Development of a best practice guideline for conducting comparable market valuation by benchmarking from gold deposit case study transactions

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Declaration

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science in Mining Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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(Signature of Candidate)

19th day of September 2019

Abstract

The comparable market valuation is an internationally accepted valuation method frequently used to value mineral assets. Valuation methods are generally associated with uncertainty. The uncertainty is associated with values of the input parameters used and assumptions made in the valuation process. Accordingly, national mining valuation codes were designed to provide guidance to the valuation process. These codes are principles-based and not prescriptive, leaving valuators (valuers) with a degree of uncertainty. The purpose of this research study was therefore, to establish a best practice guideline when using the comparable market valuation method to value a mineral project. The guideline is intended to partly reduce variation in approach by different valuators and so reduce the uncertainty in the valuation process.

According to the APB (2013), when a transaction on a property is a ‘competitive substitute’ it is acceptable to be classified as comparable. Most transactions used in mineral property valuations will not be classified as being competitive substitutes, further substantiating the importance of determining a best practice guideline for the market comparable valuation method.

Five steps were introduced, after investigating similarities between valuations of real estate and mineral properties, that form the best practice guideline for conducting the comparable market valuation. These five steps are:

- Step 1: Construct a database to be used in valuation;
- Step 2: Adjust values to real terms;
- Step 3: Distribute unit values per Mineral Resource category;
- Step 4: Perform sanity checks; and
- Step 5: Identify and apply sensible adjustments.

By building an extensive valuation transactions database, based on gold deposit case study transactions over a period of 12 years (2006 to 2017 inclusive), and

following each proposed step, the industry average unit values per resource category were determined to be:

- Inferred: 2.3 USD/oz;
- Indicated: 13.3 USD/oz; and
- Measured: 21.7 USD/oz.

The best practice guideline developed in this research study was applied to a listed gold mining company case study. The non-diversified, South African listed gold mining company used for the case study was Pan African Resources (PAR), which has several operating gold mines as well as potential projects with compliant Mineral Resource statements containing 33.3 Moz of gold. The industry average unit values per resource category were applied to the gold case study after making project-specific adjustments to determine the project resource value of USD269.4 million. This equates to a project average unit value of 8.1 USD/oz, which is the probable value that a willing buyer would potentially expect to pay for the purchase of the Mineral Resource.

The estimated market value of an asset determines the validity of any valuation. To justify the estimated value based on the comparable market valuation method, the estimated resource value was compared to the enterprise value of the listed gold mining company of USD242.7 million at the time of the valuation. This resulted in a variance of 11%. Given the fact that the share price fluctuated by approximately 15% to 17% higher or lower, preceding and succeeding the date of the valuation, an 11% variance can be deemed as acceptable. The value based on the comparable market valuation method following the proposed guideline using gold deposit case study transactions can, thus, be deemed as reliable and justifiable.

It is recommended that mineral property valuators make use of the guideline when conducting the comparable market valuation. It is also recommended that the national mining valuation codes, which are accepted globally, can consider presenting valuators with a similar guideline to ensure transparency among valuators.

Dedication

A dedication to my loving wife, Rentia, for her support and encouragement throughout the research study. Together with our two daughters, Alivia and Kira, you provided me with endless inspiration.

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1 INTRODUCTION

1.1 Chapter overview

The introductory chapter provides an overview of the globally accepted valuation method that the research study focused on, which gets applied to a code-compliant Mineral Resource. This forms the purpose of this research study, which further leads to the problem statement that formed the basis of the research work. There are three internationally accepted approaches that can be used when valuing mining projects, namely the income, market and cost approach. There are various valuation methods within each of the approaches that are sub-sets of the valuation approach. This research study was done on the market approach with a specific focus on the comparable market valuation methodology, which is a sub-set of the market approach. The comparable market valuation methodology "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" (Minxcon (Pty) Limited, 2015, p. 72).

The market value can be defined as "the price of an asset or good that can be expected in a fair, open and competitive market where buyers and sellers participate freely" (Spacey, 2018, para 1). It should be noted that the market price that an asset gets sold for at any given time might be different to the market value.

To investigate the comparable market valuation methodology and provide a guideline to mineral property valuators for conducting the method a commodity had to be used. Gold mining has a long history in South Africa and remains one of the most sought-after precious metals globally. As one of the leaders in global gold supply, South Africa has had numerous gold mine and development acquisitions over the past few decades allowing a valuator access to several comparable transactions. The comparable market valuation method conducted for gold in South Africa is as likely to succeed as any other mineral. For this reason, gold case studies were chosen as the preferred commodity to do the research.

1.2 Purpose of study

The purpose of this research study was to develop a best practice guideline for mining companies when using the comparable market valuation method to value a mineral project. The research study can furthermore guide mineral asset valuators to sense check their valuation results to increase overall confidence in the value derived.

The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC) (2016), sets out a guideline for the public reporting of Exploration Results, Mineral Resources and Mineral Reserves in South Africa. A Mineral Resource is defined as "a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling" (SAMREC, 2016, p. 18). There are three categories of Mineral Resources. The categories are subdivided in order of increasing geological confidence based on the exploration work completed and the results thereof. The categories are divided into Inferred, Indicated and Measured Mineral Resources in order of increasing geo-scientific confidence.

As per the SAMREC code, a Mineral Reserve is defined as "the economically mineable part of a Measured and/or Indicated Mineral Resource" (SAMREC, 2016, p. 25). The comparable market valuation method is one of the most widely used methods because it can be used at any stage of development. Most mineral properties that form part of an acquisition have stated Mineral Resources, but not all have stated Mineral Reserves. The market value using the comparable market valuation method gets calculated per Mineral Resource ounce and not per Mineral Reserve ounce. It is, however, important to ensure that the Mineral Resource statements used are inclusive of Mineral Reserves. The preferred valuation method for Mineral Reserves is the discounted cash flow (DCF) analysis method. As per the SAMREC code, the DCF method is mostly used on projects in the development phase, operating assets and economically viable dormant properties (SAMVAL, 2016).

The comparable market valuation method is one of the globally accepted valuation methods to value mineral projects (SAMVAL, 2016). The value is derived typically from comparable market-based figures which are obtained from an analysis of recent transactions and expressed as a monetary value per gold ounce. Many difficulties with this approach have been identified in the past within the mining industry.

Some of the generally accepted mining valuation codes are the South African Code for the Reporting of Mineral Asset Valuation (SAMVAL), the Canadian Institute of Mining, Metallurgy and Petroleum on Valuation of Mineral Properties (CIMVAL) and the Australasian Code for Public Reporting of Technical Assessments and Valuations of Mineral Assets (VALMIN). There is limited guidance from the national mining valuation codes (SAMVAL, CIMVAL and VALMIN) on how the comparable transactions should be analysed, adjusted and applied to the project being valued. This is because the codes are principles-based and not prescriptive. This leaves valuators with a degree of discretion on how to prepare a valuation using the comparable market valuation method. In South Africa and Canada, the term 'valuator' is used synonymously with the term 'valuer' (Njowa *et al*., 2014). As a matter of preference, the term 'valuator' is used for this research study.

Njowa (2017), developed a framework to harmonise mineral asset valuation methods with the financial reporting standards. The major reason for the Njowa (2017) study was that, "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 valuations" (Njowa, 2017, p. 47). A framework like this could be able to align the national mining valuation codes discussed above, to the financial reporting of mining companies in the financial statements. For a framework like this to be accepted globally by financial reporting authorities, there would need to be clear guidelines and requirements of how the valuation methods are to be conducted. The lack of such a guideline for the comparable market valuation method further motivates the need for a guideline accepted by the national valuation codes.

1.3 Problem statement and research hypothesis

One of the major reasons why the market approach is rarely employed appropriately (even by certified mineral property valuators) is because most valuators have neither training guideline nor the detailed framework for reference in conducting the approach (Ellis, 2011). Hence, the comparable market valuation method is often not used or if used, can be used incorrectly, which emphasises the importance of the current research work to establish a best practice guideline that valuators can use as a basis in conducting mineral valuations using the comparable market valuation method. To clearly identify good comparable transactions to use in the valuation of a mining project may be challenging. By using a large variety of recent transactions that reasonably compare to the project being valued, some of the non-comparable projects included in the analysis can be averaged out. It should, however, be noted that no project can be a 100% true comparable due to geological localised factors. If two mineral properties are situated next to each other, sharing a boundary fence, there will be a lot of similarities, but even then, the geological localised factors will not be the same.

An 'arms-length' transaction is defined as a transaction where there is independence between the buyer and seller and both parties act in their own self-interest without any coercion from the other party (South Africa, Income Tax Act 58 of 1962). The difficulty of finding true 'arms-length' comparable transactions can be mitigated by applying a systematic and suitable analysis of the comparable transactions to define an appropriate set of comparable transactions and assist in achieving confidence in the market comparable analysis.

Problems identified in finding comparable transactions are that every mining project is unique and differs from any other mining project in many ways. Some of the differences identified are listed below:

- Time of transaction;
- Mineral Resource confidence (Measured, Indicated and Inferred Mineral Resources);
- Processing method;
- Available infrastructure;
- Depth of orebody;
- Mining method;
- The scale of Mineral Resource;
- Mining grade;
- Legal tenure;
- Geological complexity;
- Stage of development;
- Ability to increase the Mineral Resource; and
- Socio-economic and environmental issues.

Best practice on how to allow for these factors when conducting a comparable market valuation method is not available and this can lead to two different valuators valuing the same project differently but, using the same set of comparable transactions.

A best practice guideline for conducting the comparable market valuation method will guide mineral property valuators to strategically consider and apply the necessary adjustments when valuing a mineral property. The guideline can ensure that the comparable market valuation method is employed appropriately. The question then is *'Is it possible to use gold deposit case study transactions to develop such a guideline?'*

1.4 Report structure

To gain an understanding of the prevailing research associated with the comparable market valuation method, a literature review was undertaken to support the current knowledge and problems experienced in the industry. Since valuators have been left with a degree of discretion on how to prepare a valuation using the comparable market valuation method, numerous issues have been identified in the past. There is also a degree of similarity to be identified between real estate valuations and mineral property valuations as the basis of the valuations are similar. Chapter 2 investigates the current prevailing research in the form of a detailed literature study.

Chapter 3 explains the methodology that was followed to identify how the data used for the comparable market valuation was generated. Each of the steps identified in Chapter 3 provides a best practice guideline that forms the fundamental objective of this research study. Chapter 4 details each of the five steps identified and the results obtained from each of the steps to determine industry average gold unit values per Mineral Resource category (Inferred, Indicated and Measured Mineral Resource).

Chapter 5 uses and applies the best practice guideline developed in Chapter 4 to a gold mining company case study. The resource values determined based on the comparable market valuation method, were then compared to the enterprise value of the listed gold mining company to determine if the value using the best practice guideline is a reasonable estimate. The conclusions and recommendations of this research study are captured in Chapter 6 of the report.

2 LITERATURE REVIEW

2.1 Overview of Chapter 2

The purpose of the literature review was to gain an understanding of the available literature associated with the comparable market valuation method. The chapter reviews several valuation codes and existing literature conducted on this topic.

2.2 Valuation approaches and methods

The SAMVAL code provides a guideline to valuators for the reporting of mineral valuations. According to SAMVAL (2016), the main purpose of the code is to guide valuators to consistently use minimum standards set out by the code to minimise variations between valuators. The principles on which the code is based on have been aligned with other international valuation codes such as the CIMVAL code in Canada (Canadian Institute of Mining, Metallurgy and Petroleum, 2014) and the Australian VALMIN code (The VALMIN Committee, 2015).

