	40 113	40 003	40 003	400 358	386 520	272 289	1 448 135
NSR															0.00
Copper Grade	Cu %	0.53	0.47	0.49	0.48	0.57	0.79	1.27	1.62	1.71	1.67	1.34	0.58	0.36	0.85
Gold Grade	Au g/t	0.17	0.18	0.28	0.45	0.56	0.24	0.36	0.49	0.57	0.49	0.30	0.18	0.37	0.30
Silver Grade	Ag g/t	1.29	1.25	1.26	1.39	1.60	2.02	2.68	3.28	3.47	3.43	2.81	1.38	1.16	1.95
Arsenic ppm	As ppm	103.60	139.21	82.65	47.97	25.33	52.14	75.41	81.87	52.97	56.87	72.77	90.43	54.21	73.93
Cu Processing Recoveries	%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%
Au Processing Recoveries	%	75.00%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Ag Processing Recoveries	%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%
Bulk Conc	kt	710	619	644	585	650	842	1 346	1 721	1 897	1 877	16 923	7 553	3 229	38 596
Conc Copper Grade	Cu %	23.24	23.05	24.13	25.42	26.86	31.33	33.40	33.87	32.81	32.61	28.87	24.41	24.30	28.06
Conc Gold Grade	Au g/t	6.53	7.85	12.37	21.13	22.73	8.16	8.52	9.44	10.97	8.64	5.55	5.95	21.63	8.42
Conc Silver Grade	Ag g/t	54.23	58.59	59.75	68.66	69.62	74.70	66.91	64.91	62.67	63.10	56.80	54.37	73.55	59.85
Recovered Cu Metal	**blb**	**0.36**	**0.31**	**0.34**	**0.33**	**0.38**	**0.58**	**0.99**	**1.29**	**1.37**	**1.35**	**10.77**	**4.06**	**1.73**	**23.88**
Recovered Au Metal	**Moz**	**0.15**	**0.16**	**0.26**	**0.40**	**0.48**	**0.22**	**0.37**	**0.52**	**0.67**	**0.52**	**3.02**	**1.44**	**2.25**	**10.45**
Recovered Ag Metal	**Moz**	**1.24**	**1.17**	**1.24**	**1.29**	**1.45**	**2.02**	**2.90**	**3.59**	**3.82**	**3.81**	**30.90**	**13.20**	**7.64**	**74.27**
Revenue Estimation															
Copper Price	USD/lb	2.15	2.36	2.58	2.79	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	
Gold Price	USD/oz	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	1 300	
Silver Price	USD/oz	19	19	19	19	19	19	19	19	19	19	19	19	19	
Copper Revenue	USDm	782.11	742.35	883.89	914.68	1 162.41	1 756.36	2 994.17	3 882.22	4 145.32	4 076.61	32 539.33	12 279.25	5 225.87	71 385
Gold Revenue	USDm	193.78	203.09	332.96	516.64	617.51	287.17	479.31	679.03	869.78	677.82	3 925.59	1 878.33	2 919.17	13 580
Silver Revenue	USDm	23.52	22.15	23.51	24.54	27.64	38.42	55.01	68.24	72.62	72.35	587.18	250.86	145.08	1 411
TOTAL REVENUE	USDm	999.41	967.59	1 240.35	1 455.86	1 807.57	2 081.95	3 528.49	4 629.49	5 087.72	4 826.78	37 052.10	14 408.43	8 290.12	86 376
		954.00	923.00	1 189.00	1 402.00	1 735.00	1 993.00	3 380.00	4 434.00	4 879.00	4 622.00	35 422.00	13 698.00	8 175.00	82 806
		0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.96
Operating Cost Model															
Realisation Costs	USDm	263	237	222	212	246	311	513	664	728	709	5955	2502	1206	13 768
Mining Costs	USDm	191	182	177	188	188	221	220	250	287	254	3072	2158	1038	8 426
Processing and Tailings	USDm	285	295	297	279	266	292	326	328	329	327	3248	3193	2445	11 910
G & A and ops Support	USDm	100	93	94	96	97	96	96	96	92	88	851	586	387	2 772
Infrastructure	USDm	65	84	91	41	69	57	69	83	69	30	373	359	371	1 761
Indirect Cost	USDm	171	182	180	187	182	178	182	188	178	164	1746	1190	848	5 576
Capital Expenditure Model															
Expansion Capital	USDm	874	1072	1080	831	387	92	0	0	0	0	0	0	0	4 336
Sustaining Capital	USDm	82	101	58	351	424	373	397	430	320	350	1912	866	424	6 088
VAT & Duties	USDm	79	82	66	102	75	44	43	47	35	38	209	99	47	966
Capex, Opex and Closure	USDm	-47	-34	-2	80	87	76	37	6	18	49	411	187	937	1 805
VAT & Duties (Capex)	USDm	3	1	0	5	2	3	1	0	1	5	44	21	0	86
Taxation															
Income Taxes	USDm											1496	557	254	2307
Discount Rate															
Real Discount Rate	8%														

Source: Oyu Tolgoi (2016), Oyu Tolgoi (2014(a))

The financing package includes a completion guarantee underwritten by Rio Tinto. For taking the risk of this completion guarantee, Rio Tinto will receive a fee based on the average outstanding annual debt until project completion. This fee will be serviced from project cash flows and is included in the financial modelling considered in this thesis. In addition to these major capital expenditure, there is some relatively smaller amounts that have been budgeted as part of the capital expenditure to cover the working capital, VAT, taxation duties and mine closure as summarised in Figure 7.5.

7.3.6. Taxation, Fiscal Models and Discount Rate

Oyu Tolgoi's sales are settled in US dollars, while a significant portion of their expenses are incurred in local currencies. Foreign exchange fluctuations can have a significant effect on Turquoise's operating margins, unless such fluctuations are offset by related changes to commodity prices.

Under the terms of the Investment Agreement signed by Turquoise shareholders, provides a range of key taxes have been stabilised for the term of the agreement at the rates and base as they applied as at the date of the Investment Agreement. The taxes and fees payable to the Government of Mongolia and their rates, include:-

- Corporate income tax 25%
- Mineral royalties 5% (sales value)
- Value added tax 10%
- Customs duties 5%
- Withholding tax 20%

In the case of shareholder debt, pre-Investment Agreement loans made to Oyu Tolgoi by shareholders attracted an effective annual interest rate of Intercontinental Exchange London Interbank Offered Rate (LIBOR) plus 9.9% US consumer price index (CPI) adjusted. Since 31 January 2011, the rate has decreased to LIBOR plus 6.5% and is applicable to the current loans.

Table 7.2 summarises the inputs used in the calculation of the discount rate which resulted in a range of real WACC discount rate of between 7.6% and 8.4% from which a mid-range of 8.0% for the Oyu Tolgoi copper-gold mine was considered most appropriate. No premium was added to account for country risk.

Table 7.2: Weighted Average Cost of Capital (WACC) for Oyu Tolgoi

Weighted Average Cost of Capital - USD 31-Dec-16	2016 Oyu Tolgoi Low	Mid	High
Cost of equity			
Risk free rate	1.80%	1.80%	1.80%
Beta coefficient	1.63	1.49	1.37
Unlevered beta coefficient	1.25	1.26	1.27
D/E ratio	40.00%	25.00%	11.00%
Marginal tax rate	25.00%	25.00%	25.00%
Equity risk premium	4.40%	4.90%	5.40%
Size risk premium	0.00%	0.00%	0.00%
Firm specific risk premium	2.00%	2.30%	2.50%
Nominal Cost of equity	**10.95%**	**11.40%**	**11.72%**
Cost of debt			
Nominal Pre-tax cost of debt	5.80%	6.30%	6.80%
Risk free rate	1.80%	1.80%	1.80%
Company spread	4.00%	4.50%	5.00%
Marginal tax rate	25.00%	25.00%	25.00%
Nominal Cost of debt	**4.35%**	**4.73%**	**5.10%**
Capital structure			
Equity to Invested Capital	90.0%	90.0%	90.0%
Debt to invested capital	10.0%	10.0%	10.0%
Nominal Weighted Average Cost of Capital (rounded)	**10.29%**	**10.74%**	**11.06%**
Real Weighted Average Cost of Capital (rounded)	**7.60%**	**8.03%**	**8.35%**

Sources: Damodaran; Capital IQ; Deloitte research and analysis (2016).

7.4. Oyu Tolgoi Mining Financial Valuation Model

The MAV of the Oyu Tolgoi copper-gold mine is undertaken on a 100% stand-alone basis. The free cash flow, post of tax and mineral royalties but before any interest and financing costs was discounted to determine a Project NPV for the entity using the discount rate calculated in

Table 7.2 provided above. The technical and economic inputs and assumptions discussed in the preceding section were summarised in the identified schedules as illustrated in Figure 7.5 and the principles for these are detailed in Chapter 5. This input sheet is the sources of all the inputs and assumptions into the economic valuation model (control) (Figure 7.6) and the proposed framework integrated forecasted financial statements and the DCF valuation. The economic valuation model was created to check that the mechanics of the proposed framework on the integrated forecasted financial statements appropriately considers the mining operational fundamental correctly in the estimation of value (Figure 7.7). It should be noted that the control model and proposed framework yields a very similar NPV, which confirms that the framework is sound. It should be noted that the Banking model follows the same structure as the proposed framework, and the only difference is the basis and assumptions on which the integrated forecasted financial statements are based on. Hence these models have not been included in the report but will be included as appendices on a memory stick, the extracts for the Banking model are provided in Appendix 1 being the key financial inputs and Appendix 2 being the integrated valuation model.

There were two approaches that was used to model the mining operations at Oyu Tolgoi copper-gold mine namely the Investment Banking approach (detailed in Section 4.6) and the proposed framework as discussed in Chapter 6.

Various assumptions were considered to test if the framework is working as anticipated. On the investment banking side, this is what was considered:-

- Develop a quarterly integrated financial statements using the quarterly financial reports so as to generate a number of points to statistically test its validity;
- The integrated financial model was forecasted for 6 years and a terminal value based on the two main terminal value estimation methodologies as discussed in Section 5.5;
- The revenue assumptions were driven by the commodity price forecasts and summarised in the previous section.
- The current production levels was assumed to continue at the same level at 40Mtpa RoM for the 6 forecasted periods and only SIB capital to maintain this production capacities was included in the financial model.
- The cost of production was also maintained at the same level, since all the financial models are real constant money terms.
- Separate financial models for each quarter was created which utilised the appropriate consensus forecasted commodity price and the quarterly financial results. These we used as the starting point or the basis to forecast performance for the future periods.

Proposed Framework

- The framework links the mining operational fundamentals and integrated financial statements and the MAV is determined by adjusting the cash flow statements as explained in Section 5.5 to calculate the FCFF;

- The financial model was driven by the financial statements, budget plan and LoM plan. All these were summarised the schedules in Figure 7.5.
- Once the financial model was completed, the model was run using the appropriate commodity price forecast on a **quarterly** basis to adjust financial models based on these forecast to generate the necessary points for validation.
- The bases case financial model shown in Figure 7.7 , was used to estimate the company valuation using the consensus forecast appropriate for that particular quarter. This was based on the assumption that the mining fundamentals and LoM does not change much within a period of 4 years except the depletions. Given that the LoM for the Mineral Reserves is 38 years and for the Mineral Resources is 93 years the impact will be immaterial

Once the financial models has been concluded Toprank software was run on these model to conduct a multivariate sensitivity analysis on the most important inputs in a valuation of a mineral asset as shown in Figure 7.8A. Which shows that the long term commodity prices is the single most sensitive input into an mineral project valuation exercise, followed by the other inputs that drives the revenue (Section 5.2.2) such as the head grade (Cu recoveries) and process recoveries (Net Smelter Recovery, NSR). The project NPV is less sensitive to changes in, and least sensitive to expansion capital expenditure, operational costs and the discount rate.