A similarity among all the mineral asset valuation codes, described above, is that the three internationally accepted valuation approaches that can be used when valuing mining projects, are the same. These are the income, market and cost approaches. It should be noted that valuation methods are a sub-set of valuation approaches and are, therefore, more specific.

2.2.1 Income approach

The three most common methods included under the income approach are the DCF, Monte Carlo Analysis and Option Pricing. "The DCF is widely used and generally accepted to value development and production properties in the production phase. This method 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" (Minxcon (Pty) Limited, 2015, p. 72). Since DCF inputs require substantial subjective judgements, in the case where no studies of high-level confidence exist, the DCF valuation can strictly only be applied as guided by the SAMVAL code

(SAMVAL, 2016) and used where the minimum required level of the study is at a pre-feasibility level.

2.2.2 Market approach

The market approach can be used at any stage of development and is mostly based on "the relative comparisons of similar properties for which a transaction is available in the public domain." (Minxcon (Pty) Limited, 2015, p. 72). The method is also referred to as the comparable transaction valuation method, but as a matter of preference the term comparable market valuation method is used in this report. The method "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" (Minxcon (Pty) Limited, 2015, p. 72).

2.2.3 Cost approach

The cost approach "includes the Appraised Value method which is widely used and the Multiple of Exploration Expenditure which is used to value early-stage exploration properties. The valuation is dependent on the historical and future exploration expenditure, as this approach is based on the principle of contribution to value" (Minxcon (Pty) Limited, 2015, p. 72).

Mineral assets can be classified as Dormant Properties, early-stage and advanced-stage Exploration Properties, Development Properties, Production Properties or Defunct Properties. Each of these assets has various valuation approaches that are more generally used when valuing the asset at the applicable stage of development. Table 2-1 describes this relationship.

Table 2-1: Relationship between stages of development and valuation approaches for mineral assets

Valuation Approach	Exploration Properties	Development Properties	Production Properties	Dormant Properties		Defunct Properties
				Economically Viable	Not Viable	
Income	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	Widely used	Not generally used	Not generally used	Not generally used	Less widely used	Quite widely used

Source: SAMVAL (2016, p. 14)

According to the guidelines set out by SAMVAL (2016), it ultimately remains the competent valuator's responsibility to choose the appropriate justifiable valuation method and conduct the valuation to the best of their ability. Thus, there is no clear guidance or best practice provided by the code as to what should be taken into consideration when conducting a valuation but, rather a guideline stipulating ethical behaviours and sound judgement that should be applied. SAMVAL (2016) requires that at least two of the three valuation approaches should be applied when valuing a mineral property, making the market approach one of the most widely used methods because it can be used at any stage of development. The market approach is used either as the primary valuation together with the cost approach or as a secondary valuation together with the income approach.

The Polish Code for Mineral Asset Valuation (POLVAL code), which is not as well-known as the SAMVAL, VALMIN and CIMVAL codes, was also introduced in 2008 (Ranosz, 2016). Similar to the SAMVAL code, the POLVAL code also ascribes the valuation method depending on the stages of development of the project. The market approach can be used to valuate any mineral project at any stage of development, thus, allowing the approach to be used more often with more flexibility than the Income and Cost Approaches (Ranosz, 2016).

Lilford and Minnitt (2005), stated that the market approach has various valuation methodologies within the approach of which the USD per ounce method is one of the methods most often used to value gold properties. This method is based on recent transactions and there is a definite element of subjectivity. It is further emphasised that "valuation methodologies are not typically black boxes that anyone can use to generate an answer" (Lilford and Minnit, 2005, p. 40). Due to this, the experience and knowledge of a valuator become an important factor in choosing the most appropriate method and applying it correctly. In certain cases, a valuator may have to move away from the normal method and change the methodology to suit a specific project. The problem with this is that experienced valuators are not always available, leaving less experienced valuators with the task of applying valuation methodologies, which might not be appropriate. A lack of guidance and guidelines can lead to inaccurate valuations of mineral properties.

According to Torkelson *et al*. (2010), the historically favoured valuation method for valuing mineral properties was using the market approach using the comparable sales method. The concerns and difficulty experienced over time by valuators to find true comparable transactions led to the income approach becoming the preferred valuation method.

2.3 Sales comparison approach for real estate and mineral properties

The valuation approach that is used to valuate real estate properties is referred to as the sales comparison approach. This approach is similar to the market approach's comparative market valuation method. To determine a best practice guideline for conducting the comparable market valuation method, it is important to investigate other existing markets where there is to a certain extent a best practice guideline when conducting the sales comparison approach. Pagourtzi *et al*. (2003), stated that the value of any asset is a function of the usefulness of the asset, which is dependent on its demand and supply of a product that might be produced from the asset. A valuation determines the best-estimated value at which an asset can be bought for or sold for at a specific date in time. The estimated market value of an asset determines the validity of any valuation. The same approach was, therefore, used in this research report to test the validity of the valuation by comparing the calculated comparative value of the Mineral Resources to the market value of the company.

In the real estate market, the purpose of a valuation is to determine a “best estimate of the trading price of a building” (Pagourtzi *et al*., 2003, p. 384). Similarly, for mineral valuations, one of the purposes of a mineral valuation is to determine the market value which is “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 wherein the parties had each acted knowledgeably, prudently, and without compulsion” (SAMVAL, 2016, p. 25).

One of the biggest concerns for valuing real estate is that the information used to make investment decisions is not always clear and can be ambiguous to the buyer or client. The methodology and thought process that gets followed by the real estate valuator to determine the fair value is often unclear. The same concerns have also been raised in the minerals industry with regards to the comparable market valuation method used to value Mineral Resources. The steps followed in determining the value is often not described clearly nor easy to understand leaving the investor with a certain degree of uncertainty (Pagourtzi *et al*., 2003).

The Indiana Department of Local Government Finance (2013), sets out certain steps which should be followed by a valuator when valuing real estate using the comparable market valuation method. Although mineral properties are more complex since it is more difficult to obtain true comparables, the steps to be followed might be similar. Certain similarities that exist between real estate and minerals is that both the demand and supply are cyclical and the price a buyer is willing to pay for either a commodity or property will generally rise and fall if supply or demand factors shift. It was, thus, considered worthwhile to investigate the best practice for valuing real estate and adapt it for this research study on valuing mineral properties where possible using the comparable market valuation method.

In both these cases, the suitability of the approach is determined by the amount of available similar sales at the disposal of a valuator. More frequent sales of similar properties will improve confidence in the value calculated. In both cases, usually no two properties are exactly alike, and adjustments have to be made to real estate sales comparisons in the same way that is made to mineral properties. Usually, three to five comparable transactions of real estate are considered adequate for conducting a valuation, but the confidence is improved as the number of transactions increase. The number of proposed transactions for this research study will similarly also improve with an increase in the number of mineral property transactions. Some of the sales comparisons used will also need to be adjusted to real terms as the sales would have taken place at different times in the past.

According to the International Association of Assessing Officers (IAAO) (2003, p. 5), market value is defined as "the most probable price (in terms of money) that a property should bring in a competitive and open market under the conditions necessary to a fair sale - the buyer and seller each acting cautiously and knowledgeably, and assuming the price is not affected by undue stimulus."

This assumes that a market should be fair with both the buyer and seller being well informed and typically motivated to each gain the best possible price for the sale of an asset. According to the IAAO, the formula for the comparable sales method can be summarised as follows (International Association of Assessing Officers, 2003, p. 9):

"$MV_S = SP_C + ADJ_C$

- MV_S represents the market value estimate;
- SP_C represents the selling price of a comparable sale property; and
- ADJ_C represents adjustments to the comparable sale."

The formula stated by the IAAO is relevant to this research study and forms the basis of the mineral property valuation calculation. The following steps that are required in the sales comparison approach are (Indiana Department of Local Government Finance, 2013, pp. 22-23):

1. "Definition of the appraisal problem
2. Data collection and verification
3. Analysis of market data to develop units of comparison and select attributes for adjustment

4. Develop reasonable adjustments
5. Application of the adjustments to the comparable sales
6. Analysis of adjusted prices to estimate value of subject property."

Furthermore, the Indiana Department of Local Government Finance (2013) highlighted the importance of the adjustments as being the most important step in conducting a sales comparison, which is relevant to the mineral valuations. The adjustment process was broken down into the following five steps (Indiana Department of Local Government Finance, 2013):

- Step 1: Recognise all the appropriate components of comparison affecting the market value of the asset to be valued;
- Step 2: Quantify the differences of the identified components of the comparable sales to the asset being valued;
- Step 3: Develop a strategic way to apply the adjustments to the subject and calculate a net adjustment for each comparable sale;
- Step 4: Range the adjusted values of the comparable sales to determine what adjustments would increase or decrease the unit value of the asset or property to be valued; and
- Step 5: Combine the adjustments to calculate the final value of the property to be valued.

The steps described above formed the basis of the proposed best practice for conducting the comparable market valuation method using gold case studies. Sales of gold mines or development properties with substandard features must be adjusted upward and sales with superior features must be adjusted downward to the gold mine or Mineral Resource being valued.

2.4 Sales comparison approach methodology

Ellis (2011) demonstrated a methodology for adjusting units of a Mineral Resource by means of example transaction analyses and sales comparison analyses. Instead of describing the numerous difficulties and criticisms of the sales comparison approach often introduced by numerous authors, Ellis (2011) focussed on ways to employ adjustments to the comparable sales. SAMVAL (2016) recommended that at least two of the three valuation approaches should be used to value mineral properties.

Ellis (2011) observed that the accepted range of adjustments that the real estate appraiser feels comfortable with and typically can apply is relatively small adjustments (10% to 30%). However, adjustments in this range might not be applicable where a mineral property is involved. The complexity of mineral properties often justifies that large value adjustments are necessary when conducting the comparable market valuation method. The magnitude of the adjustment can be greater than 100% when considering important mineral geological parameters such as grade, size of orebody, depth and seam thickness before even considering non-physical factors such as political, socio-economic and other factors that might influence the value of a mineral property.

Ellis (2011) described typical factors that are generally used to adjust mineral transactions. Ellis (2011) also acknowledged the similarities of the method to the sales comparison grid which is often used by real estate appraisers. The foundation of the adjustments is general information about to the actual transaction and is listed below (Ellis, 2011, p. 96):

- “Agreement/transaction date
- Buyer/acquirer’s name
- Effective Date of Appraisal (of the subject property)
- Price paid per unit (e.g. $/reserve equivalent tonne)
- (Average) product price at agreement/transaction date (e.g. $/tonne)
- Long-term product price expected at agreement date
- (Long-term) product price at effective date of appraisal.”

The first adjustment made to the transactions is then to convert the unit price to real terms which is a combination of the product price and inflation changes. After the initial process, the valuator should list adjustment factors which he/she typically considers. The ranking of these adjustments should be applied by each valuator's individual preference. The adjustment factors are listed below (Ellis, 2011, p. 96):

- "Minority interest
- Project development status
- Deposit grade
- Deposit/project size
- Property control and security of tenure
- Capital investment requirement
- Operating cost/net operating income
- Production loss/recovery/metallurgical complexity
- Product quality
- Product market stability
- Discovery and expansion potential
- Location and access
- Infrastructure
- Permitting issues
- Reclamation
- Country risk
- Project risk
- Taxes, royalties, levies."

The adjustment factors and the order in which these factors should be applied were considered in this research study.

Bradley (2015), highlighted that there are important things that an investor should know about mineral asset valuations. Two of the important factors applicable to the market approach are highlighted in this section. It is firstly, that the valuation is based on a Mineral Resource statement or exploration data. If the information supporting these data are fallacious and cannot be verified, then the valuation also has no meaning. Secondly, valuations are subjective in nature and inexperienced valuators might not incorporate important characteristics of a mining project into the valuation, thus, either overestimating or underestimating the value of the mineral asset.

Godek *et al*. (2011) argued that when the comparable market valuation method is used where several comparable transactions are gathered and averaged, is random and imprecise. Godek *et al*. (2011) further stated that the regression analysis is superior to the comparable market valuation method because it uses more data and is more accurate. It should, however, be noted that research on the regression analysis method has only been performed on different multiples for existing companies, such as revenue-, enterprise value-, and earnings before interest tax depreciation and amortisation (EBITDA) multiples. The comparable market valuation method using historical transactions is different from comparing company multiples and hence not regarded as relevant to the mineral valuation being investigated.

2.5 Comparable mineral properties

Some of the valuation codes do not use the term comparable sales but rather refer to the transaction as a 'sale' (The VALMIN Committee, 2015) or 'comparable transaction' (Canadian Institute of Mining, Metallurgy and Petroleum, 2014, pp. 1–10). Ellis (2016) investigated the meaning of the term 'comparable mineral properties' by examining the analysis published by the Appraisal Practices Board of the U.S. Appraisal Foundation (APB, 2013).

The APB (2013), investigated the findings on what was appropriate as being considered a comparable transaction and to what magnitude adjustments to a transaction are deemed appropriate. If a transaction on a property is a 'competitive substitute' it is acceptable to be classified as comparable (APB, 2013). This is arguable since most transactions used in mineral property valuations will not be classified as being a competitive substitute and that the order of magnitude of the adjustments will more probably than not be higher than deemed acceptable by the APB.

The suggestions of the APB and the arguments considered by Ellis (2016) further substantiate the importance of determining a best practice guideline for the market comparable valuation method that can be agreed to by all the mineral valuation codes and be used as a guidance by mineral property valuators.

2.6 Summary of Chapter 2

Based on the existing literature available it can be concluded that there is a need in the mineral valuation profession for a best practice guideline when conducting the comparable market valuation method. The proposed best practice guideline and its use are described in detail in the remainder of the report by using gold deposit case study transactions in South Africa. The following chapter introduces the procedures followed to determine the best practice guideline.

3 METHODOLOGY

3.1 Overview of Chapter 3

This chapter describes the actions that were taken to investigate the identified research problem. The main aim was to identify how the data used for the comparable market valuation was generated and adjusted.

3.2 Steps followed

To achieve the research study objectives, the steps outlined below were followed. The first step was to generate a valuation transactions database of historical gold transactions that occurred in South Africa over 12 years. The steps set out below were subsequently applied to the data gathered:

i. Gather the appropriate amount of gold transactions to form the basis of the valuation transactions database.
ii. Table important information regarding the transactions.
iii. Convert the historical transactions to current terms to be able to compare all transactions on the same economic level by adjusting the historical transaction prices to current-day terms by determining the difference in price and exchange rate from the time these historical transactions took place to current-day parameters.
iv. Analyse the transactions to recognise if there are outliers that need to be removed for rational reasons and adjust the valuation curve.
v. Construct a current term valuation curve to determine average unit values per Mineral Resource category.
vi. List the essential adjustment factors to be applied to the sales transactions.
vii. Determine the most sensitive factors of a gold mine and rank the adjustments accordingly.
viii. Apply the adjustments to the mineral property being valued.
ix. Calculate the value based on the comparative market valuation method.
x. Compare valuation results based on the different practices used to highlight the importance of necessary best practice guideline for the comparative market valuation method.

xi. Determine the importance of introducing specific project risk criteria to a comparable market valuation as well as distinguishing between the different Mineral Resource categories when doing valuations.

xii. Recommend best practice that can be used as guidance by valuators when conducting the comparable market valuation method.

As discussed in more detail in the literature study, there are recommended steps that can be followed by a valuator when conducting a comparable market valuation method. The steps set out by the Indiana Department of Local Government Finance (2013) that are required in the sales comparison approach are listed in Section 2.3.

3.3 Summary of Chapter 3

The steps set out above were adopted and amended for this research study. The chapters preceding this chapter introduced the problem and motivation of this research study. The following steps were introduced that form the best practice guideline for conducting the comparable market valuation method by benchmarking from gold deposit case study transactions:

- Step 1: Construct a database to be used in the valuation;
- Step 2: Adjust values to real terms;
- Step 3: Distribute unit values per Mineral Resource category;
- Step 4: Perform sanity checks; and
- Step 5: Identify and apply sensible adjustments.

Each of the steps identified provides a best practice guideline that forms the fundamental objective of this research study. The adjustments to be identified in Step 5 can be considered as being subjective. Therefore, this research study proposes a method for identifying and applying the adjustments in a justifiable manner. The following chapter details each of the five steps identified and the results obtained from each of the steps.

4 ANALYSIS AND RESULTS

4.1 Step 1: Construct a database to be used in the valuation

4.1.1 Introduction to database construction

To conduct a comparable market valuation, the first step is to gather information about comparable historical transactions that occurred over a period for the applicable commodity to be valued. The transaction database forms the basis of the comparable market valuation and it is, thus, regarded as one of the most important steps in the process. It is usually also the part that is the most time-consuming. The following section describes the considerations which are important when gathering the comparable transactions to be used to construct the valuation transactions database.

4.1.2 Timeline

The price a buyer is prepared to pay, and the price a seller is prepared to accept, depend largely on the commodity price cycle. To determine and understand the price trend of gold over the past decades, the actual historical gold price (in USD/oz) from January 1971 until April 2018 were sourced from Kitco (2018). These prices are referred to as the gold spot prices and are measured in terms of the actual prices that existed at the time in the past.

To understand the relative value of a gold ounce from one year to the next it is important that the historical prices are adjusted to real terms. Price indices are used to present data in real terms rather than nominal terms (Thompson, 2009). If a historical price needs to be expressed in real terms at a base date (x), the following formula can be used (Thompson, 2009, p. 3):

$$Year\ y\ value * \left(\frac{index\ number\ for\ year\ x}{index\ number\ for\ year\ y}\right) = year\ y\ value \text{ in } year\ x\ prices$$

If for example the price of a gold in 1970 is to be expressed in 2018 price terms, the following formula can be used where *year y value* represents the gold price in 1970 and *year x* represents 2018. One of the indexes often used to calculate this adjustment is the consumer price index (CPI).

The real gold price in Figure 4-1, thus, refers to the same statistic after it has been adjusted for the United States (US) CPI that was sourced from January 1970 until April 2018 (United States Department of Labour, 2018). The US CPI over the past several decades has averaged around 4.03% from 1971-2018. The price adjustment of an item to 2018 terms, thus, increases as the historical date moves further away from the base date (2018). This effect can also be seen in Figure 4-1 with the gap between gold spot price and gold real terms narrowing as the dates come closer to the base date.

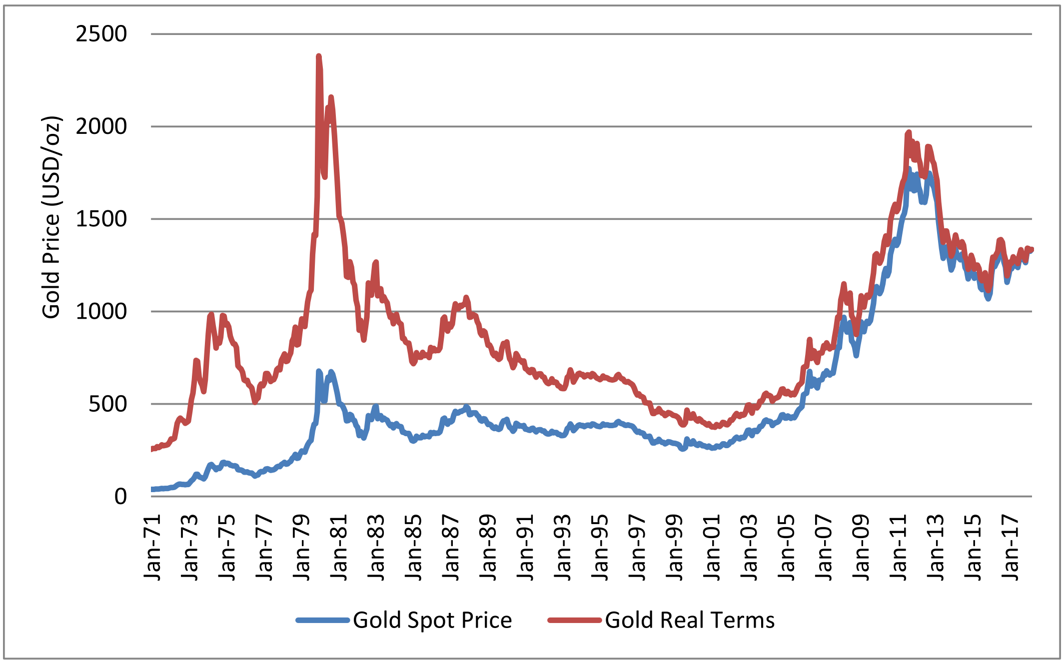

Figure 4-1: Historical gold price trend (Kitco, 2018)

When the historical trend of the gold prices is viewed (Figure 4-1), it is evident that there have been two significant price jumps that occurred. In January 1980, gold reached a spot price of USD850/oz. When the rise in gold price in the 1980s is measured in 2018 monetary terms, it is was close to the USD2 500/oz level which was the highest the historical gold price has been. This gold price jump was however short-lived and reduced significantly in the subsequent year. In 2001, the gold price began with the second historical price jump which increased more firmly than during 1980s.

The global gold market has attracted a lot of attention since 2001. During the 2013 calendar year, the market observed an end to the 12-year bull run in gold prices and 2014 was a year of consolidation for gold with the price drivers continuing to adjust from concerns over the health and stability of the global financial system. From Figure 4-1, the upswing in the gold price occurred around 2006, after several years of decline or near-stagnation.

Based on the information above it is reasonable that transactions that occurred before 2006 should not be included in the transaction database as the transactions were unlikely to have been driven by the comparable commodity price cycle. It is recommended that valuators do a high-level investigation on the commodity price, on which the comparable market valuation model is to be used for, to ensure that historical transactions that took place during market conditions that materially differ from the current investor sentiment are not included.

4.1.3 Country

Any mine or Mineral Resource that must be valued is situated in a specific country. Most countries have a different set of mining laws and mineral regulatory codes that apply to the exploitation of minerals in that specific country. The calculation of a mineral royalty and the tax paid is also country-specific and done according to the country's tax laws as set out by the authorities. The mineral royalty is a compulsory regular payment that mines must make to national states for extracting Mineral Resources. The payments can be fixed as a percentage of the revenue generated from mining the specific mineral. A royalty, thus, has a direct impact on the revenue of a mine and directly influences the viability and attractiveness of a mine. It will, thus, also influence the price an investor would pay to acquire a mineral property.