However, given that Oyu Tolgoi deposit have vast resources and reserves which could last 93 years at the current production rate and the company have noted they are planning to increase the production rates by three times in a stepwise process. The ROM fed was also included in the Toprank analysis, which showed that increase in the RoM is even more sensitive than the long-term copper prices if considered separately from other by-products as illustrated in Figure 7.8B. This further support the fact that for larger mineral deposit, mining companies should establish the most optimal production rates and get the best value from the mineral asset as illustrated in Table 7.4. Which shows that there is value in increasing the production rates. Some authors such as Hall (2003) have noted that increasing production rate alone may end up destroying value if cut-off grade is not adjusted and additional capital and mining costs are ignored. It should be noted that this is not a simple linear relationship between increased production and increased value, the different technical and economic assumptions were considered as part of the feasibility studies for these various scenarios being evaluated.

Smith (2011a, p208) further commented that "*the economic life of mine for a mineral resource is thus a key decision variable which is largely driven by the rate of extraction, with the optimum strategy encompassing the entire resource. The optimal strategy should be focused on exploitation of the entire resource so as to maximise the present value – the challenge is however to find the optimal trajectory which achieves the maximum as conditions vary over the life*". Hence the business plan and LoM plan are a dynamic process that changes as circumstances changes.

Oyu Tolgoi is a very large project that includes five separate deposits as illustrated in Figure 7.1. The long-term development of Oyu Tolgoi would involve the resources in all deposits. Alternative production cases have been developed to provide early stage analysis of the development flexibility that exists with respect to later phases of the Oyu Tolgoi deposits (Heruga, Hugo South, and the second lift of Hugo North). Development of these deposits will require separate development decisions in the future based on then prevailing macro-economic conditions and the development experience obtained from developing and operating the initial phases of Oyu Tolgoi.

Figure 7.6: Simple Technical and Economic Valuation Model (Control)

CASH FLOW STATEMENT		1	2	3	4	5	6	7	8	9	10	15.5	25.5	35.5	
DESCRIPTION /YEARS	**UNITS**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**21**	**31**	**TOTAL**
												20	30	40	
Summary Production Statistics		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2040	
Plant ROM Feed	**kt**	**39 980**	**39 169**	**39 699**	**37 066**	**35 045**	**37 888**	**40 002**	**40 113**	**40 003**	**40 003**	**400 358**	**386 520**	**272 289**	**1 448 135**
Copper Grade	Cu %	0.53	0.47	0.49	0.48	0.57	0.79	1.27	1.62	1.71	1.67	1.34	0.58	0.36	0.85
Gold Grade	Au g/t	0.17	0.18	0.28	0.45	0.56	0.24	0.36	0.49	0.57	0.49	0.30	0.18	0.37	0.30
Silver Grade	Ag g/t	1.29	1.25	1.26	1.39	1.60	2.02	2.68	3.28	3.47	3.43	2.81	1.38	1.16	1.95
Arsenic ppm	As ppm	103.60	139.21	82.65	47.97	25.33	52.14	75.41	81.87	52.97	56.87	72.77	90.43	54.21	73.93
Molybdenum	mo ppm	55.85	57.83	45.72	50.18	55.04	38.62	53.11	51.82	36.15	29.97	38.96	44.77	57.03	46.16
Recovered Cu Metal	**blb**	**0.36**	**0.31**	**0.34**	**0.33**	**0.38**	**0.58**	**0.99**	**1.29**	**1.37**	**1.35**	**10.77**	**4.06**	**1.73**	**23.88**
Recovered Au Metal	**Moz**	**0.15**	**0.16**	**0.26**	**0.40**	**0.48**	**0.22**	**0.37**	**0.52**	**0.67**	**0.52**	**3.02**	**1.44**	**2.25**	**10.45**
Recovered Ag Metal	**Moz**	**1.24**	**1.17**	**1.24**	**1.29**	**1.45**	**2.02**	**2.90**	**3.59**	**3.82**	**3.81**	**30.90**	**13.20**	**7.64**	**74.27**
Revenue Estimation															
Copper Price	USD/lb	2.15	2.36	2.58	2.79	3.02	3.02	3.021	3.021	3.021	3.021	3.021	3.021	3.021	
Gold Price	USD/oz	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	
Silver Price	USD/oz	19	19	19	19	19	19	19	19	19	19	19	19	19	
Copper Revenue	USDm	782.11	742.35	883.89	914.68	1 162.41	1 756.36	2 994.17	3 882.22	4 145.32	4 076.61	32 539.33	12 279.25	5 225.87	71 385
Gold Revenue	USDm	193.78	203.09	332.96	516.64	617.51	287.17	479.31	679.03	869.78	677.82	3 925.59	1 878.33	2 919.17	13 580
Silver Revenue	USDm	23.52	22.15	23.51	24.54	27.64	38.42	55.01	68.24	72.62	72.35	587.18	250.86	145.08	1 411
Total Gross Revenue	USDm	984.42	953.08	1 221.75	1 434.02	1 780.46	2 050.72	3 475.57	4 560.05	5 011.40	4 754.38	36 496.32	14 192.30	8 165.76	85 080
Realisation Costs	USDm	(263.0)	(237.0)	(222.0)	(212.0)	(246.0)	(311.0)	(513.0)	(664.0)	(728.0)	(709.0)	(5 955.0)	(2 502.0)	(1 206.0)	(13 768.0)
Net Sales Revenue	**USDm**	**721.42**	**716.08**	**999.75**	**1 222.02**	**1 534.46**	**1 739.72**	**2 962.57**	**3 896.05**	**4 283.40**	**4 045.38**	**30 541.32**	**11 690.30**	**6 959.76**	**71 312**
Operating Cost															
Mining Costs	USDm	(191.00)	(182.00)	(177.00)	(188.00)	(188.00)	(221.00)	(220.00)	(250.00)	(287.00)	(254.00)	(3 072.00)	(2 158.00)	(1 038.00)	(8 426.0)
Processing and Tailings	USDm	(285.00)	(295.00)	(297.00)	(279.00)	(266.00)	(292.00)	(326.00)	(328.00)	(329.00)	(327.00)	(3 248.00)	(3 193.00)	(2 445.00)	(11 910.0)
G & A and ops Support	USDm	(100.00)	(93.00)	(94.00)	(96.00)	(97.00)	(96.00)	(96.00)	(96.00)	(92.00)	(88.00)	(851.00)	(586.00)	(387.00)	(2 772.0)
Infrastructure	USDm	(65.00)	(84.00)	(91.00)	(41.00)	(69.00)	(57.00)	(69.00)	(83.00)	(69.00)	(30.00)	(373.00)	(359.00)	(371.00)	(1 761.0)
Indirect Cost	USDm	(171.00)	(182.00)	(180.00)	(187.00)	(182.00)	(178.00)	(182.00)	(188.00)	(178.00)	(164.00)	(1 746.00)	(1 190.00)	(848.00)	(5 576.0)
Total Operating Costs	**USDm**	**(812.00)**	**(836.00)**	**(839.00)**	**(791.00)**	**(802.00)**	**(844.00)**	**(893.00)**	**(945.00)**	**(955.00)**	**(863.00)**	**(9 290.00)**	**(7 486.00)**	**(5 089.00)**	**(30 445.0)**
Net Profit Before Income Tax		(90.6)	(119.9)	160.7	431.0	732.5	895.7	2 069.6	2 951.0	3 328.4	3 182.4	21 251.3	4 204.3	1 870.8	40 867.2
Income Tax		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1 496.0)	(557.0)	(254.0)	(2 307.0)
Net Profit After Income Tax		(90.6)	(119.9)	160.7	431.0	732.5	895.7	2 069.6	2 951.0	3 328.4	3 182.4	19 755.3	3 647.3	1 616.8	38 560.2
Capital Expenditure															
Expansion Capital	USDm	(874.00)	(1 072.00)	(1 080.00)	(831.00)	(387.00)	(92.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(4 336.00)
Sustaining Capital	USDm	(82.00)	(101.00)	(58.00)	(351.00)	(424.00)	(373.00)	(397.00)	(430.00)	(320.00)	(350.00)	(1 912.00)	(866.00)	(424.00)	(6 088.00)
VAT & Duties	USDm	(79.00)	(82.00)	(66.00)	(102.00)	(75.00)	(44.00)	(43.00)	(47.00)	(35.00)	(38.00)	(209.00)	(99.00)	(47.00)	(966.00)
Capex, Opex and Closure	USDm	47.00	34.00	2.00	(80.00)	(87.00)	(76.00)	(37.00)	(6.00)	(18.00)	(49.00)	(411.00)	(187.00)	(937.00)	(1 805.00)
VAT & Duties (Capex)	USDm	(3.00)	(1.00)	0.00	(5.00)	(2.00)	(3.00)	(1.00)	0.00	(1.00)	(5.00)	(44.00)	(21.00)	0.00	(86.00)
Total Capital Exependiture	USDm	**(991.00)**	**(1 222.00)**	**(1 202.00)**	**(1 369.00)**	**(975.00)**	**(588.00)**	**(478.00)**	**(483.00)**	**(374.00)**	**(442.00)**	**(2 576.00)**	**(1 173.00)**	**(1 408.00)**	**(13 281.00)**
Net Cash Flow After Tax	USDm	**(1 081.58)**	**(1 341.92)**	**(1 041.25)**	**(937.98)**	**(242.54)**	**307.72**	**1 591.57**	**2 468.05**	**2 954.40**	**2 740.38**	**17 179.32**	**2 474.30**	**208.76**	**25 279.22**
Discount Rate	USDm	**0.93**	**0.86**	**0.79**	**0.74**	**0.68**	**0.63**	**0.58**	**0.54**	**0.50**	**0.46**	**0.30**	**0.14**	**0.07**	
Cash Flow	USDm	**(1 001.47)**	**(1 150.48)**	**(826.58)**	**(689.44)**	**(165.07)**	**193.92**	**928.66**	**1 333.41**	**1 477.94**	**1 269.33**	**5 211.20**	**347.65**	**13.59**	
Cumulative Cash Flow	USDm	**(1 001.47)**	**(2 151.95)**	**(2 978.53)**	**(3 667.97)**	**(3 833.04)**	**(3 639.13)**	**(2 710.46)**	**(1 377.05)**	**100.89**	**1 370.21**	**6 581.41**	**6 929.06**	**6 942.65**	
NPV	**USDm**	**6 942.65**													
IRR	**%**	**21%**													

Source: Annual Reports (2013, 2014, 2016), Oyu Tolgoi (2016)

Figure 7.7: Integrated Financial Statement linking Mineral Asset Valuation Model (Proposed Framework)

Integrated Financial Statements Turquoise Hill Resources Ltd USD (000s)			1	2	3	4	5	6	7	8	9	10	11	12	13
	Historical	*Historical*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*
INCOME STATEMENT	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Revenue	**1 735 646**	**1 634 762**	721 416	716 081	999 745	1 222 021	1 534 456	1 739 719	2 962 567	3 896 048	4 283 404	4 045 379	30 541 316	11 690 301	6 959 764
Growth (%)	*NA*	*-5.8%*	*-55.9%*	*-0.7%*	*39.6%*	*22.2%*	*25.6%*	*13.4%*	*70.3%*	*31.5%*	*9.9%*	*-5.6%*	*655.0%*	*-61.7%*	*-40.5%*
Cost of Goods Sold	**1 235 113**	**974 956**	641 000	654 000	659 000	604 000	620 000	666 000	711 000	757 000	777 000	699 000	7 544 000	6 296 000	4 241 000
% of Sales	*71.2%*	*59.6%*	88.9%	91.3%	65.9%	49.4%	40.4%	38.3%	24.0%	19.4%	18.1%	17.3%	24.7%	53.9%	60.9%
Gross Profit	**500 533**	**659 806**	**80 416**	**62 081**	**340 745**	**618 021**	**914 456**	**1 073 719**	**2 251 567**	**3 139 048**	**3 506 404**	**3 346 379**	**22 997 316**	**5 394 301**	**2 718 764**
% of Sales	*28.8%*	*40.4%*	*11.1%*	*8.7%*	*34.1%*	*50.6%*	*59.6%*	*61.7%*	*76.0%*	*80.6%*	*81.9%*	*82.7%*	*75.3%*	*46.1%*	*39.1%*
Operating Expenses (SG&A)	**386 192**	**515 896**	171 000	182 000	180 000	187 000	182 000	178 000	182 000	188 000	178 000	164 000	1 746 000	1 190 000	848 000
% of Sales	*22.3%*	*31.6%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*	*26.9%*
Operating Income (EBIT)	**114 341**	**143 910**	**-90 584**	**-119 919**	**160 745**	**431 021**	**732 456**	**895 719**	**2 069 567**	**2 951 048**	**3 328 404**	**3 182 379**	**21 251 316**	**4 204 301**	**1 870 764**
Interest Expense	**6 061**	**5 190**	**1 086**	**8 247**	**37 013**	**75 796**	**83 652**	**43 207**	**6 462**	**820**	**779**	**738**	**697**	**656**	**615**
Pretax Income	**108 280**	**138 720**	**-91 670**	**-128 167**	**123 733**	**355 225**	**648 805**	**852 513**	**2 063 105**	**2 950 229**	**3 327 626**	**3 181 641**	**21 250 619**	**4 203 646**	**1 870 149**
Income Tax Expense	**51 001**	**-166 086**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1 496**	**557**	**254**
Tax Rate	*NM*	*NM*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	25.0%	25.0%
Net Income	**57 279**	**304 806**	**-91 670**	**-128 167**	**123 733**	**355 225**	**648 805**	**852 513**	**2 063 105**	**2 950 229**	**3 327 626**	**3 181 641**	**21 249 123**	**4 203 089**	**1 869 895**
Operating Income (EBIT)	114 341	143 910	-90 584	-119 919	160 745	431 021	732 456	895 719	2 069 567	2 951 048	3 328 404	3 182 379	21 251 316	4 204 301	1 870 764
Depreciation	393 296	356 243	400 731	445 746	487 198	535 532	559 620	561 176	556 617	552 581	542 793	537 268	4 346 156	3 181 444	2 530 498
Amortisation	0	0													
EBITDA	**507 637**	**500 153**	**310 147**	**325 827**	**647 944**	**966 552**	**1 292 076**	**1 456 895**	**2 626 184**	**3 503 630**	**3 871 197**	**3 719 647**	**25 597 472**	**7 385 745**	**4 401 262**
BALANCE SHEET	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Current Assets															
Cash and Cash Equivalents	862 755	1 343 878	717 508	0	0	0	0	0	2 050 432	5 112 098	8 627 325	11 905 721	35 001 165	40 474 931	43 599 310
Inventories	396 782	321 409	208 619	212 850	214 477	196 577	201 784	216 755	231 401	246 372	252 881	227 495	2 455 258	2 049 086	1 380 269
Trade and Other Receivables	14 519	12 210	5 712	5 669	7 915	9 675	12 148	13 774	23 455	30 845	33 912	32 028	241 798	92 553	55 101
Prepaid Expenses and Other Assets	76 903	53 375	25 872	27 536	27 233	28 292	27 536	26 931	27 536	28 444	26 931	24 813	264 163	180 042	128 299
Due from related parties	7 864	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623	3 623
Total Current Assets	**1 588 312**	**1 734 495**	**961 333**	**249 678**	**253 248**	**238 167**	**245 091**	**261 082**	**2 336 447**	**5 421 382**	**8 944 672**	**12 193 679**	**37 966 007**	**42 800 236**	**45 166 602**
Fixed Assets															
PP&E, Net of Accum. Depreciation	6 597 395	6 319 983	6 910 252	7 686 506	8 401 307	9 234 776	9 650 156	9 676 980	9 598 364	9 528 782	9 359 989	9 264 721	7 494 565	5 486 121	4 363 622
Inventories	52 757	539	539	539	539	539	539	539	539	539	539	539	539	539	539
Deferred Income Tax Assets	0	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000	165 000
Financial Assets	60 553	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078	20 078
TOTAL ASSETS	**8 299 017**	**8 240 095**	**8 057 202**	**8 121 801**	**8 840 173**	**9 658 560**	**10 080 864**	**10 123 680**	**12 120 428**	**15 135 781**	**18 490 278**	**21 644 017**	**45 646 189**	**48 471 973**	**49 715 841**
LIABILITIES															
Current Liabilities															
Borrowings and Financial Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade and Other Payables	185 852	166 766	103 048	105 138	105 942	97 100	99 672	107 067	114 302	121 697	124 912	112 372	1 212 786	1 012 156	681 790
Deferred Revenue	140 135	72 004	45 011	44 678	62 377	76 245	95 739	108 545	184 842	243 084	267 252	252 401	1 905 548	729 387	434 237
Payable to Related Parties	53 784	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801	34 801
Liabilities held for Sale	120 871	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Current Liabilities	**500 642**	**273 571**	**182 860**	**184 617**	**203 120**	**208 146**	**230 212**	**250 414**	**333 944**	**399 582**	**426 965**	**399 575**	**3 153 136**	**1 776 344**	**1 150 828**
Long Term Liabilities															
Borrowings and Financial Liabilities	14 086	13 574	13 062	12 550	12 038	11 526	11 014	10 502	9 990	9 478	8 966	8 454	7 942	7 430	6 918
Deferred Income Tax Liabilities	122 820	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916	52 916
Line of Credit			0	191 520	768 169	1 226 817	978 763	149 376	0	0	0	0	0	0	0
Decommissioning Obligations	93 004	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421	104 421
TOTAL LIABILITIES	**730 552**	**444 482**	**353 259**	**546 024**	**1 140 664**	**1 603 826**	**1 377 326**	**567 628**	**501 271**	**566 397**	**593 268**	**565 366**	**3 318 415**	**1 941 111**	**1 315 083**
EQUITY															
Share Capital	11 432 060	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122	11 432 122
Additional Paid In Capital	1 555 721	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774	1 555 774
Accumulated Income (loss)	-4 505	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14
Deficit	-4 788 340	-4 473 360	-4 565 030	-4 693 197	-4 569 464	-4 214 239	-3 565 434	-2 712 922	-649 817	2 300 412	5 628 037	8 809 678	30 058 801	34 261 890	36 131 785
Equity Attributable to owners of Turquoise Hill	**8 194 936**	**8 514 522**	**8 422 852**	**8 294 685**	**8 418 418**	**8 773 643**	**9 422 448**	**10 274 960**	**12 338 065**	**15 288 294**	**18 615 919**	**21 797 560**	**43 046 683**	**47 249 772**	**49 119 667**
Attributable to non-controlling interest	-626 471	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909	-718 909
TOTAL EQUITY	**7 568 465**	**7 795 613**	**7 703 943**	**7 575 776**	**7 699 509**	**8 054 734**	**8 703 539**	**9 556 051**	**11 619 156**	**14 569 385**	**17 897 010**	**21 078 651**	**42 327 774**	**46 530 863**	**48 400 758**
TOTAL LIABILITIES & EQUITY	**8 299 017**	**8 240 095**	**8 057 202**	**8 121 801**	**8 840 173**	**9 658 560**	**10 080 864**	**10 123 680**	**12 120 428**	**15 135 781**	**18 490 278**	**21 644 017**	**45 646 189**	**48 471 973**	**49 715 841**

by Godknows Njowa, 2017

Figure 7.7: Integrated Financial Statement linking Mineral Asset Valuation Model (Proposed Framework) *continued...*

Integrated Financial Statements *(continued)*															
Turquoise Hill Resources Ltd															
USD (000s)			1	2	3	4	5	6	7	8	9	10	11	12	13
	Historical	*Historical*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*	*Projected*
CASH FLOW STATEMENT	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
CASH FLOW FROM OPERATING ACTIVITIES															
Net Income			-91 670	-128 167	123 733	355 225	648 805	852 513	2 063 105	2 950 229	3 327 626	3 181 641	21 249 123	4 203 089	1 869 895
Add Back Non-Cash Items															
Depreciation			400 731	445 746	487 198	535 532	559 620	561 176	556 617	552 581	542 793	537 268	4 346 156	3 181 444	2 530 498
Amortisation															
Changes in Working Capital															
Inventory			112 790	-4 231	-1 627	17 900	-5 207	-14 971	-14 646	-14 971	-6 509	25 386	-2 227 762	406 172	668 817
Trade and Other Receivables			6 498	42	-2 246	-1 760	-2 474	-1 625	-9 681	-7 390	-3 067	1 884	-209 770	149 245	37 452
Prepaid Expenses			27 503	-1 664	303	-1 059	756	605	-605	-908	1 513	2 118	-239 351	84 121	51 743
Accounts Payable			-63 718	2 090	804	-8 842	2 572	7 395	7 234	7 395	3 215	-12 539	1 100 414	-200 631	-330 365
Deferred Revenue			-26 993	-333	17 699	13 868	19 494	12 807	76 296	58 242	24 168	-14 851	1 653 147	-1 176 161	-295 150
Net Cash Provided by Operating Activities			**365 142**	**313 484**	**625 863**	**910 865**	**1 223 566**	**1 417 899**	**2 678 320**	**3 545 178**	**3 889 739**	**3 720 907**	**25 671 957**	**6 647 278**	**4 532 890**
CASH FLOW FROM INVESTING ACTIVITIES															
Capital Expenditure - Purchase of PP&E			-991 000	-1 222 000	-1 202 000	-1 369 000	-975 000	-588 000	-478 000	-483 000	-374 000	-442 000	-2 576 000	-1 173 000	-1 408 000
Financial Assets			0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Used in Investing Activities			**-991 000**	**-1 222 000**	**-1 202 000**	**-1 369 000**	**-975 000**	**-588 000**	**-478 000**	**-483 000**	**-374 000**	**-442 000**	**-2 576 000**	**-1 173 000**	**-1 408 000**
CASH FLOW FROM FINANCING ACTIVITIES															
Revolving Credit Facility (Line of Credit)			0	191 520	576 649	458 647	-248 054	-829 387	-149 376	0	0	0	0	0	0
Long Term Debt			-512	-512	-512	-512	-512	-512	-512	-512	-512	-512	-512	-512	-512
Net Cash Provided by (Used in) Fnce Activities			**-512**	**191 008**	**576 137**	**458 135**	**-248 566**	**-829 899**	**-149 888**	**-512**	**-512**	**-512**	**-512**	**-512**	**-512**
Net Cash Flow			-626 370	-717 508	0	0	0	0	2 050 432	3 061 666	3 515 227	3 278 395	23 095 445	5 473 766	3 124 378
Beginning Cash Balance			1 343 878	717 508	0	0	0	0	0	2 050 432	5 112 098	8 627 325	11 905 721	35 001 165	40 474 931
Ending Cash Balance			717 508	0	0	0	0	0	2 050 432	5 112 098	8 627 325	11 905 721	35 001 165	40 474 931	43 599 310
DCF ANALYSIS AND VALUATION															
Unlevered Free Cash Flow			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15.5**	**25.5**	**35.5**
Net Income			-91 670	-128 167	123 733	355 225	648 805	852 513	2 063 105	2 950 229	3 327 626	3 181 641	21 249 123	4 203 089	1 869 895
Depreciation and Amortisation															
Deferred Taxes			-26 993	-333	17 699	13 868	19 494	12 807	76 296	58 242	24 168	-14 851	1 653 147	-1 176 161	-295 150
Other non-cash items															
Working capital changes			83 074	-3 763	-2 767	6 239	-4 352	-8 596	-17 698	-15 874	-4 848	16 849	-1 576 469	438 907	427 647
Capital Expenditure			-991 000	-1 222 000	-1 202 000	-1 369 000	-975 000	-588 000	-478 000	-483 000	-374 000	-442 000	-2 576 000	-1 173 000	-1 408 000
Net interest Expenses			1 086	8 247	37 013	75 796	83 652	43 207	6 462	820	779	738	697	656	615
Less Taxes (EBIT - Tax %)	0.0%												-374	-139	-64
UFCF			-1 025 503	-1 346 015	-1 026 323	-917 872	-227 402	311 930	1 650 166	2 510 416	2 973 725	2 742 377	18 750 123	2 293 351	594 943
Discount Rate	8%		0.92	0.85	0.78	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.28	0.12	0.06
NPV ('000')	**6 979 439**		**-945 168**	**-1 143 390**	**-803 528**	**-662 325**	**-151 236**	**191 201**	**932 252**	**1 307 145**	**1 427 089**	**1 212 969**	**5 295 100**	**286 459**	**32 869**

Source: Annual Reports (2013, 2014, 2016)

Table 7.3: Alternative Production Case definitions

ALTERNATIVE PRODUCTION CASE	PRODUCTION AND PLANT CAPACITY ASSUMPTIONS
2016 Reserves Case	Plant capacity 40 Mt/a for life based on the declared Mineral Reserves.
2016 Resources Case	Plant capacity 40 Mt/a for life based on the declared Mineral Resources.
Resources 50 Case	Plant capacity 40 Mt/a with a 5% improvement in throughput capacity per year for five years to 125% of initial capacity. The average production is 50 Mt/a.
Resources 100 Case	Resources 50 followed by an expansion to 100 Mt/a.
Resources 120 Case	Resources 50 followed by an expansion to 120 Mt/a.