The political instability of a country refers to the damage that an investment in a country can suffer due to political changes that cause instability in that country. If investors regard a country as having a high risk, then the price the investor would be willing to pay would most likely also be discounted to account for the political risk. A recent example of the significance of the risk that could materially impact investments was the changes that the Democratic Republic of Congo (DRC) made to the mining code in March 2018. According to the law, the DRC raised its royalties and removed previous clauses that protected mining companies from changes for 10 years. One of the significant changes was the increase in royalties on cobalt from 2% to 10% (Ross, 2018).

It is, thus, recommended that as far as possible the valuator should attempt to gather transactions that are situated in the same country as the project being valued. This will attempt to account for country-specific risks and alterations in mining codes, which are likely to have been taken into consideration during the acquisition.

It is, however, allowable that a similar transaction that took place in another country may be used if it can be justified. For example, one of the transactions (number 14) included in the valuation transactions database in this study is a mine situated in Namibia, which is South Africa's neighbouring country. The first justification of the inclusion of the transaction is that the Namibian Dollar is pegged to the South African Rand, thus, the conversion to USD terms of the amount paid at the time of the transaction is the same as if it were in South Africa. When the values get adjusted to real terms using the gold price and not country-specific inflation (as detailed in Section 4.2), the adjustment is similar to a South African transaction.

4.1.4 Amount of transactions

As per the literature study, the similarities in valuation that do exist between real estate and minerals were noted. According to the Indiana Department of Local Government Finance (2013), the suitability of the approach is determined by the amount of available similar sales that a valuator can use. More frequent sales of similar properties will improve confidence in the value calculated. Three to five comparable transactions of real estate are usually adequate, but the confidence is improved as the number of transactions increase (Indiana Department of Local Government Finance, 2013).

The number of proposed transactions that a valuator will use in a mineral valuation similarly also improves with an increase in the number of mineral property transactions used. Mineral properties are, however, more complex to value because it is more difficult to obtain true comparable transactions. It is, therefore, important that the maximum amount of transactions that can be gathered be used to improve the reliability and confidence in the value. By following the real estate approach, a minimum of five to 10 comparable transactions should ideally be used in a comparable valuation. If the valuator finds it difficult to gather information of transactions on the specific commodity in the specific country of the mineral property being valued, then the valuator could consider building a more extensive database of transactions that occurred in neighbouring countries similar to the country of the project being valued.

4.1.5 Important information

Gold mine transactions from January 2006 to April 2018 were gathered from the public domain. The following information is regarded as important to construct the valuation transactions database:

- Mine or development property name;
- Details of the buyer;
- Details of the seller;
- Stake percentage bought;
- Date of the transaction;
- The exchange rate at the date of the transaction;
- Purchase price in ZAR or USD; and
- Mineral Resource statement (per Mineral Resource category).

All the information above is normally available in the public domain. It is important for a competent valuator to have the information readily available to be able to support the calculation of the valuation if necessary.

In some instances, the acquiring company only buys a portion of the target company's shares and does not buy out the full company. This share percentage directly impacts the actual Mineral Resource base bought in the transaction and can skew the unit price calculated if not considered. The date of the transaction is also essential in the construction of the valuation transactions database as it is used for numerous reasons. It is firstly, used to determine if the transaction falls within the set-out timeline as discussed in Section 4.1.2. Secondly, the exchange rate at the date the transaction took place is used to convert the purchase price into ZAR or USD terms (depending on monetary transactional agreements of purchase price), and lastly, it is used to covert the transaction to real terms.

As discussed in Section 1.4 the comparable market valuation method can also be used to value exploration and development properties. The preferred valuation method for Mineral Reserves is the DCF, while the preferred method for valuing Mineral Resources is the comparable market valuation method (important to ensure that the Mineral Resource statements used are inclusive of Mineral Reserves).

4.1.6 Exclusion of transactions

In gathering data of comparable transactions, it often happens that certain information regarding transactions cannot be found in the public domain. The split between Inferred, Indicated and Measured Mineral Resources is not always readily available and can usually be retrieved from the company's annual reports. Careful consideration should be applied by the valuator when limited understanding or information is available for a transaction. If the valuator does not fully comprehend the details of a transaction, it is better to disregard the transaction and remove the transaction from the valuation transactions database as it might skew the valuation.

When the unit value (USD/oz) of a transaction is an outlier, the reason should be explored. If no motive can be determined as to why the purchase price of the transaction was knowingly higher or lower when compared to the market average the valuator should consider excluding the transaction from the database. Adjustments to a transaction cannot be made to compensate for strategic and sentimental transactions which might have occurred in the past. Van Zyl (2017), indicated that the intended goal of a valuation is to determine the 'Value-in-Exchange' and not the 'Value-in-Use'. The value to the owner may include sentiment and not represent the actual value in the marketplace. This is important to consider since the DCF method calculates the Value-in-Use of a developing and producing mineral asset that is not necessarily the value that the asset would be sold for in a transaction. The comparative market valuation method on the other hand uses historical Value-in-Exchange transactions as the basis of the valuation.

The following transactions can be excluded from the valuator's valuation transactions database to ensure that all transactions in the valuation transactions database are unbiased:

- Transactions that were negotiated, but never realised;
- Transactions where no Mineral Resources could be sourced;
- Purchase considerations comprising of an upfront payment and a deferred payment (Deferred payment can, as an example, comprise of a percentage of free cash flow over a certain period and is usually subject to a minimum payment). The free cash flow cannot be forecasted and hence the purchase price cannot be determined accurately;
- Purchase considerations comprising of the issuing of shares, where the share price at the time of valuation cannot be determined;
- Transactions where the commodity of choice is mined and treated as a by-product. (An example is a copper mine also recovering gold as a by-product. The transaction should rather be considered as a copper transaction than a gold transaction); and
- Purchasing of mines under business rescue or mines that have been liquidated (usually done at significantly lower purchase prices).

In constructing the gold valuation transactions database for this research study, several transactions were excluded from the database due to one or more of the reasons above. Two of the transactions that were excluded, included transactions of assets held by Pamodzi Gold, which was placed under liquidation during 2009.

The acquisition of the East Rand Proprietary Mines Limited (ERPM) mine complex, which is a wholly-owned subsidiary of DRDGold, by White Water Resources (Sharenet, 2010) was also excluded. The unit price was by far the lowest in the valuation transactions database and an obvious outlier. One of the reasons for the transaction being an outlier is because mining in the underground mine complex of ERPM that has been discontinued because of rising underground water in the central basin (old mine workings). There was also a share issue as part of the transaction which could bias valuation. The transaction was, therefore, excluded.

The acquisition of the South Deep asset between Barrick Gold Corporation and Gold Fields, (Mail&Gaurdian, 2006), was also excluded. The unit price was by far the highest in the valuation transactions database having an average unit price approximately 210% higher than any other transaction. One of the reasons for the transaction being an outlier is because the transaction by Gold Fields was strategic. The transaction enabled Gold Fields to be the majority shareholder of Western Areas which it planned to delist from the Johannesburg Stock Exchange (JSE). This positioned Gold Fields as a premier gold producer in South Africa. There were also numerous synergies between other mines owned by Gold Fields situated in the area.

4.1.7 Valuation transaction database result

The resultant valuation transactions database of gold transactions over a period of 12 years is presented in Table 4-1. A total of 20 comparable gold transactions were sourced and did not include the excluded transactions discussed in Section 4.1.6. All the transactions that were sourced are available in the public domain and were sourced from several articles in the public domain. Where no information of

Mineral Resources applicable to the transaction was available, the information was sourced from published annual reports of the respective companies.

The purchase price of each transaction was either reported in ZAR or USD terms. The exchange rate at the date of the transaction was used to then convert the purchase price into USD terms and ZAR terms as applicable. The dates included in Table 4-1 indicate the date at which the transactions were announced. All the Mineral Resources stated in Table 4-1 are inclusive of Mineral Reserves and reported as total (not attributable) Mineral Resources of the selling company.

Table 4-1: Gold transactions in database (various sources)

Ref #	Operation name	Buyer	Seller	Date	Exchange rate (ZAR/USD)	Price paid (ZARm)	Price paid (USDm)	Stake %	Inferred Resource (Moz)	Indicated Resource (Moz)	Measured Resource (Moz)
1	Aflease Gold Limited	Micawber	Aflease Gold Limited	Aug-06	7.1	21.2	3.0	26%	1.5	2.8	0.0
2	Agnes Mines	Skeat Mining	Metorex	Dec-08	9.9	16.2	1.6	100%	1.3	0.0	0.0
3	Barbrook	Eastern Gold Fields	Caledonia	Apr-08	7.8	70.0	9.0	100%	2.4	0.0	0.0
4	Eersteling	Pvt Canadian	Caledonia	Mar-08	8.0	29.9	4.0	100%	0.3	0.1	0.0
5	Pamodzi Free State	Harmony Gold	Pamodzi Holding	Sep-09	7.5	405.0	53.9	100%	2.3	5.7	4.0
6	Barberton Mines	Pan African	Metorex	Jun-09	8.0	386.0	48.0	100%	0.6	0.8	1.0
7	Agnes Mines	Wesco	Skeat Mining	Jul-10	7.5	336.0	44.7	100%	8.2	2.6	0.7
8	Tau Lekoa	Simmers and Jack	AngloGold Ashanti	Dec-08	9.9	600.0	60.1	100%	0.6	3.1	0.5
9	Transvaal Gold Mining Estates (TGME)	Stonewall Mining	Simmers and Jack	Sep-10	7.1	25.0	3.5	100%	1.8	0.7	0.0
10	Ezulwini	Gold One International	First Uranium Limited	Mar-12	7.6	539.7	70.9	100%	25.5	2.0	0.7
11	Evander	Pan African and Wits Gold	Harmony Gold	Jan-12	8.0	1 700.0	212.2	100%	10.4	20.7	1.4
12	Cooke 1 - 4	Sibanye	Gold One	Aug-13	10.1	1 610.0	159.7	74%	7.6	6.5	5.7
13	Jeanette and Evander	Wing Hing	Taung Gold	Apr-11	6.7	3 897.6	580.0	87%	11.5	11.7	0.0
14	Navachab	QKR Corporation Ltd	Anglo Gold Ashanti	Feb-14	11.0	1 205.0	110.0	100%	0.3	3.2	0.5
15	Joel, Beatrix, Bloemhoek, DBM, Robijn	Sibanye	WitsGold	Dec-13	10.3	407.0	39.4	100%	140.5	41.6	0.0
16	Moab Kotsong	Harmony Gold	AngloGold Ashanti Limited	Oct-17	13.7	4 105.7	300.0	100%	4.1	10.5	1.7
17	Kopanang	Harmony Gold	Heaven-Sent SA Sunshine Investment Company	Oct-17	13.7	100.0	7.3	100%	0.7	1.5	0.9
18	West Rand Tailings Retreatment Project	DRD Gold	Sibanye Stillwater	Nov-17	14.1	1 300.0	92.3	100%	0.0	0.0	3.8
19	Burnstone	Tranter	Great Basin Gold	Aug-07	7.2	260.0	36.0	26%	0.4	1.1	6.6
20	Blyvooruitzicht	Village Main Reef	DRD Gold	Feb-12	7.6	192.0	25.1	74%	13.2	4.9	4.4

Note: Transaction Ref# 14 is a mine situated in Namibia, which is a neighbouring country to South Africa.

The dates used in Table 4-1 are the dates at which the announcements were made in the public domain. All the sources of the different transactions are listed in Table 4-2.

Table 4-2: Sources of gold transactions in valuation transactions database

Ref #	Sources
1	Sharenet (2006)
2	Bakkes (2010)
3	Caledonia Mining Corporation (2008a)
4	Caledonia Mining Corporation (2008b)
5	Sharenet (2009b)
6	Sharenet (2009a)
7	Creamer (2010)
8	Hill (2009)
9	Business Report (2010a)
10	Sharenet (2012)
11	Fin24 Archives (2012)
12	Gold One International Limited (2013)
13	Wing Hing International (Holdings) Limited (2011)
14	Marketwire (2014)
15	Sibanye Stillwater (2013)
16	Harmony Gold Mining Company Limited (2017b)
17	Odendaal (2017)
18	Seccombe (2017)
19	Business Report (2007)
20	DRD Gold (2012)

Table 4-3 displays the price paid per total gold ounce (including Inferred, Indicated and Measured Mineral Resources) at the time of the transaction. At this stage, no adjustments have been made to consider the split between Mineral Resource categories or to convert the values into real terms.

Table 4-3: Gold values (unadjusted)

Ref #	Price paid (USD million)	Total resource (Moz)	Unadjusted value (USD/oz)
1	3.0	1.1	2.7
2	1.6	1.3	1.3
3	9.0	2.4	3.8
4	4.0	0.4	8.8
5	53.9	12.0	4.5
6	48.0	2.4	20.2
7	44.7	11.4	3.9
8	60.1	4.2	14.3
9	3.5	2.5	1.4
10	70.9	28.2	2.5
11	212.2	32.5	6.5
12	159.7	14.7	10.9
13	580.0	20.2	28.7
14	110.0	3.9	28.1
15	39.4	182.1	0.2
16	300.0	16.3	18.4
17	7.3	3.0	2.4
18	92.3	3.8	24.2
19	36.0	8.1	17.1
20	25.1	22.5	1.5

4.1.8 Summary of valuation transactions database construction

The following can be concluded and recommended:

- The transactions to be considered in the valuation should have a maximum determined timeframe to ensure that market conditions that materially differ from the current investor sentiment are not included.
- Transactions that occurred in the same country as the valuation to be conducted should be used as much as possible.
- Valuation transactions database confidence increases with an increase in the number of transactions. It is recommended that a minimum of five to 10 comparable transactions should be used.
- The information listed in Section 4.1.4 and 4.1.5 is regarded as important to construct the valuation transactions database.

- Biased transactions should be disregarded as they can potentially skew a valuation.

4.2 Step 2: Adjust values to real terms

4.2.1 Introduction to the value adjustment

In constructing a valuation curve using appropriate gold transactions since 2006, the time value of money should be taken into consideration. The same item bought 12 years ago at a certain price will cost much more in today's terms due to factors like inflation. In the real estate comparable market valuation method, the valuators most often apply inflation to adjust property sales to real terms as the sale took place at a different time in the past. One of the differences between mining and real estate is that mining costs have generally risen at rates higher than normal consumer price inflation in South Africa (Van Zyl, 2017). According to Van Zyl (2017), typical mining cost inflation over the past 12 years was approximately 8.0% compared to the Reserve Bank CPI target range of between 4.5% and 6.0%. Any of these inflation values could be reasonably used to adjust transactions to current terms although there would be significant variances between the adjusted prices.

The transactions used to construct the valuation curve in this research study occurred at specific points in time and, therefore, at specific USD-denominated gold prices. Van Zyl (2017), stated that when the purchase price of the transaction paid per ounce at the time of the transaction gets adjusted to current terms by using the ratio between the spot gold price at the time of the transaction and the current gold price, the adjustment is appropriate. The price does not need to be further adjusted for inflation because the gold price adjustment would also adjust and offset an inflationary adjustment.

It can, therefore, be recommended that to report historical transactions in current terms and compare all transactions on the same economic level, the USD gold price must be determined for each historical transaction at the time it took place. The historical transaction values should then be adjusted to current terms, by determining the difference in spot gold price from the time of these historical transactions to the current gold price.

4.2.2 Methodology of Step 2

Due to the volatility of commodity prices including the gold price, the price can increase and decrease significantly from one month to the next. Using the spot price at the effective valuation date to do the adjustment of the purchase prices to real terms might, therefore, differ largely. It is recommended that a price level at the effective date of the valuation should rather be calculated to ensure that an appropriate current price is used.

One of the methods of calculating the price level, as used by a South African mining consultancy firm (Minxcon, 2012), was to determine a current proxy ZAR gold price by using the average monthly commodity price for the three months preceding the actual month of the valuation, together with the average 12-month forecast for the commodity price, to calculate an appropriate price level as at the effective date of the valuation.

Although this method cannot mitigate the volatility associated with the gold price, the method aims to manage the uncertainty linked with the gold price to a certain extent. The rationale for using the method is essentially to try and manage the market expectation at the valuation date that is likely to drive the calculated market value. This method was also adopted in the current research and is recommended in the adjustment of the sales transaction to current terms as part of the best practice guideline.

The effective date of the research study was chosen and fixed at May 2018. The calculation of the current proxy gold price, adopting the method used by Minxcon (2012), is presented in Table 4-4. The actual gold price for the three months preceding May 2018 and the 12-month forecasted gold price were equally weighted to calculate the current proxy gold price used.

Table 4-4: Methodology used to calculate the current proxy gold price

Period	Gold price (USD/oz)
Average price for February 2018	1 331
Average price for March 2018	1 325
Average price for April 2018	1 335
Historical three-month average	**1 330**
Average 12-month forecast	1 300
Calculated proxy gold price	**1 315**

Sources:

1. Historical gold price: Kitco (2018)
2. Gold price forecast: BMI Research (2018)

To test and understand the impact that the price could have by simply using the average monthly spot price, the actual average monthly prices, from the effective date of the valuation (May 2018), were sourced. The actual average monthly prices as well as the average price over the 16-month period are indicated in Figure 4-2.

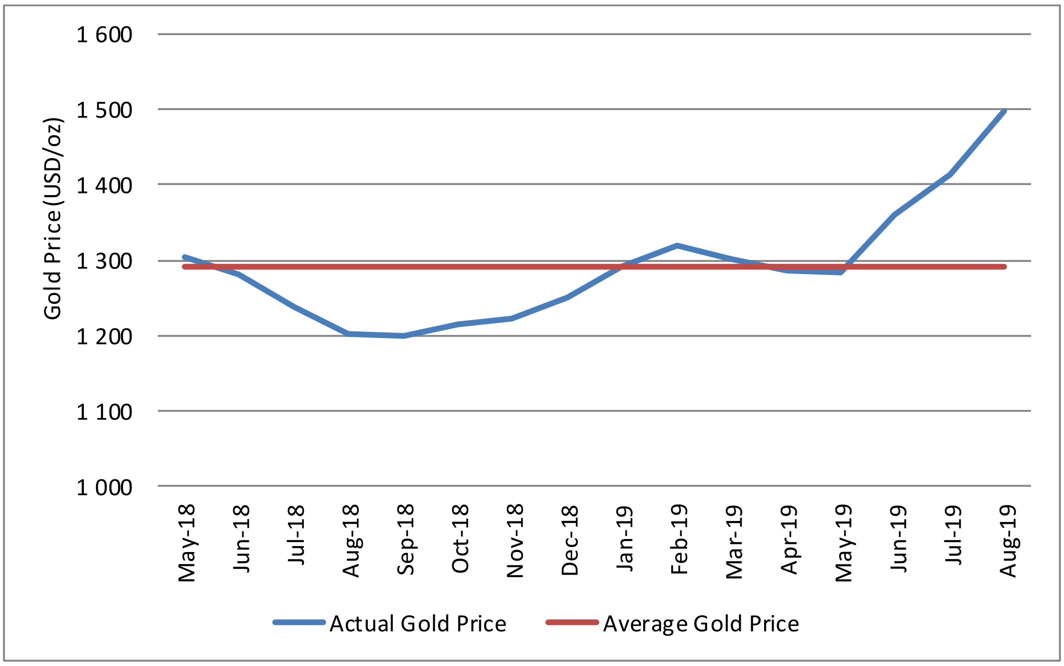

Figure 4-2: Actual and average gold price (Kitco, 2018)

The difference between the lowest and highest average monthly gold price is approximately 300 USD/oz. If the spot price rather than the proxy gold price was used at the lowest or highest point in the graph the appropriate current price of the valuation would be different by about 25%. This would make the adjusted values of the database to be significantly different. By comparing the average gold price over the 16-month period (1 291 USD/oz), from the effective date of the valuation, to the calculated proxy gold price in Table 4-4, it varies by only 1.8%. It can, therefore, be recommended that this type of approach is used to calculate the appropriate current price to mitigate the volatility associated with the gold price.

The adjustment ratio was then calculated by dividing the current proxy gold price calculated at the effective date of the valuation by using the average monthly gold price in which the transaction was announced. At the time of the announcement the purchase price had already been determined although it might have been months before the conclusion of the transaction. The exchange rates at the time of the transactions are already incorporated into the USD price per ounce. By determining a USD per ounce unit value for the current valuation at the valuation date, the unit values are multiplied by the current exchange rate to determine a ZAR value of the project. No additional exchange rate adjustments need to be made to avoid double-accounting.

It is important to note that when a valuator does not adjust the price per ounce by using the ratio of the spot price at the time of transaction and the calculated current gold price, then the price paid per ounce should be adjusted in another way (inflation adjustment). This is to reflect the price in real terms at the time of the transaction.

4.2.3 Adjustment ratios applied

The ratio between the spot gold price at the time of the transaction and the calculated proxy gold price of USD1 315/oz calculated in Table 4-4 per transaction are presented in Table 4-5. The value per ounce when adjusted to reflect changes in the price of gold after the transaction are presented in Table 4-5. The adjustment is made by multiplying the previous price paid per ounce by the adjustment ratio.

Table 4-5: Adjusted gold base values

Ref #	Date	Gold spot price (USD/oz)	Adjustment ratio applied	Unadjusted values (USD/oz)	Adjusted base values (USD/oz)
1	Aug-06	633	2.08	2.7	5.5
2	Dec-08	816	1.61	1.3	2.1
3	Apr-08	910	1.45	3.8	5.4
4	Mar-08	968	1.36	8.8	12.0
5	Sep-09	997	1.32	4.5	5.9
6	Jun-09	946	1.39	20.2	28.1
7	Jul-10	1 193	1.10	3.9	4.3
8	Dec-08	816	1.61	14.2	23.1
9	Sep-10	1 309	1.00	1.4	1.4
10	Mar-12	1 674	0.79	2.5	2.0
11	Jan-12	1 656	0.79	6.5	5.2
12	Aug-13	1 347	0.98	10.9	10.6
13	Apr-11	1 474	0.89	28.7	25.6
14	Feb-14	1 300	1.01	28.1	28.5
15	Dec-13	1 224	1.07	0.2	0.2
16	Oct-17	1 280	1.03	18.4	18.9
17	Oct-17	1 280	1.03	2.4	2.5
18	Nov-17	1 282	1.03	24.2	24.8
19	Aug-07	665	1.98	17.1	33.8
20	Feb-06	1 743	0.75	1.5	1.1

4.2.4 Summary of the value adjustment

It is recommended that to report historical transactions in current terms and compare all transactions on the same economic level, the USD gold price must be determined for each historical transaction at the time it took place. The historical transaction values should then be adjusted to current terms, by determining the difference in spot gold price from the time of these historical transactions to the current gold price. It is recommended that a price level at the effective date of the valuation should rather be calculated to ensure that an appropriate current price is used. The adjusted unit values should then be used in the remainder of the valuation.