A comparison was made of the 2016 Reserves Case (base case) with the alternative production cases as defined in Table 7.3. Four cost sensitivity options were analysed for all the alternative production cases and are summarised in Table 7.4. Each sensitivity assumes an improvement in the costs and productivities. The improvements could be the result of optimisation and efficiencies from the experience that will be gained over the years of developing and operating the plant and mines at Oyu Tolgoi. The cost assumptions are:-

- Underground construction capital costs reduced by 30%;
- Operating costs reduced by 15%;
- G&A costs are assumed to reach a long-term average annual cost of USD50m from Year 7. This cost is based on a review of costs from studies of other copper projects; and
- Rail freight available to the project after 2020 and the concentrate freight cost is reduced to USD25/t.

Table 7.4: 2016 Reserves Base Case and Alternative Production Case (Base Case Prices)

OPTION	COST ASSUMPTIONS	UNITS	2016 RESERVES CASE	2016 RESOURCES CASE	RESOURCES 50 CASE	RESOURCES 100 CASE	RESOURCES 120 CASE
A	2016 Base Case	USDbn	6.94	8.37	9.32	8.88	8.80
B	Underground Construction Capital Reduced by 30%	USDbn	7.85	9.64	10.57	10.59	10.51
C	Underground Construction Capital Reduced by 30% and Operating Costs by 15%	USDbn	8.97	10.20	11.86	12.00	11.98
D	Underground Construction Capital Reduced by 30%, Operating Costs by 15% and G&A Costs Reduced	USDbn	9.14	10.43	12.20	12.50	12.57
E	Underground Construction Capital Reduced by 30%, Operating Costs by 15%, G&A Costs Reduced and Rail Transport	USDbn	9.62	11.02	13.15	13.58	13.69

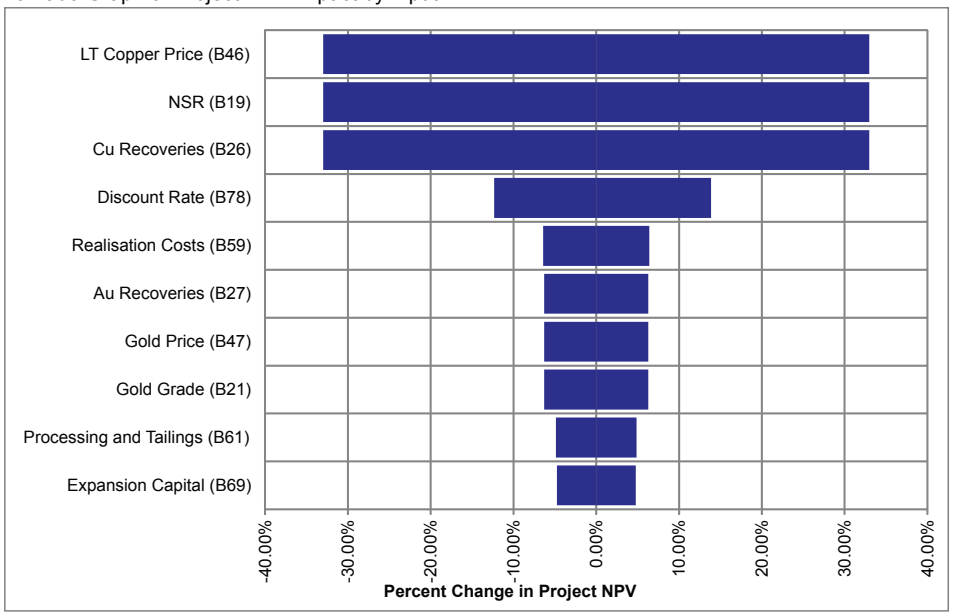
Note: Based on USD3.02/lb copper, USD1,300/oz gold, USD19.00oz silver and 8% discount rate

It should be noted that the alternative production cases provide some optionality and flexibility on how Oyu Tolgoi can be fully developed. This provides some additional value to the company valuations. As argued earlier, it seems that the market gives very little or no value to the Mineral Resources that are not in the LoM plan for a mineral asset in production. This is further supported in that "*Commodity price increases, increased production rates, and operating cost reductions are all seen as conditions or actions that can improve value, and lead to cut-off grade reductions, thereby increasing ore reserves*" (Hall, 2003, p1).

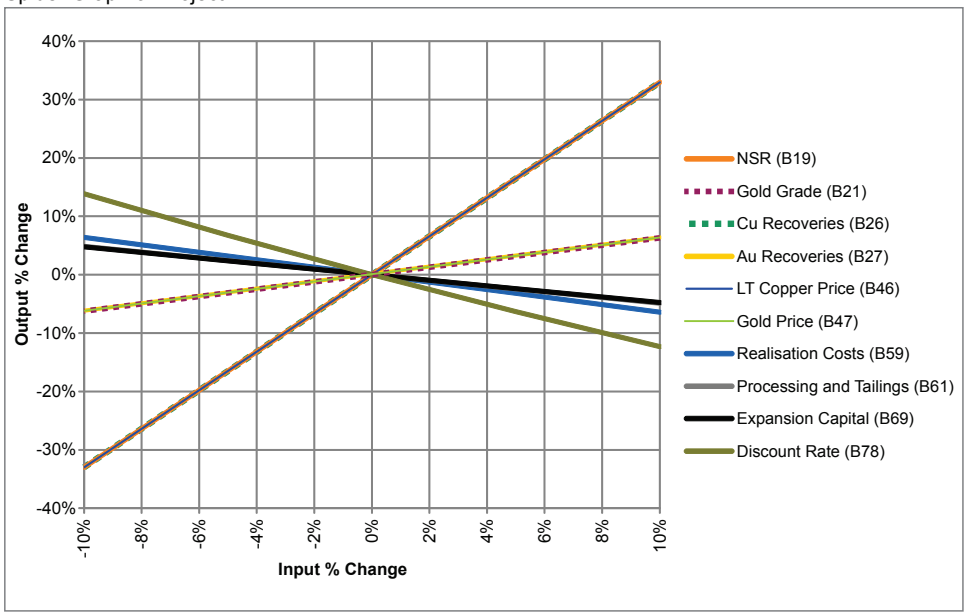
Figure 7.8: Tornado Graphs and Spider Diagrams for the 2016 Reserves Base Case (Sensitivity Analysis)

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Tornado Graph of Project NPV Impact by Input

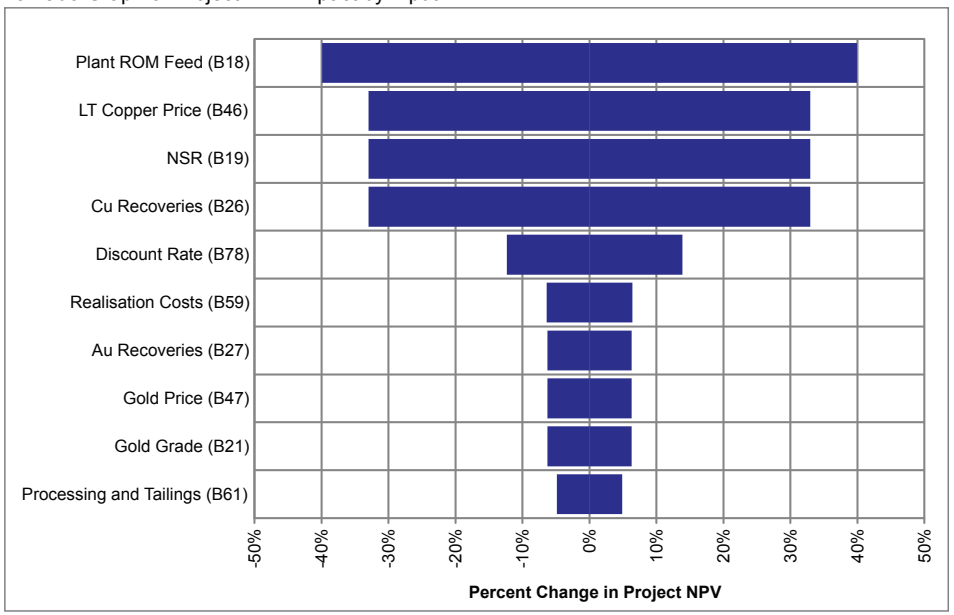


Spider Graph of Project NPV

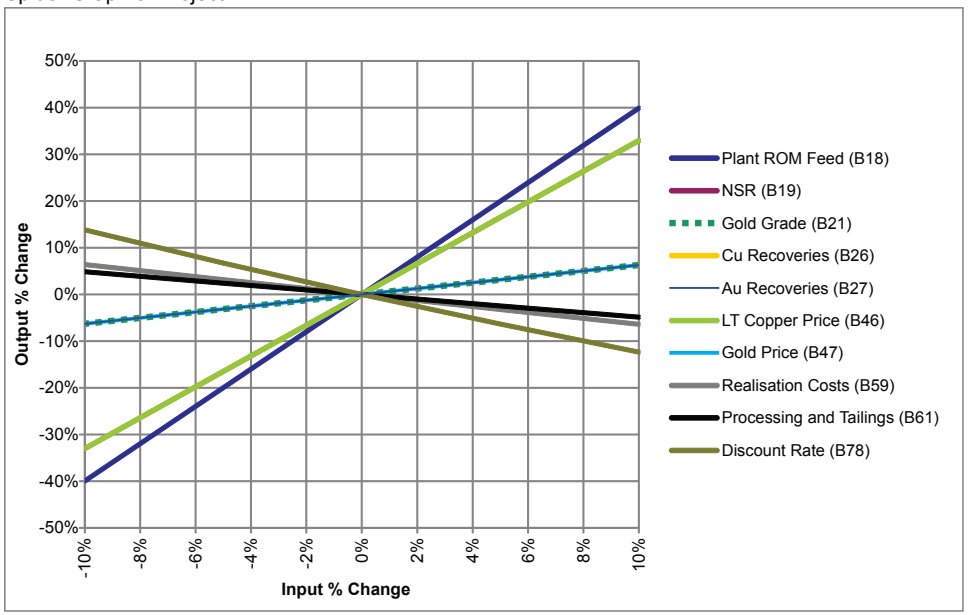


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Tornado Graph of Project NPV Impact by Input



Spider Graph of Project NPV



7.4.1. Summary and Analysis of the Valuation Results

The various financial models were run based on the assumptions documented in the preceding section at different financial reporting dates from July 2014 to December 2016, depending on the availability of information. The summarised valuation results based on the various models and calculations as discussed in this thesis are presented in Table 7.5 and this information is graphically illustrated in Figure 7.9.

Table 7.5: Summarised Valuation Results for Turquoise Hill Resources

SUMMARISED VALUATION RESULTS FOR TURQUOISE HILL RESOURCES IN USDm												
Financial Report Date	**Mar-14**	**Jun-14**	**Sep-14**	**Dec-14**	**Mar-15**	**Jun-15**	**Sep-15**	**Dec-15**	**Mar-16**	**Jun-16**	**Sep-16**	**Dec-16**
Market Capitalization	7,174	7,434	7,226	6,607	6,056	8,299	6,376	5,417	4,659	5,996	6,509	6,575
Framework Model	N/A	7,276	6,991	6,401	7,096	6,076	6,622	5,934	4,761	6,797	6,796	6,795
Banking Model	N/A	N/A	N/A	5,249	4,261	3,164	2,525	2,761	3,981	4,575	2,607	N/A
Enterprise Value (EV)	6,708	6,863	6,261	5,132	4,508	6,442	4,345	3,368	2,474	7,852	8,368	8,434

It should be noted that for the banking model the December 2016 was noted included because the quarterly results for this period were not available at the date of submission this thesis. In addition information before September 2014 was considered to be not relevant since Turquoise used to own a coal mine in Mongolia and there was enough information to separate the revenues, associated operating and capital expenditure between these two mining operations. The graph in Figure 7.9 shows the variation of the values generated from the different models and calculations and these were compared to the market capitalisation as the proxy for company value. The following observations were made:-

- The Enterprise Value is a calculated from the market capitalisation after adjusting for cash and debt, hence it mirrors the market capitalisation graph until the company acquired the debt for the construction of the underground mining operation in June 2016;
- The developed framework models trends close with the market movements, however it can be seen that there is some lag between the model and the market capitalisation; and
- The banking model conflicts with the other valuation methods in estimating consistently lower mineral asset valuations over the period analysed, probably because it utilises the historical figures as the starting point for forecasting purposes. In addition the banking model is sometimes completely out of sync with the market movements.