4.3 Step 3: Distribute unit values per Mineral Resource category

4.3.1 Introduction to value distribution per Mineral Resource category

The definitions of the Mineral Resource categories are described as follows (SAMREC, 2016):

- Inferred Mineral Resource: "An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity. An Inferred Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration." (SAMREC, 2016, p. 20).
- Indicated Mineral Resources: "An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation." (SAMREC, 2016, p. 21).
- Measured Mineral Resources: "A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit. Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation. A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be

> converted to a Proved Mineral Reserve or to a Probable Mineral Reserve." (SAMREC, 2016, p. 22).

The issue regarding the use of Inferred Mineral Resource in valuation has been an ongoing concern in the mineral asset valuation fraternity. The SAMREC committee created a SAMREC/SAMVAL Inferred Resource Working Group in South Africa during 2011 to debate on the valuation of Inferred Mineral Resources in the minerals industry (SAMCODE, 2011). In an issues paper produced by the working group, it was concluded that Inferred Mineral Resources are an essential part of valuing a mineral asset, especially during company transactions (SAMCODE, 2011). An Inferred Mineral Resource is, thus, considered speculative in nature and the portion of a transaction attributed to an Inferred Resource should, in theory, be far less than for an Indicated and Measured Resource.

SAMREC (2016) outlines the relationship between Exploration Results, Mineral Resources and Mineral Reserves (Figure 4-3), reflecting the increasing level of geoscientific knowledge and confidence as well as the consideration of inputs from the other relevant disciplines. Modifying factors include various relevant factors that are applied to either Indicated or Measured Mineral Resources to convert it to Mineral Reserves.

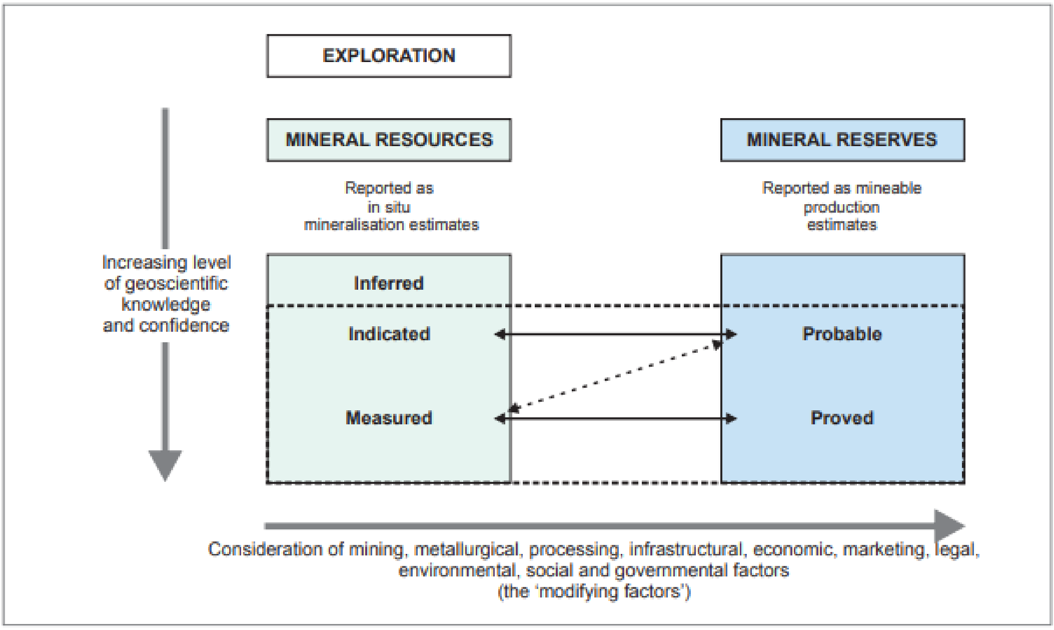

Figure 4-3: Relationship between Exploration Results, Mineral Resources and Mineral Reserves (SAMREC, 2016, p. 13)

The statement above is further emphasised by the mining project lifecycle and the associated valuation methodology curve (Figure 4-4). The curve indicates the project initiation stages from exploration through to mine production and the associated studies and Mineral Resource confidence that is normally accompanied by the stage. The curve indicates that Inferred Mineral Resources are not included as part of pre-feasibility and feasibility studies and can also not be converted into a Mineral Reserve. The project value is usually also expected to increase with increasing geological confidence (Mineral Resource category) and as the study phase of a project increases. The unlocked value of the Mineral Resource, thus, increases as the Mineral Resource category increases. Both Indicated, and Measured Mineral Resources are included in pre-feasibility and feasibility studies and can also be converted into a Mineral Reserve. The expected confidence of an Indicated and Measured Resource is, thus, more aligned than compared to an Inferred Mineral Resource.

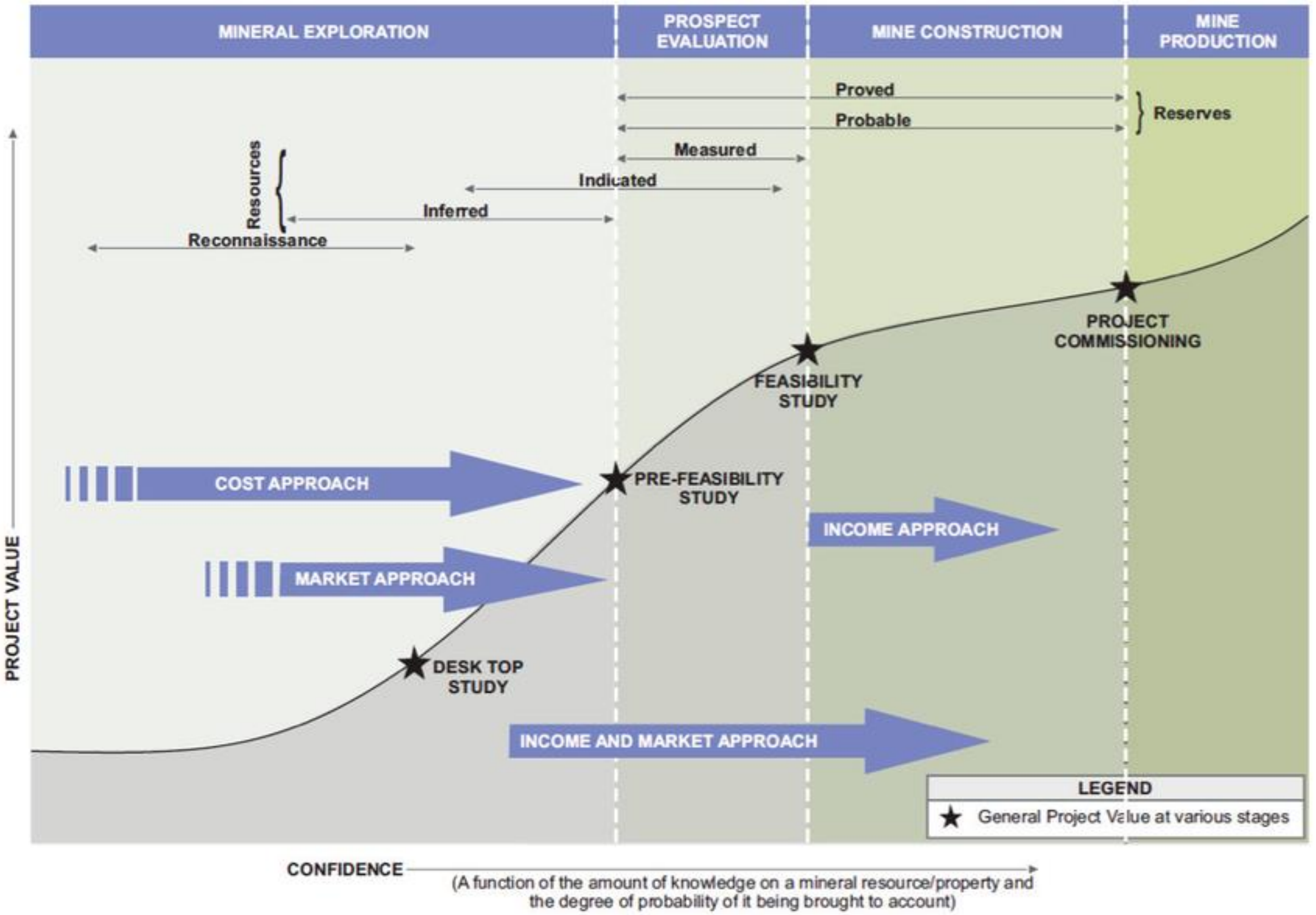

Figure 4-4: Project lifetime valuation methodology curve (Telfer *et al*., 2013, p. 63)

The concept that an Inferred Mineral Resource should have a lower value than an Indicated and Measured Mineral Resource, in theory, should also form part of the transaction price that a buyer is willing to pay for a development property. If 100% of a Mineral Resource is in the Inferred category, a buyer will most likely pay a discounted price per ounce compared to a Mineral Resource that is 100% in the Measured Mineral Resource category. The problem with this statement is to try and split the total transaction price between the Mineral Resource categories to determine a unit price per Mineral Resource category. A proposed methodology was developed and is discussed in the following section on a possible way of determining the relationship between the Mineral Resource categories.

4.3.2 Methodology of Step 3

As previously mentioned it is important to source the Mineral Resource statement (per Mineral Resource category) when constructing a valuation transactions database. The attributable ounces that must be used are generally reported per Mineral Resource category. Based on the valuation transactions database constructed (Table 4-1) the portion of the Mineral Resource category attributable to the total Mineral Resource was determined per transaction and is presented in Table 4-6.

Table 4-6: Mineral Resource distribution per transaction

Ref #	Adjusted base values (USD/oz)	Portion Inferred Resources (%)	Portion Indicated Resources (%)	Portion Measured Resources (%)
1	5.5	34%	66%	0%
2	2.1	100%	0%	0%
3	5.4	100%	0%	0%
4	12.0	73%	26%	1%
5	5.9	19%	48%	33%
6	28.1	24%	34%	42%
7	4.3	71%	22%	7%
8	23.1	14%	73%	13%
9	1.4	72%	28%	0%
10	2.0	91%	7%	2%
11	5.2	32%	64%	4%
12	10.6	38%	33%	29%
13	25.6	50%	50%	0%
14	28.5	7%	81%	12%
15	0.2	77%	23%	0%
16	18.9	25%	65%	10%
17	2.5	22%	49%	29%
18	24.8	0%	0%	100%
19	33.8	5%	14%	81%
20	1.1	59%	21%	20%

From the valuation transactions database, it is apparent that certain historical transactions occurred where a significant portion of the Mineral Resources were in the Inferred category (e.g. transaction numbers 2, 3 and 10). In theory, the adjusted base value (USD/oz) paid for the Mineral Resource should be an indication of what a willing buyer is prepared to pay for an Inferred Mineral Resource. The same argument can be had for a transaction where a significant portion of the Mineral Resource was in the Measured or Indicated Resource category.

The objective was to determine what the correlation of the average price per resource and the percentage of the specific resource is, between an Inferred, Indicated and Measured Mineral Resource. By determining the relationship, it would allow the valuator to split a transaction price proportionately between the Mineral Resource categories.