Further, to this analysis the different models and calculations were further analysed individually against the market capitalisation. The best fit or correlation between the model and the market capitalisation was presented in Figure 7.10 and the full results are tabulated in Table 7.6, from which it can be seen that:-

- The exponential relationship between the proposed framework and the market capitalisation (Figure 7.10A) shows a poor correlation (R^2 = 0.37) due to the outlier identified in almost all the models at June 2015. A stronger correlation (R^2 = 0.77) was established when this outlier was removed. Further to this analysis, the power function

also shows a stronger correlation (R^2 = 0.77), with the rest of the other functions showing a stronger correlation greater than 0.70. These functions give the strongest correlation due to the fact that they are both influenced by commodity price cyclic movements and forecasting, and especially that all analysts forecasts predicted the copper price to recover to the USD3.00/lb;

- The polynomial relationship between the market capitalisation and the banking model in Figure 7.10B, shows no correlation (R^2 = 0.05) before the removal of the outlier but improves significantly (R^2 = 0.55) after the outlier was excluded. Further analysis shows that all the other common functions shows that there is no correlation. This suggests that some relationship exists, even though its relatively poor compared to the proposed framework. This is ascribed here again to the banking model reliance on the historical financial performance;
- The polynomial relationship between the calculated EV compared to the market capitalisation is illustrated in Figure 7.10C and shows some correlation both before (R^2 = 0.50) and after removing the outlier (R^2 = 0.72). The relationship is mainly affected by the cash and debt adjustments and hence the big swing in June 2016 going forward.

The June 2015 results were considered as an outlier because the market expectation of the commodity prices was not realised or achieved and there was a correction in the copper market during this period. It is evident in all the valuation models considered in this thesis. Figure 7.9 shows that the EV mirrors the Market Capitalisation model at this point, so it is not an outlier as far as the EV is concerned. It should be noted that the EV and the Market Capitalisation are actual observed figures from the market (Based on the listing on the TSX) and the two are related as noted in Section 4.5.

The fundamental differences between the calculated values based on historical performance of the company represented by both the EV and the Market Capitalisation and Framework Model is that the framework model is futuristic in nature (forward looking), with very little or no influence from the historical performance. However, the market participants that trade in a company's shares create their own forward looking estimates based on the publicly disseminated information to inform their investment decisions. Hence this thesis was aimed at developing a framework that can be used to estimate the value of mining companies.

Figure 7.9: Comparison of Turquoise Hill Resources value estimated using different model

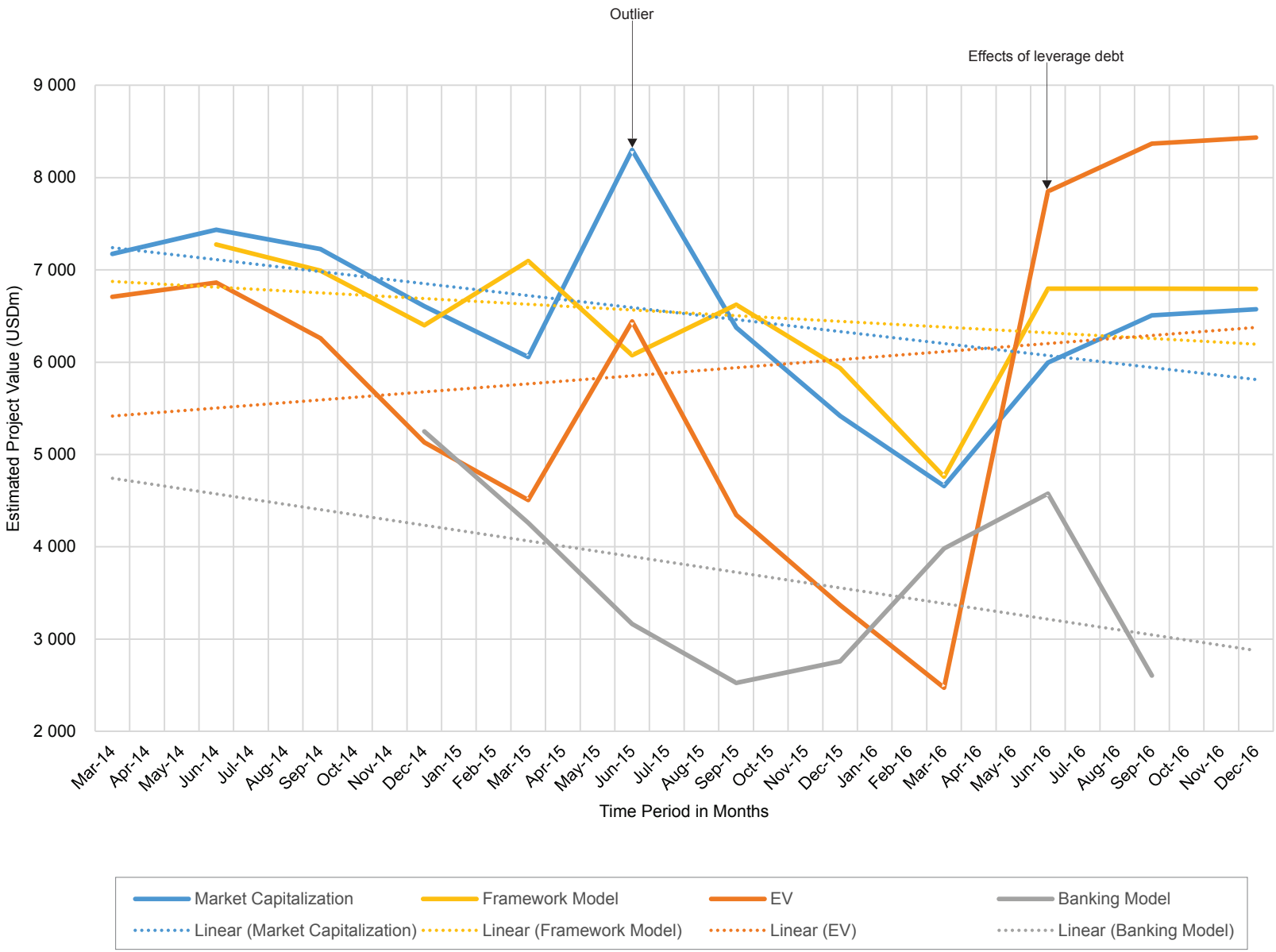
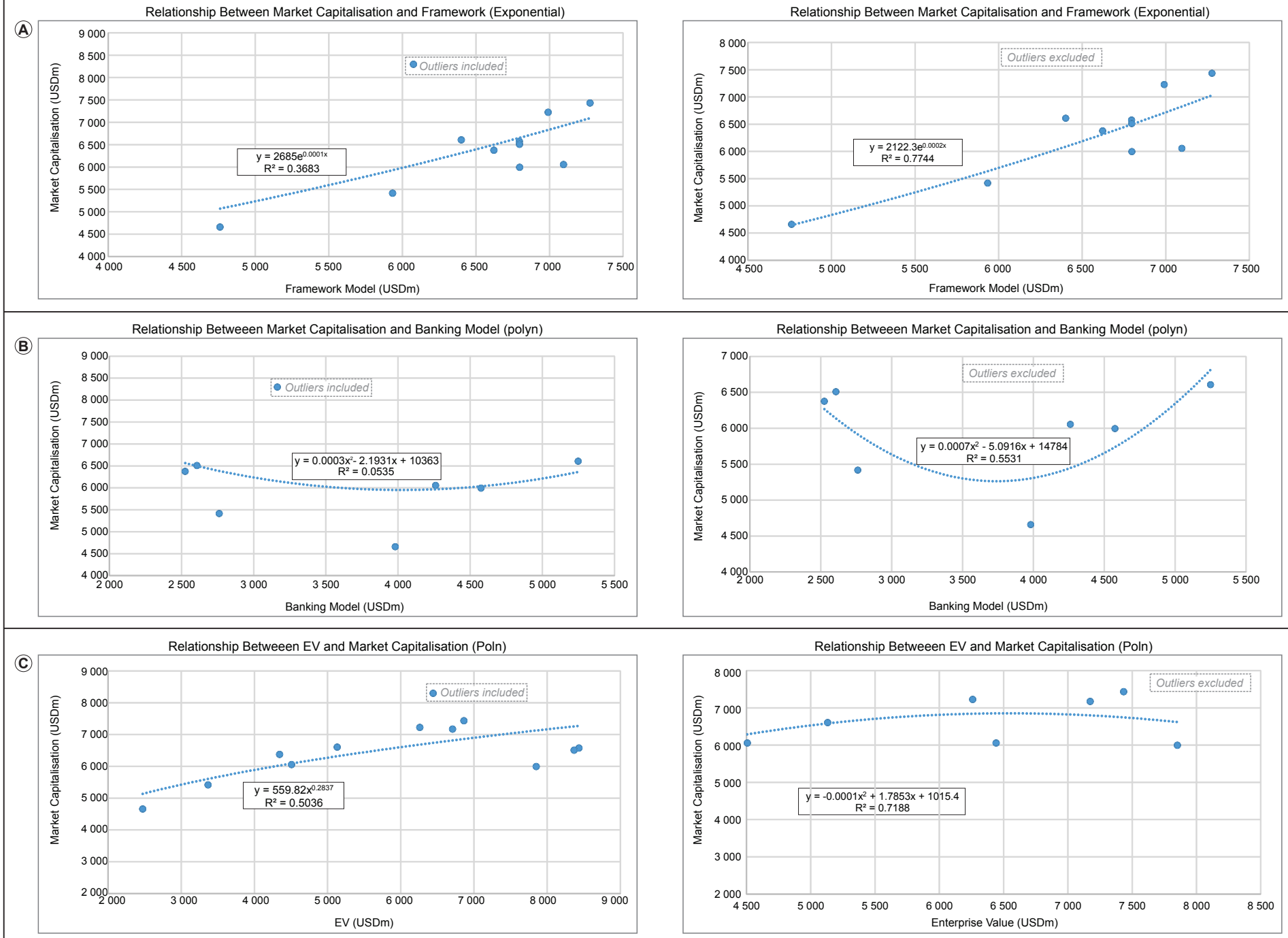


Figure 7.10: Relationships between the Market Capitalisation, EV, Framework Model and Banking Model



The correlation coefficient (r^2) measures the robustness of the relationship between two variables (Investopedia (n.d.)). When the value of r r^2 is greater than zero, it is a positive relationship; when the value is less than zero, it is a negative relationship. A value of zero indicates that there is no relationship between the two variables. In general, the higher the r^2, the better the model fits the data being analysed. Theoretically, if a proposed model could explain 100% of the variance, the fitted values would always equal the observed values and, therefore, all the data points would fall on the fitted regression line. The financial model with the greatest correlation coefficient is the better estimate of the value of the mineral asset. The results of the regression analysis is summarised in Table 7.6.

Table 7.6: Comparison of Correlation Coefficient (R^2) the Different Models against the Market Capitalisation

R SQUARED VALUES	BANKING MODEL		PROPOSED FRAMEWORK		EV	
RELATIONSHIP	BEFORE OUTLIER REMOVED	AFTER OUTLIER REMOVED	BEFORE OUTLIER REMOVED	AFTER OUTLIER REMOVED	BEFORE OUTLIER REMOVED	AFTER OUTLIER REMOVED
Linear	0.01	0.00	0.29	0.73	0.33	0.53
Exponential	0.02	0.00	0.37	0.77	0.37	0.55
Logarithmic	0.02	0.00	0.30	0.72	0.45	0.62
Power	0.02	0.00	0.39	0.77	0.50	0.65
Polynomial	0.05	0.55	0.35	0.73	0.76	0.72
AVERAGE	**0.02**	**0.11**	**0.34**	**0.75**	**0.48**	**0.61**
DECISION	✗	✗	✗	✓	✗	✓

The proposed framework shows the greatest correlation to the Market Capitalisation compared to all the other models. The higher value suggests that the proposed framework model is the better estimate of Turquoise company valuation compared to the Banking Model and EV since, as previously stated the mineral asset valuation of Oyu Tolgoi drives the value of the listed company Turquoise.