The Mineral Resource distributions per transaction presented in Table 4-6, were used to construct a scatter plot. The scatter plot is fundamentally a graph that shows the relationship between two variables. In this case, the average adjusted unit values (USD/oz) and the percentage distributions of the specific Mineral Resource category (Inferred, Indicated or Measured) to the total Mineral Resource were plotted along the two axes. The pattern of the resulting points revealed the correlation between the two variables. The general pattern of the correlation between the two variables was then determined by using trend lines.

A trend line is a straight or curved line that gets created from various data. Various trend lines exist that can be used, usually determined by the type of data applicable. There are six trend line types which can be created, and it is important to use the correct trend line to interpret the data accurately (Microsoft Office, 2007). When data values increase and decrease at increasingly higher rates, then the exponential trend line is the most suitable trend (Microsoft Office, 2007). For the Inferred, Indicated and Measured Mineral Resource graphs the data followed this pattern and the exponential trend line was used to determine the general pattern.

A trend line is based on a mathematical equation as presented on each of the graphs (Figure 4-5 and Figure 4-6). The corresponding unit value can be read off from the graph as well although using the mathematical equation would be more accurate. The exponential equation formula that is used in Windows Microsoft Excel software are described in the following paragraph (Byard, 2017). The formula aims to determine the adjusted transaction base value on the y-axis at various distributions of Inferred, Indicated and Measured Mineral Resources.

Exponential equation

*y = c * exp(b * x)*

Where the Windows Microsoft Excel software formula are given by (Byard, 2017):

c = EXP(INDEX(LINEST(LN(y),x),1,2))

b = INDEX(LINEST(LN(y),x,1)

According to Goodwin and Leech (2006), the correlation coefficient is a statistical formula that can be used to determine the strength and direction of a linear relationship between two variables on a scatterplot. The linear relationship between the two variables can have a value ranging from -1.0, being a perfect negative relationship, to +1.0 being a perfect positive relationship. If no relationship exists between the two variables, the value would be zero. The formula for the correlation (R_{xy}) is described below.

Correlation coefficient equation

$R_{xy} = \frac{\sum z_x z_y}{n}$,

where z_x and z_y are the z scores for each pair of X and Y variables, respectively and n is the total number of pairs (Goodwin and Leech, 2006).

When the value of the relationship is between 0 and +1/-1 there is a relationship, although it is not perfectly negative or positive. It is important to understand the relationship and interpret it in the correct way. The positive or negative sign represents the direction of the relationship. "Positive coefficients indicate that when the value of one variable increases, the value of the other variable also tends to increase. Positive relationships produce an upward slope on a scatterplot. Negative coefficients represent cases when the value of one variable increases, the value of the other variable tends to decrease." (Frost, 2018: How to Interpret Pearson's Correlation Coefficients, para 3).

Whether a correlation can be regarded as a strong, medium and weak correlation will always depend on the study area and can be different for each study (Frost, 2018). According to Frost (2018: How Strong of a Correlation is Considered Good? para 2), "The correlation coefficient should accurately reflect the strength of the relationship.". This means that even if the correlation is not that strong, the value will accurately represent the data. The results of the correlation coefficient determined in Section 4.3.3 were thus not classified as being strong, medium or weak. The values calculated accurately reflects the strength of the relationships for the data used in this report.

4.3.3 Results

The correlation of value and proportion of the Inferred Mineral Resource is presented in Figure 4-5. By using the correlation coefficient equation described above, the correlation coefficient of the data was estimated to be -0.64 indicating a negative correlation.

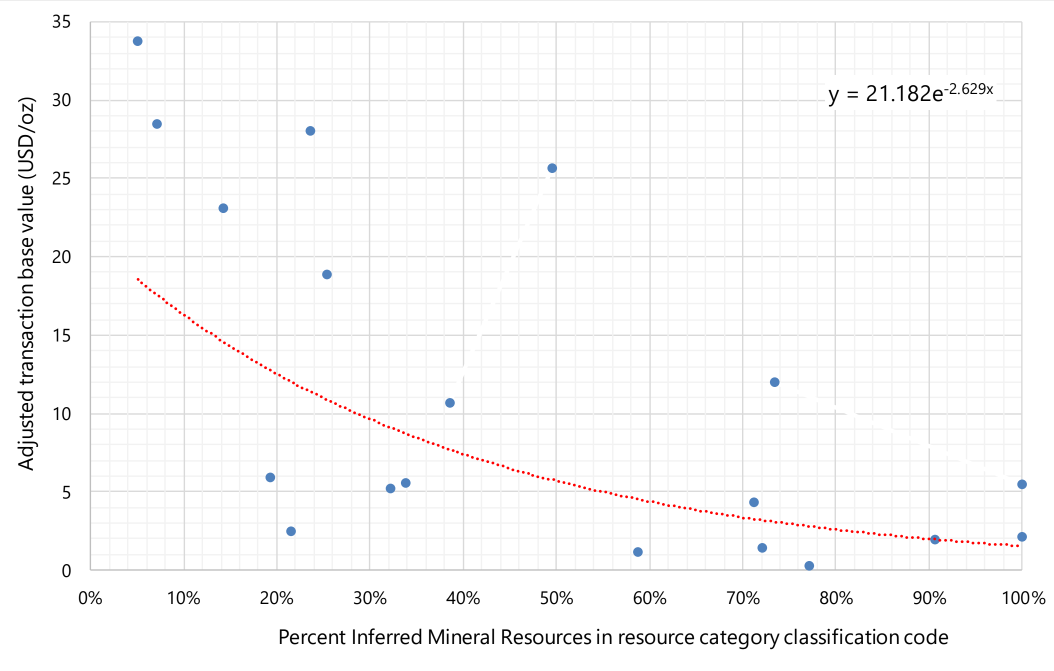

Figure 4-5: Inferred Mineral Resource scatter plot

As per expectation, the negative correlation of Inferred Mineral Resources indicates that the higher the percentage of Inferred Mineral Resources in a resource estimate the lower the expected transaction value per ounce would be. The correlation of value and proportion of the Indicated Mineral Resource is presented in Figure 4-6. The correlation coefficient of the data was estimated to be 0.30 indicating a marginal positive correlation.

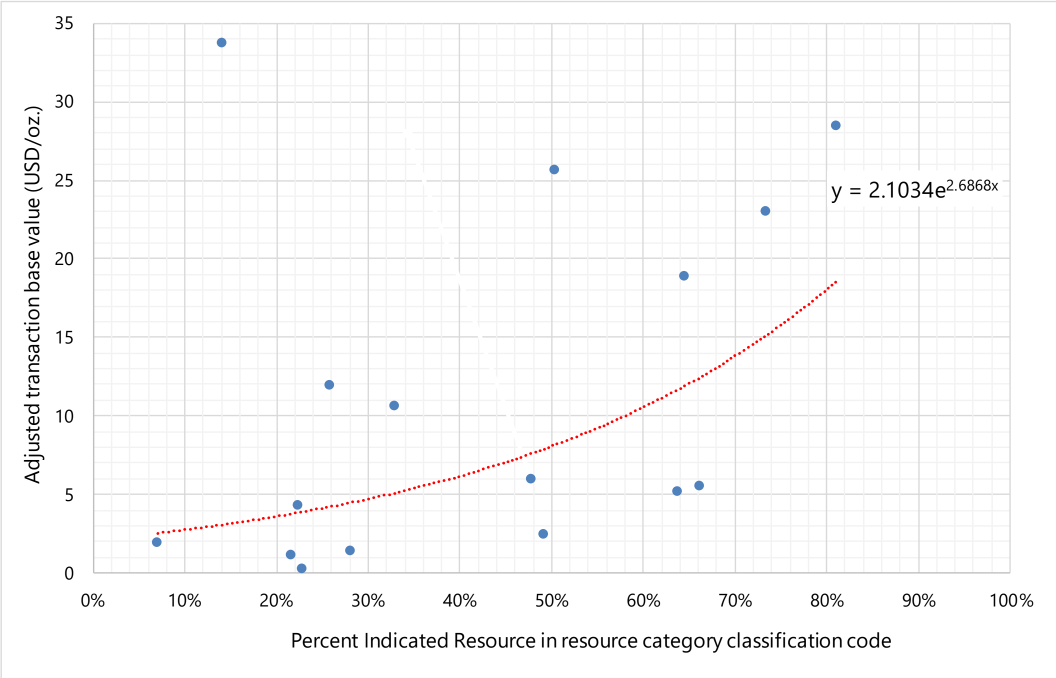

Figure 4-6: Indicated Mineral Resource scatter plot

The positive correlation of the Indicated Mineral Resources indicates that the higher the percentage of Indicated Mineral Resources in a resource estimate the higher the expected transaction value per ounce would be. As discussed previously the data of the Indicated Mineral Resource graph fluctuates. An Indicated Mineral Resource has higher geological confidence than an Inferred Mineral Resource but has lower geological confidence than a Measured Mineral Resource. Hence, the buyer in a transaction has different views on what a justifiable price should be for an Indicated Mineral Resource, although from the graphs presented above the value of an Indicated Mineral Resource is expected to increase as the percentage of the Indicated Mineral Resource increases. The correlation of value and proportion of the Measured Mineral Resource is presented graphically in Figure 4-7. The correlation coefficient of the data was estimated to be 0.45 indicating a marginal positive correlation.

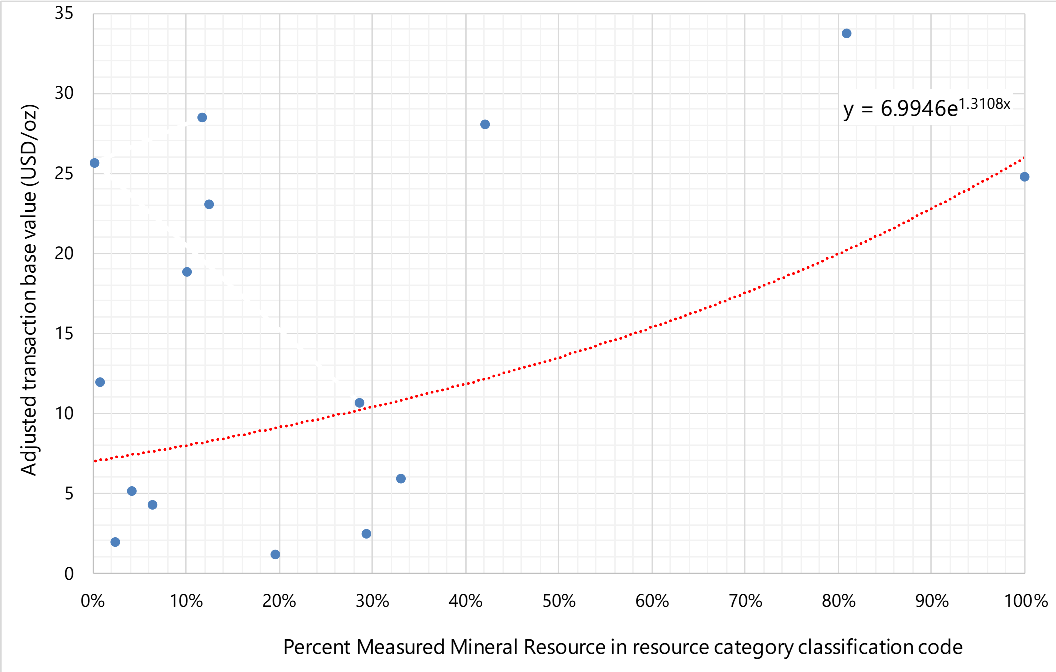

Figure 4-7: Measured Mineral Resource scatter plot

The marginal positive correlation of the Measured Mineral Resources indicates that the higher the percentage of Measured Mineral Resources in a resource estimate, the higher the expected transaction value per ounce would be. This result is as per expectation because of the higher geological confidence associated with a Measured Mineral Resource.