7.4.2. Transaction and Trading Comparables

Comparable methods allow the value estimated for a mining project to be benchmarked against mining project values (mining companies) established in the market (Roberts, 2006). Comparable methods thus are a key tool for ensuring value estimates are congruent with what the market would actually pay for a similar mineral asset (Roberts, 2006). The comparable transaction method uses the transaction price of comparable properties to establish a value for the subject property. These methodologies can provide a benchmark for development and producing properties when calculating the fundamental value of the asset (Davis, 2002). Comparable transactions also take into account the market factor for reserve and other risks.

Implementing market comparable analysis involves a number of challenges, for example how to select valid comparables and estimate the market value of comparable projects from the companies that own those projects. Baurens (2010, p 24) summarised the challenges and limitations of using the transaction and trading comparables for the valuation of mineral asset or mining companies and these are:-

- "*There are a limited number of transactions for mineral properties;*
- *There are no true comparables in the mining industry (unlike oil and gas). Each property is unique with respect to key factors such as geology, mineralization, costs and stage of exploration;*
- *Effective date of valuation is important (value of a property will vary widely from day to day, week to week and year to year because of the volatility of mineral price);*
- *Therefore, especially for purposes of litigation, it is necessary to establish a date on which to value the asset; and*
- *Subjective judgment is needed to identify similar properties".*

The foundation for transaction and trading comparables is built upon the premise that similar companies provide a highly relevant reference point for valuing a given mineral asset due to the fact that they share key business and financial characteristics, performance drivers, and risks. A material disconnect between the derived valuation ranges from the various methodologies and might be an indication that key assumptions or calculations need to be revisited.

The results of the transaction and trading comparables conducted by Turquoise as summarised in Figure 7.11, notwithstanding the limitations noted above, shows that the valuation results based on the Price/NAV methodology is within acceptable valuation range for mineral assets. Compared to other valuation models discussed in the previous sections a value of approximately USD7.0b for 100% of Turquoise was obtained using Price/NAV method. It should be further noted that the valuation results based on the EV/Reserves and EV/Resources multiples are considerably much higher when compared to the base case financial model based on the declared Mineral Reserves as at 31 December 2015. However, if these valuation results are compared with the alternative production cases that take into account the full resources base, the valuation results range from USD11.7b to USD15.5b. This is because the valuations are considering a comparable resource base and attributing some value to the mineral resources that are outside the LoM, due to the optionality that these additional Mineral Resources provide to the company.

The results presented here further support the fact that the valuation results from the models and calculations are considered reasonable. However, it was illustrated that Turquoise is still trading at valuations below its peers and with on-going mineral project evaluation to increase production the company would continue to increase shareholder value.

Figure 7.11: Summarised Market Comparable Approach Valuations

Analysis of potential full production upside[1]

TRADING COMPS[2]

Turquoise Hill
Resources Ltd.

Current EV[3]	USD5.7B
Reserves[4]	36.8B lb.
Resources[5]	94.5B lb.
NAV	USD6.9B

EV/Reserves	EV/M+1 Resources[5]	Price/NAV
TRQ EV/Reserves (USD/lb.)	TRQ EV/M+1 Resources (USD/lb.)	TRQ P/NAV
USD0.156	USD0.061	0.825x
Average EV/Reserves (USD/lb.)	Average EV/M+1 Resources (USD/lb.)	Average P/NAV
USD0.321	USD0.124	0.961x
USD0.289 *Range +/- 10%* USD0.353	USD0.111 *Range +/- 10%* USD0.136	0.865x *Range +/- 10%* 1.058x
Implied TRQ EV (USD B)	Implied TRQ EV (USD B)	Implied TRQ NAV (USD B)
USD11.8B	USD11.7B	USD6.7B
USD10.6B *Range +/- 10%* USD13.0B	USD10.5B *Range +/- 10%* USD12.9B	USD6.0B *Range +/- 10%* USD7.3B

TRANSACTION COMPS[2]

Turquoise Hill
Resources Ltd.

Current EV[3]	USD5.7B
Reserves[4]	36.8B lb.
Resources[5]	94.5B lb.
NAV	USD6.9B

EV/Reserves	EV/M+1 Resources[5]	Price/NAV
TRQ EV/Reserves (USD/lb.)	TRQ EV/M+1 Resources (USD/lb.)	TRQ P/NAV
USD0.156	USD0.061	0.825x
Average EV/Reserves (USD/lb.)	Average EV/M+1 Resources (USD/lb.)	Average P/NAV
USD0.361	USD0.164	1.107x
USD0.325 *Range +/- 10%* USD0.397	USD0.148 *Range +/- 10%* USD0.181	0.996x *Range +/- 10%* 1.217x
Implied TRQ EV (USD B)	Implied TRQ EV (USD B)	Implied TRQ NAV (USD B)
USD13.38B	USD15.5B	USD7.7B
USD12.0B *Range +/- 10%* USD14.60B	USD14.0B *Range +/- 10%* USD17.1B	USD6.9B *Range +/- 10%* USD8.5B

Source: Investor Presentation (2016)
Brokers, Capital IQ, Mergermarket, company technical reports, annual reports and press articles as of November 25, 2016 | Note: Full production comparables analysis shows Turquoise Hill valuation in five years

1. Valuation is based on the current trading multiples in $2.60 per pound copper price environment; current long term (2-3 years) copper price assumption varies between $2.75 - $3.00 per pound; transaction comps based mostly on deals done in $2.18 - $2.51 per pound copper price ranges; does not include valuation uplift from the expected copper price increase ~ 2020
2. Valuation based on range derived for companies with projects with similar characteristics and in full production
3. Adjusted for project finance drawdown cash
4. Reserves and Resources are based on equivalent units of production
5. Resources include Reserves

7.5. Discussion on linking Financial Reporting and MAV

The analysis on the Base Case financial model, highlighted the importance of the long term commodity prices (copper and gold in the case of Oyu Tolgoi) in the estimation of mineral asset valuation in the developed framework which is mainly forecasted using forward looking dynamics.

It is a general trend that when exploiting a mineral deposit, the mine plan is optimised with respect to the deposit to maximise returns during the initial mining periods. This would improve the project NPV of the mineral project and would allow the debt instruments raised as part of the project financing to be paid early, thereby increasing the shareholder value over the LoM.

If the investment banking approach is applied, the 3 years historical financial performance based on the financial statements is used to forecast the next 3 to 6 years and then adding a terminal value for the rest of the LoM. This approach has a number of fundamental weaknesses when applied to the valuation of the mineral assets compared to the developed framework and these include:-

- the production profile and the grade distribution over the LoM is usually significantly different since in most cases the grade distribution over the deposit is never consistent or uniform. Due to the optimisation studies being conducted on mineral projects, the extraction plan tends to favour mining higher grades in the early years and mining lower grade towards the end of the LoM, as shown in the Oyu Tolgoi case study;
- as the RoM grades decreases over the LoM, the process recoveries also decreases, resulting in companies requiring to mine more tonnages to produce the same metal or product (the mine plan is optimised with respect to the deposit to maximise returns during the initial mining periods); and
- the terminal value approach would be considered inappropriate because a mineral project has a finite life, whereas most terminal value models forecast value into perpetuity.

The banking methodology starts at the base year and is influenced more by the historical performance as noted in the historical financial statements. The basis would be that the company would continue to perform as it has done in the past and ignore the mining fundamentals that vary from mining block to mining block

The proposed framework utilises the mining operational fundamentals based on the financial statements, Mineral Reserves, Budget plan and LoM plan to forecast the FCFF that would be used in the valuation of the mineral asset. This is the fundamental difference that makes the proposed framework a better model to estimate MAV in the extractive industries, because it takes into consideration the peculiarities of each mineral deposit. This further supports the argument that the single most important asset in the extractive industries is the Mineral Reserves.

The proposed framework utilises estimates and assumptions regarding the development and operation of the Oyu Tolgoi Project. These estimates are based on many assumptions and analyses made by the Turquoise's management in light of their experience and perception of historical trends, current conditions and expected future developments, as well as other factors that the management believes are appropriate in the circumstances as documented in the Technical Report. These estimates and assumptions upon which they are based are subject to a variety of risks and uncertainties and other factors that could cause actual expenditures to differ materially from those estimated.

7.6. Validation of Framework using Oyu Tolgoi Case Study

The proposed framework to harmonise the emerging financial reporting requirements and MAV methodologies was statistically validated by applying the framework on a real life case study, the Oyu Tolgoi copper-gold mine, as tabulated in Table 7.6. It was demonstrated that the Framework Model is better at estimating company value than the Investment Banking Model because it takes into consideration the fundamental technical inputs as dictated by the characteristics of the orebody and how the orebody will be extracted. In addition, the statistical evaluation shows that the results from the proposed framework are a better estimate of the company value and hence the MAV of the Oyu Tolgoi copper-gold mine. Therefore it may be more applicable to the mineral industry than the current practices.

7.7. Observations and Conclusions on Oyu Tolgoi

It is important to use an appropriate long-term commodity price forecasts in the estimation of the MAV and in the estimation of the mineral reserves. The long-term commodity prices are the single most sensitive input in any financial valuation model for a mining company and would affect the share performance of that particular share on the stock exchange as shown in the case study.

It was also observed that the company should also have to assess the economic impact of any sustained lower metal prices on recoverability and, therefore, the cut-off grade and level of the declared Mineral Reserves and Mineral Resources. These factors will adversely impact on the Turquoise's future cash flows, earnings, results of operations, stated reserves and financial condition, which will have a material adverse impact on its share price.

In the end, the commodity price emerges as the most important factor in determining MAV and the declared Mineral Reserves, as it is the most difficult factor to forecast with assurance, and as the factor with which is associated the highest level of risk.

When estimating the value of Turquoise on Oyu Tolgoi mine, only the Mineral Reserves were considered in the framework model. The developed model gave very good correlations (0.77) relative to the market capitalisation as the proxy for value of the company. It was observed that almost all the

value attributable to Turquoise emanated from the Mineral Reserves and very little or no value is attributed to the additional Mineral Resources that are out of the current LoM plan, except the optionality value that these Mineral Resources provides in the future as was discussed under comparable methods.

8. OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

8.1. Introduction

This chapter summarises the observations and conclusions from applying the framework that was developed in this thesis to link MAV methodologies and the emerging financial reporting requirements discussed in Chapter 6. The framework was tested in Chapter 7 by applying the framework to the Oyu Tolgoi copper-gold mining project. This chapter concludes by highlighting the contribution of this research to the body of knowledge, the limitations of this research and finally recommendations for future research work to close the gaps identified in MAV and financial reporting in the minerals industry.

8.2. Observations

A few key observations from the research study include the following:

- An evaluation methodology must anticipate both the future course of a project's operation based on the LoM plan and the future behaviour of the market in order to yield reliable results. The evaluation methods discussed in this thesis are presently the best available and are commonly used. When used correctly with correct interpretation, the evaluation methods are powerful tools to help understand the economics of mining investments and form the basis of reasonable MAV as demonstrated in the Oyu Tolgoi Case, discussed in Chapter 7;
- The link between the determination of value (mineral asset valuation) and the decision making process (mineral project evaluation) has always been understood, but is not yet fully cohesive. The problem is that decision making is often based on the value driving project evaluation, such that the highest value option is frequently promoted over the actual technical and geological aspects of mining the deposit. The two are used for different purposes in the mineral industry, though they are closely linked. This thesis highlighted the similarities and differences between these two processes as discussed in detail in Chapter 5. However, it provides a solid foundation for the development of the framework which links the MAV methodologies and emerging financial reporting requirements;
- The extractive industry is providing increased transparency on financial performance and additional information that affects the operations through integrated annual reports as discussed in Chapter 6. A survey by KPMG showed a number of consistent trends such as the inclusion of additional disclosures on Mineral Resources and Mineral Reserves and production tables (KPMG, 2009). The survey also indicated that non-GAAP performance measures illustrate how the industry is attempting to provide information for users of financial statements in addition to the requirements of IFRSs. The continuation of the IASB's Extractive Activities and IVSC projects are essential in assisting companies to progress in this area.
- All operating mines and development projects should be valued using the free cash flow capitalisation DCF valuation methodology. This methodology yields the most reliable, fair and reasonable results by capturing the pertinent aspects of the business' investment case as

illustrated in Chapter 7. The use of the DCF method in combination with other methods, like the trading comparable or precedent transaction analysis, is an effective approach to obtain a realistic range of appropriate mining company values. This combination of techniques is indeed the method that most mining companies and investment banks use today. When using several valuation techniques, their individual shortfalls are eliminated and the ultimate goal in the field of company valuation can be reached which is to determine a fair and reasonable company value.

- It is important to use reasonable and appropriate long-term commodity prices in the definition of Mineral Reserves and the estimation of MAV. The single most sensitive input in any financial valuation model for a mining company is the long-term commodity prices. This affects the share performance of that particular share on the stock exchange, as shown in the case study.
- It is also noted that issue around the appropriate long-term commodity prices could be the reason why the USA provides a mandatory method to estimate commodity prices even if it causes issues elsewhere in the process. Also, the MAV codes still allow different Valuers to come up with different MAVs based on different commodity prices. However, in this thesis argues that global harmonisation on process or methodology is vital, not to specific items like forecast commodity prices.

8.3. Research contributions

At the beginning of the 20th century it was realised that the extractive industries, is one of the biggest sector globally. In the extractive industries the single most important asset is the definition of resources and reserves, yet this is not reflected anywhere in the financial statements. The major mining countries realised that there was a need to develop standards and guidelines to define Mineral Resources and Mineral Reserves, which was achieved through the CRIRSCO template as discussed in Chapter 3. In this thesis it was argued that there is no globally accepted standard or guideline for the valuation of extractive industries assets and the lack of a specific accounting standard for extractive industries except IFRS 6 that was issued as a temporary solution to facilitate the implementation of IRFS standards in the extractive industries. This thesis examines these specific issues.

Firstly, it is argued that there is a gap between reflecting and accounting for Mineral Reserves in the financial reporting systems and how these mineral assets are valued and reported upon. These identified gaps between MAV methodologies and financial reporting requirements formed the basis of this work. Hence this thesis developed a framework as presented in Chapter 6 to link the existing and emerging financial reporting requirements and MAV methodologies. This framework is applicable to developmental projects and operating mines and was validated in Chapter 7 by applying the framework to a real life case study, the Turquoise Hill Resources Oyu Tolgoi copper-gold project. It is important to note that this methodology was validated to be applicable to single asset mining company.

The second and equally important contribution to knowledge, was the harmonisation framework developed to harmonise the national MAV Code and create a global template similar to CRIRSCO's template for the reporting of exploration results, Mineral Resources and Mineral Reserves.

The framework which was presented in Chapter 3 was also published in the *Resources Policy* journal in the Njowa *et al* (2014) paper. The veracity of the framework model has been demonstrated because it formed part of the basis on the creation of the draft IMVAL template published in July 2016 and the SME Standards and Guidelines for Valuation of Mineral Properties in 2016.

These contributions are important because the multi-disciplinary approach from Resources – Reserves, MAV and financial reporting is still an emerging discipline is becoming increasingly recognised as best practice, and therefore is driving an initiative to eradicate inconsistencies. This coupled with the fact that financial reporting in the mineral industry is not yet fully developed as IFRS 6 appears to be the only mineral specific financial reporting standard. This is supported by the fact that currently there is a lack of a comprehensive accounting standard for the extractive industries to guide the accounting, recognition and presentation of these assets on the primary financial statements.

8.4. Research limitations

This thesis limits the extent of the discussion on linking the MAV methodologies and financial reporting requirements to development projects and operating mines only. The framework is most suitable to these two stages of development that are close to reaching a steady state productions level, with no further expansionary capital projects and the commodity prices are within the forecasted range used in the LOM planning parameters.

It should be noted that the other stages of development have been specifically excluded in the development of the framework, since the factors that drive value at these stages of development could be different and level of confidence attached to the estimates resulting in different approaches and methodologies being applicable, as discussed in Chapter 1. Oyu Tolgoi Case Study valuation and analysis was conducted using the DCF analysis as the primary methodology supported by the comparable market methodologies as the secondary method. These two methodologies where discussed in detail regarding the major inputs or factors in the DCF analysis for both Mineral Project Evaluation and Mineral Asset Valuation. The market based methodologies will be utilised to corroborate with the income approach.

The factors that drive value are exactly the same in Exploration, it's just that there is not enough evidence to produce reliable estimates, and therefore the methodology has to be different. I would certainly agree with you that if you want to use DCF analysis then you are going to be constrained by this lack of information, but this does NOT exclude these properties from the methodology, it just makes them less reliable.

Mineral Reserve and Mineral Resource estimates are materially dependent on prevailing commodity prices, and the cost of extracting and processing minerals at the individual mine sites. Market fluctuations in the commodity price, or increases in the costs to recover metals from the mineral project, may render mining of Mineral Reserves uneconomical, and will affect the mining company's operations in a materially adverse manner.

8.5. Recommendations for future research work

Following on from the work conducted in this thesis in the development of a framework to link MAV and the financial reporting requirements, the issues listed below constitute possible future areas of research:-

- The framework developed in this study can be applied to a mineral company's optimisation studies to evaluate the impact of the continuous improvements initiatives to the overall value of the project post the implementation of these initiatives. Optimisation was outside the scope of this thesis, however there is scope to use the developed framework to evaluate different optimisation initiatives and scenarios;
- The framework that was developed was applied to a multi-commodity (copper, gold, silver and molybdenum) mining company (Turquoise Hill Resources) with a single mineral asset (Oyu Tolgoi). There is Scope for the application of this framework to a mining company with several mining operations or shafts and be applied to a multi-national multi-asset mining companies.; and
- The relationship between the banking model valuation and the market capitalisation valuation exhibited weak polynomial, quadratic, logarithmic and exponential relationships, which are different to all the other linear relationships exhibited between the other models. Although providing explanations for these underlying relationships was not part of the central theme of this research, it warrants further investigation because the results of such an investigation would provide further insights into the problem where mining fundamentals are not being considered in the model.

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Appendix 10.1: Banking Model Inputs

Quarterly Income Statement

Turquoise Hill Resources Ltd

USD (000s)	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-16	Jun-16	Sep-16
INCOME STATEMENT	**2014**	**2014**	**2015**	**2015**	**2015**	**2015**	**2016**	**2016**	**2016**
Revenue	**466 144**	**725 473**	**426 157**	**421 261**	**431 701**	**355 643**	**422 654**	**329 744**	**226 341**
Growth (%)		*55.6%*	*-41.3%*	*-1.1%*	*2.5%*	*-17.6%*	*18.8%*	*-22.0%*	*-31.4%*
Cost of Goods Sold	**379 969**	**376 973**	**257 867**	**225 662**	**252 172**	**239 255**	**207 916**	**237 127**	**232 490**
% of Sales		*52.0%*	*60.5%*	*53.6%*	*58.4%*	*67.3%*	*49.2%*	*71.9%*	*102.7%*
Gross Profit	**86 175**	**348 500**	**168 290**	**195 599**	**179 529**	**116 388**	**214 738**	**92 617**	**-6 149**
% of Sales	*18.5%*	*48.0%*	*39.5%*	*46.4%*	*41.6%*	*32.7%*	*50.8%*	*28.1%*	*-2.7%*
Operating Expenses (SG&A)	**74 318**	**172 341**	**102 966**	**138 491**	**154 349**	**120 090**	**82 798**	**99 957**	**69 896**
% of Sales		*23.8%*	*24.2%*	*32.9%*	*35.8%*	*33.8%*	*19.6%*	*30.3%*	*30.9%*
Operating Income (EBIT)	**11 857**	**176 159**	**65 324**	**57 108**	**25 180**	**-3 702**	**131 940**	**-7 340**	**-76 045**
Interest Expense	**-2 087**	**4 776**	**1 133**	**16**	**1 246**	**2 795**	**457**	**10 112**	**7 361**
Pretax Income	**13 944**	**171 383**	**64 191**	**57 092**	**23 934**	**-6 497**	**131 483**	**-17 452**	**-83 406**
Income Tax Expense	**12 154**	**12 928**	**11 763**	**12 888**	**11 298**	**-202 035**	**9 852**	**6 589**	**-5 611**
Tax Rate		*NM*	*NM*	*NM*	*NM*	*NM*	*NM*	*NM*	*NM*
Net Income	**1 790**	**158 455**	**52 428**	**44 204**	**12 636**	**195 538**	**121 631**	**-24 041**	**-77 795**
Operating Income (EBIT)	11 857	176 159	65 324	57 108	25 180	-3 702	131 940	-7 340	-76 045
Depreciation	122 974	86 712	86 465	81 982	95 407	114 159	86 465	96 968	89 066
Amortization		0	0	0	0	0	0	0	0
EBITDA	**134 831**	**262 871**	**151 789**	**139 090**	**120 587**	**110 457**	**218 405**	**89 628**	**13 021**

Source: Turquoise Quarterly Financial Statements (2014, 2015, 2016)

Quarterly Balance Sheet

Turquoise Hill Resources Ltd

USD (000s)	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-16	Jun-16	Sep-16
BALANCE SHEET	**2014**	**2014**	**2015**	**2015**	**2015**	**2015**	**2016**	**2016**	**2016**
ASSETS									
Current Assets									
Cash and Cash Equivalents	345 177	862 755	954 220	1 166 867	1 310 360	1 343 878	1 482 195	1 478 470	1 436 511
Inventories	548 617	396 782	331 706	342 889	329 596	321 409	323 857	287 409	240 361
Trade and Other Receivables	11 426	14 519	14 192	14 285	10 562	12 210	57 487	20 090	16 775
Prepaid Expenses and Other Assets	25 575	76 903	76 827	59 657	42 182	53 375	42 104	12 628	9 692
Due from related parties	4 184	7 864	4 445	15 015	9 717	3 623	3 064	666 452	849 247
Assets held for sale	48 184	229 489	300 593	33 136	14 643				
Total Current Assets	**983 163**	**1 588 312**	**1 681 983**	**1 631 849**	**1 717 060**	**1 734 495**	**1 908 707**	**2 465 049**	**2 552 586**
Fixed Assets									
PP&E, Net of Accum. Depreciation	6 641 613	6 597 395	6 555 469	6 453 229	6 387 718	6 319 983	6 272 750	6 254 464	6 312 066
Inventories	166 354	52 757	43 533	92 752	20 299	539	0	0	0
Deferred Income Tax Assets	11 383	0	0	0	0	165 000	165 000	165 000	174 309
Financial Assets (Loans due from related party)	430 024	60 553	22 363	15 599	9 605	20 078	14 793	3 501 935	3 319 737
TOTAL ASSETS	**8 232 537**	**8 299 017**	**8 303 348**	**8 193 429**	**8 134 682**	**8 240 095**	**8 361 250**	**12 386 448**	**12 358 698**
LIABILITIES									
Current Liabilities									
Borrowings and Financial Liabilities	0	0	0	0	0	0	0	0	
Trade and Other Payables	278 717	185 852	138 934	168 542	177 136	166 766	160 330	238 724	269 335
Deferred Revenue	159 345	140 135	71 882	126 413	51 183	72 004	79 519	50 781	54 682
Payable to Related Parties	52 489	53 784	42 818	36 910	41 788	34 801	30 554	0	
Liabilities held for Sale	32 909	120 871	127 871	0	0	0	0	0	
Total Current Liabilities	**523 460**	**500 642**	**381 505**	**331 865**	**270 107**	**273 571**	**270 403**	**289 505**	**324 017**
Long Term Liabilities									
Borrowings and Financial Liabilities	0	14 086	13 961	13 834	13 705	13 574	13 440	4 104 477	4 111 980
Deferred Income Tax Liabilities	98 872	122 820	129 231	135 815	141 125	52 916	60 989	36	3 335
Decommissioning Obligations	101 292	93 004	94 497	95 462	105 397	104 421	100 078	100 830	101 771
TOTAL LIABILITIES	**723 624**	**730 552**	**619 194**	**576 976**	**530 334**	**444 482**	**444 910**	**4 494 848**	**4 541 103**
EQUITY									
Share Capital	12 394 283	11 432 060	11 432 084	11 432 084	11 432 084	11 432 122	11 432 122	11 432 122	11 432 122
Additional Paid In Capital	1 555 148	1 555 721	1 557 426	1 555 773	1 555 790	1 555 774	1 555 774	1 555 774	1 555 774
Accumulatted Income (loss)	-3 785	-4 505	-5 400	-2 327	-4 301	-14	-918	-1 617	2 173
Deficit	-5 816 401	-4 788 340	-4 692 170	-4 665 618	-4 644 434	-4 473 360	-4 354 433	-4 324 666	-4 356 067
Equity Attributable to owners of Turquoise Hill	**8 129 245**	**8 194 936**	**8 291 940**	**8 319 912**	**8 339 139**	**8 514 522**	**8 632 545**	**8 661 613**	**8 634 002**
Attributable to non-controlling interest	-620 332	-626 471	-607 786	-703 459	-734 791	-718 909	-716 205	-770 013	-816 407
TOTAL EQUITY	**7 508 913**	**7 568 465**	**7 684 154**	**7 616 453**	**7 604 348**	**7 795 613**	**7 916 340**	**7 891 600**	**7 817 595**
TOTAL LIABILITIES & EQUITY	**8 232 537**	**8 299 017**	**8 303 348**	**8 193 429**	**8 134 682**	**8 240 095**	**8 361 250**	**12 386 448**	**12 358 698**

Source: Turquoise Quarterly Financial Statements (2014, 2015, 2016)

Appendix 10.2: Banking Financial Mode (excerpt)

Integrated Financial Statements

Turquoise Hill Resources Ltd

USD (000s)

	Historical	Historical	Projected	Projected	Projected	Projected	Projected							
	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-16	Jun-16	Sep-16	Dec-16	Mar-17	Jun-17	Sep-17	Dec-17
INCOME STATEMENT	**2014**	**2014**	**2015**	**2015**	**2015**	**2015**	**2016**	**2016**	**2016**	**2016**	**2017**	**2017**	**2017**	**2017**
Revenue	466 144	725 473	471 557	483 346	495 430	507 816	520 511	533 524	546 862	560 534	574 547	588 911	603 633	618 724
Growth (%)	*NA*	*55.6%*	*-35.0%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*	*2.5%*
Cost of Goods Sold	379 969	376 973	282 934	290 008	297 258	304 689	312 307	320 114	328 117	336 320	344 728	353 346	362 180	371 235
% of Sales	*81.5%*	*52.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*	*60.0%*
Gross Profit	86 175	348 500	188 623	193 339	198 172	203 126	208 204	213 410	218 745	224 213	229 819	235 564	241 453	247 490
% of Sales	*18.5%*	*48.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*	*40.0%*
Operating Expenses (SG&A)	74 318	172 341	93 601	95 941	98 340	100 798	103 318	105 901	108 549	111 263	114 044	116 895	119 818	122 813
% of Sales	*15.9%*	*23.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*	*19.8%*
Operating Income (EBIT)	11 857	176 159	95 022	97 397	99 832	102 328	104 886	107 508	110 196	112 951	115 775	118 669	121 636	124 677
Interest Expense	-2 087	4 776	986	986	986	986	986	986	986	986	986	986	986	986
Pretax Income	13 944	171 383	94 036	96 411	98 846	101 342	103 900	106 522	109 210	111 965	114 789	117 683	120 650	123 691
Income Tax Expense	12 154	12 928	11 284	11 569	11 862	12 161	12 468	12 783	13 105	13 436	13 775	14 122	14 478	14 843
Tax Rate	*87%*	*8%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*	*12.0%*
Net Income	1 790	158 455	82 751	84 842	86 985	89 181	91 432	93 740	96 105	98 529	101 014	103 561	106 172	108 848
Operating Income (EBIT)	11 857	176 159	95 022	97 397	99 832	102 328	104 886	107 508	110 196	112 951	115 775	118 669	121 636	124 677
Depreciation	122 974	86 712	103 582	102 744	101 919	101 107	100 307	99 520	98 745	97 983	97 232	96 493	95 765	95 049
Amortization	0	0												
EBITDA	134 831	262 871	198 604	200 141	201 751	203 435	205 193	207 028	208 941	210 933	213 006	215 161	217 401	219 725
BALANCE SHEET	**2014**	**2014**	**2015**	**2015**	**2015**	**2015**	**2016**	**2016**	**2016**	**2016**	**2017**	**2017**	**2017**	**2017**
Current Assets														
Cash and Cash Equivalents	345 177	862 755	1 060 521	1 195 786	1 332 306	1 470 145	1 609 370	1 750 047	1 892 244	2 036 032	2 181 481	2 328 662	2 477 650	2 628 518
Inventories	548 617	396 782	353 158	361 987	371 037	380 313	389 820	399 566	409 555	419 794	430 289	441 046	452 072	463 374
Trade and Other Receivables	11 426	14 519	10 498	10 760	11 029	11 305	11 588	11 878	12 174	12 479	12 791	13 111	13 438	13 774
Prepaid Expenses and Other Assets	25 575	76 903	36 989	37 914	38 862	39 833	40 829	41 850	42 896	43 968	45 068	46 194	47 349	48 533
Due from related parties	4 184	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864	7 864
Assets held for sale	48 184	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489	229 489
Total Current Assets	983 163	1 588 312	1 698 519	1 843 801	1 990 587	2 138 949	2 288 960	2 440 693	2 594 223	2 749 626	2 906 981	3 066 366	3 227 862	3 391 552
Fixed Assets														
PP&E, Net of Accum. Depreciation	6 641 613	6 597 395	6 543 609	6 490 660	6 438 537	6 387 226	6 336 715	6 286 991	6 238 042	6 189 855	6 142 419	6 095 723	6 049 754	6 004 501
Inventories	166 354	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757	52 757
Defferred Income Tax Assets	11 383	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial Assets	430 024	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553	60 553
TOTAL ASSETS	8 232 537	8 299 017	8 355 438	8 447 771	8 542 434	8 639 486	8 738 985	8 840 994	8 945 574	9 052 791	9 162 710	9 275 399	9 390 926	9 509 364
LIABILITIES														
Current Liabilities														
Borrowings and Financial Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade and Other Payables	278 717	185 852	173 515	177 853	182 299	186 856	191 528	196 316	201 224	206 255	211 411	216 696	222 114	227 666
Deferred Revenue	159 345	140 135	126 142	129 295	132 528	135 841	139 237	142 718	146 286	149 943	153 691	157 534	161 472	165 509
Payable to Related Parties	52 489	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784	53 784
Liabilities held for Sale	32 909	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871	120 871
Total Current Liabilities	523 460	500 642	474 311	481 803	489 482	497 352	505 420	513 689	522 165	530 852	539 757	548 885	558 241	567 830
Long Term Liabilities														
Borrowings and Financial Liabilities	0	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086	14 086
Deferred Income Tax Liabilities	98 872	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820	122 820
Decommissioning Obligations	101 292	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004	93 004
TOTAL LIABILITIES	723 624	730 552	704 221	711 713	719 392	727 262	735 330	743 599	752 075	760 762	769 667	778 795	788 151	797 740
EQUITY														
Share Capital	12 394 283	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060	11 432 060
Additional Paid In Capital	1 555 148	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721	1 555 721
Accumulatted Income (loss)	-3 785	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505	-4 505
Deficit	-5 816 401	-4 788 340	-4 705 589	-4 620 747	-4 533 762	-4 444 581	-4 353 149	-4 259 410	-4 163 305	-4 064 776	-3 963 762	-3 860 201	-3 754 029	-3 645 182
Equity Attributable to owners of Turquoise Hill	8 129 245	8 194 936	8 277 687	8 362 529	8 449 514	8 538 695	8 630 127	8 723 866	8 819 971	8 918 500	9 019 514	9 123 075	9 229 247	9 338 094
Attributable to non-controlling interest	-620 332	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471	-626 471
TOTAL EQUITY	7 508 913	7 568 465	7 651 216	7 736 058	7 823 043	7 912 224	8 003 656	8 097 395	8 193 500	8 292 029	8 393 043	8 496 604	8 602 776	8 711 623
TOTAL LIABILITIES & EQUITY	8 232 537	8 299 017	8 355 438	8 447 771	8 542 434	8 639 486	8 738 985	8 840 994	8 945 574	9 052 791	9 162 710	9 275 399	9 390 926	9 509 364
CASH FLOW STATEMENT	**2014**	**2014**	**2015**	**2015**	**2015**	**2015**	**2016**	**2016**	**2016**	**2016**	**2017**	**2017**	**2017**	**2017**
CASH FLOW FROM OPERATING ACTIVITIES														
Net Income			82 751	84 842	86 985	89 181	91 432	93 740	96 105	98 529	101 014	103 561	106 172	108 848
Add Back Non-Cash Items														
Depreciation			103 582	102 744	101 919	101 107	100 307	99 520	98 745	97 983	97 232	96 493	95 765	95 049
Changes in Working Capital														
Inventory			43 624	-8 829	-9 050	-9 276	-9 508	-9 746	-9 989	-10 239	-10 495	-10 757	-11 026	-11 302
Trade and Other Receivables			4 021	-262	-269	-276	-283	-290	-297	-304	-312	-320	-328	-336
Prepaid Expenses			39 914	-925	-948	-972	-996	-1 021	-1 046	-1 072	-1 099	-1 127	-1 155	-1 184
Accounts Payable			-12 337	4 338	4 446	4 557	4 671	4 788	4 908	5 031	5 156	5 285	5 417	5 553
Deferred Revenue			-13 993	3 154	3 232	3 313	3 396	3 481	3 568	3 657	3 749	3 842	3 938	4 037
Net Cash Provided by Operating Activities			247 562	185 061	186 316	187 635	189 021	190 473	191 994	193 584	195 245	196 977	198 784	200 664
CASH FLOW FROM INVESTING ACTIVITIES														
Capital Expenditures - Purchase of PP&E			-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796
Financial Assets			0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Used in Investing Activities			-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796
CASH FLOW FROM FINANCING ACTIVITIES														
Net Cash Flow			197 766	135 265	136 520	137 839	139 225	140 677	142 198	143 788	145 449	147 181	148 988	150 868
Beginning Cash Balance			862 755	1 060 521	1 195 786	1 332 306	1 470 145	1 609 370	1 750 047	1 892 244	2 036 032	2 181 481	2 328 662	2 477 650
Ending Cash Balance			1 060 521	1 195 786	1 332 306	1 470 145	1 609 370	1 750 047	1 892 244	2 036 032	2 181 481	2 328 662	2 477 650	2 628 518
DCF ANALYSIS AND VALUATION														
Unlevered Free Cash Flow			**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**
Net Income			82 751	84 842	86 985	89 181	91 432	93 740	96 105	98 529	101 014	103 561	106 172	108 848
Depreciation and Amortisation			103 582	102 744	101 919	101 107	100 307	99 520	98 745	97 983	97 232	96 493	95 765	95 049
Deferred Taxes			-13 993	3 154	3 232	3 313	3 396	3 481	3 568	3 657	3 749	3 842	3 938	4 037
Working capital changes			75 222	-5 678	-5 820	-5 966	-6 115	-6 268	-6 424	-6 585	-6 750	-6 918	-7 091	-7 269
Capital Expenditure			-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796	-49 796
Net interest Expenses			986	986	986	986	986	986	986	986	986	986	986	986
Less Taxes (EBIT - Tax %)	12.0%		-11 403	-11 688	-11 980	-12 279	-12 586	-12 901	-13 224	-13 554	-13 893	-14 240	-14 596	-14 961
UFCF			187 349	124 564	125 526	126 546	127 624	128 762	129 960	131 220	132 542	133 927	135 377	136 893
Discount Rate	8%		1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.86	0.86	0.86	0.86
NPV	**5 248 928**		187 349	124 564	125 526	126 546	118 171	119 224	120 333	121 500	113 633	114 821	116 064	117 364