The equations per Mineral Resource category are indicated below:

- Inferred Mineral Resource equation:
  - *y = 21.182 * exp(-2.629 * x)*
- Indicated Mineral Resource equation:
  - *y = 2.1034 * exp(2.6868 * x)*
- *Measured Mineral Resource equation:*
  - *y = 6.9946 * exp(1.3108 * x)*

Based on the equations given above, the average unit values that a Mineral Resource was bought for in real terms depending on the percentage of the Mineral Resource category present, was calculated by replacing the percentage of the Mineral Resource with the '*x*' values in the equations above.

The results of the Inferred Mineral Resource graph where the majority of the Mineral Resource is in the Inferred category were compared to where the majority of the Mineral Resources are in the Measured Resource category to determine the difference in unit price that buyers are expected to pay for a Mineral Resource per category. The preferred indication of what the expected value of an Inferred Mineral Resource should be compared to the Measured Mineral Resource would be at the point where most of the stated resources included in a transaction are either in the Inferred or Measured Mineral Resource category. Therefore, the two points that were selected were at the higher end of the graphs, were 75% and 100%. At these two points, the preferred indication of both the Inferred and Measured unit prices can be compared against one another to determine the proportion of Inferred to Measured unit price.

Table 4-7: Inferred versus Measured Resource unit prices

Percentage of Mineral Resource	Average Inferred unit price (USD/oz)	Average Measured unit price (USD/oz)	Proportion of Inferred to Measured unit price
75%	2.95	18.70	16%
100%	1.53	25.95	6%
Average	**2.24**	**22.32**	**11%**

Based on the results in Table 4-7 it was determined that on average an Inferred Mineral Resource will trade at approximately 11% of the price that a Measured Mineral Resource would trade at. For this research report a smoothed average of 10% was deemed adequate to use in the remainder of this research study.

The results of the Indicated Mineral Resource graph were then compared to the Measured Mineral Resource category to determine the difference in unit price that buyers are expected to pay for a Mineral Resource per category. Both Indicated and Measured Mineral Resources can be converted to Mineral Reserves which can be used in pre-feasibility studies. For this reason, the market sentiment of the two categories are more closely correlated than an Inferred Mineral Resource.

The anticipated indication of what the expected value of an Indicated Mineral Resource should be compared to the value of a Measured Mineral Resource can be calculated over a bigger spread of data than comparing Inferred Mineral Resources to Measured Mineral Resources. Therefore, three points indicating the lower, middle and higher ends were selected. Three points were selected at 25%, 50% and 75% to provide an even spread across these two classifications to determine the proportion of Indicated to Measured unit price. The results are presented in Table 4-8.

Table 4-8: Indicated versus Measured Resource unit prices

Percentage of Mineral Resource	Average Indicated unit price (USD/oz)	Average Measured unit price (USD/oz)	Proportion of Indicated to Measured unit price
25%	4.12	9.71	42%
50%	8.06	13.47	60%
75%	15.78	18.70	84%
Average	**9.32**	**13.96**	**67%**

Based on the results in Table 4-8 it was determined that on average an Indicated Mineral Resource will trade at approximately 67% of the price that a Measured Mineral Resource would trade at. For this research study a smoothed average of 70% was deemed adequate to use for analysis purposes.

Based on the results above the unadjusted Mineral Resource values per ounce described in Table 4-3 were then proportionately split between the different Mineral Resource categories based on the 10% attributed value for an Inferred Mineral Resource and 70% attributed value for an Indicated Mineral Resource. By multiplying the Mineral Resource ounces with the attributed values per Mineral Resource the total transaction value should approximately be equal to the original transaction value. Hence the combined unadjusted value remains the same but gets split per Mineral Resource category. The unadjusted unit values per Mineral Resource category per transaction are given in Table 4-9.

Table 4-9: Unadjusted value per Mineral Resource category

Ref #	Unadjusted value (USD/oz)	Inferred value (USD/oz)	Indicated value (USD/oz)	Measured value (USD/oz)
1	**2.7**	0.4	4.0	0.0
2	**1.3**	1.3	0.0	0.0
3	**3.8**	3.8	0.0	0.0
4	**8.8**	2.5	17.7	25.2
5	**4.5**	0.6	4.0	5.7
6	**20.2**	2.6	18.5	26.4
7	**3.9**	1.0	7.3	10.5
8	**14.2**	1.8	12.4	17.8
9	**1.4**	0.0	5.0	0.0
10	**2.5**	1.1	7.9	11.3
11	**6.5**	1.0	6.9	9.8
12	**10.9**	1.7	11.9	17.0
13	**28.7**	5.4	38.0	54.3
14	**28.1**	3.3	23.0	32.8
15	**0.2**	0.0	0.9	0.0
16	**18.4**	2.5	17.8	25.5
17	**2.4**	0.3	2.2	3.1
18	**24.2**	0.0	0.0	24.2
19	**17.1**	1.8	12.7	18.1
20	**1.5**	0.3	2.2	3.2
Average		**1.9**	**11.3**	**19.0**

The same methodology discussed in Section 4.2.2 was then applied to the unit values per Mineral Resource category. The time-adjusted values per Mineral Resource category are presented in Table 4-10.

Table 4-10: Adjusted value per Mineral Resource category

Ref #	Adjustment ratio applied	Inferred value (USD/oz)	Indicated value (USD/oz)	Measured value (USD/oz)
1	2.08	0.8	8.4	0.0
2	1.61	2.1	0.0	0.0
3	1.45	5.4	0.0	0.0
4	1.36	3.4	24.0	34.3
5	1.32	0.8	5.3	7.5
6	1.39	3.7	25.7	36.7
7	1.10	1.2	8.1	11.6
8	1.61	2.9	20.0	28.6
9	1.00	0.0	5.1	0.0
10	0.79	0.9	6.2	8.9
11	0.79	0.8	5.5	7.8
12	0.98	1.7	11.6	16.6
13	0.89	4.8	33.9	48.5
14	1.01	3.3	23.2	33.2
15	1.07	0.0	1.0	0.0
16	1.03	2.6	18.3	26.2
17	1.03	0.3	2.3	3.2
18	1.03	0.0	0.0	24.8
19	1.98	3.6	25.1	35.8
20	0.75	0.2	1.7	2.4
Average		**2.3**	**13.3**	**21.7**

The mean values per Mineral Resource category were calculated by determining the average unit values of each category. The mean unit value per Mineral Resource category calculated based on the methodology presented in this section are given in Table 4-11.

Table 4-11: Average adjusted Mineral Resource value per category

Resource category	Mean value (USD/oz)
Inferred	2.3
Indicated	13.3
Measured	21.7
Measured, Indicated and Inferred	**12.0**
Measured and Indicated	**17.2**

The distributions of all the unit values per Mineral Resource are presented graphically as a scatter graph in Figure 4-8. The average unit values per Mineral Resource category are also indicated on the graph as bars.

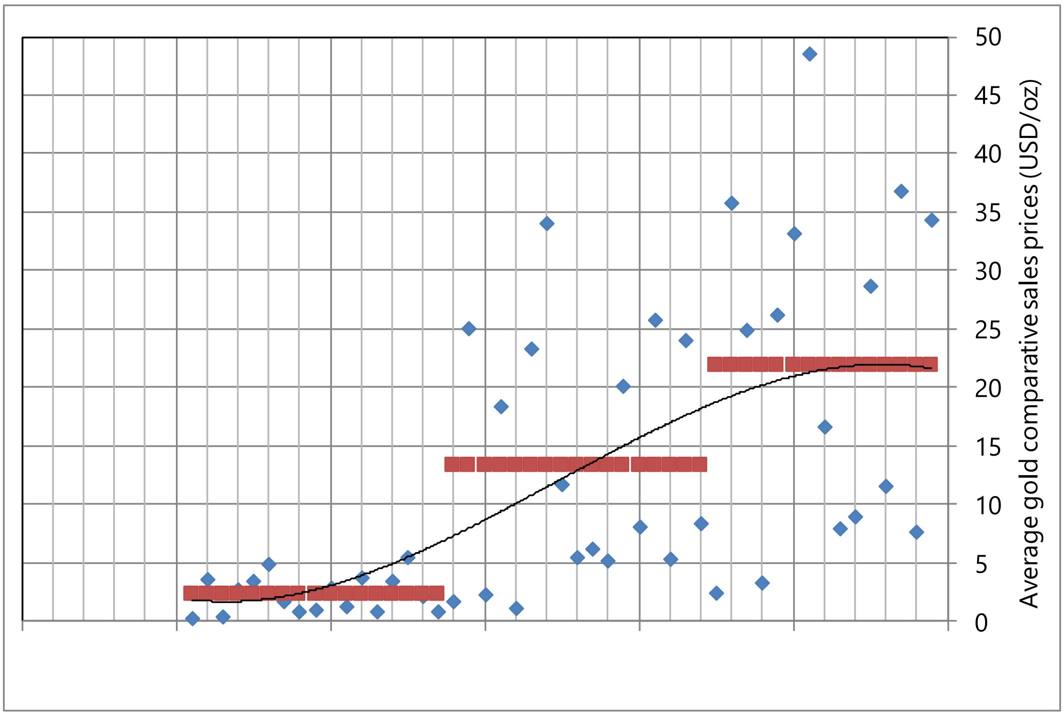

Figure 4-8: Transaction value distribution

4.3.4 Summary of value distribution

It is evident that the distribution of unit values per Mineral Resource category is an important step in conducting a comparable market valuation. The following guideline can be followed by a valuator to determine the attributable portion that the average willing buyer might consider as acceptable when purchasing a mineral property at a certain geological confidence level.

Scatter plots and trend lines can be used as a tool to determine the relationship between the average adjusted unit values (USD/oz) and the percentage distributions of the specific Mineral Resource category (Inferred, Indicated or Measured) to the total Mineral Resource. The differences between the results obtained per Mineral Resource category can then be compared to determine the relationship between the categories. By applying this average relationship to the transaction and adjusting it to real terms, the unit values per Mineral Resource category can be determined in a justifiable way.

4.4 Step 4: Perform sanity checks

4.4.1 Introduction to sanity checks

A valuator's main intention during a comparable market valuation should be to attempt to determine a justifiable value possible for the Mineral Resource being valued. A sanity check is an indication to the valuator whether the unit values determined are within a reasonable range when compared to overall market values.

Other factors also exist on which a valuator can determine market values. To do a sanity check on the calculated values, it is advisable to compare the results obtained from any other method to the average values determined in Section 4.3.3. Although this step in the guideline is not compulsory it is only advisable for a valuator to improve the overall confidence in the unit values to be used. If there is a major difference in the numbers when doing a sanity check, it can alert the valuator early on that the unit values are either too low or too high. The transactions can then be re-analysed to ensure any outliers that might skew the valuation are investigated. In this way, only arms-length transactions are used.

One of the methods used regularly by mining analysts is to determine the enterprise value (EV) for listed companies and express the values as a function of the declared Mineral Resource ounces of that company. The main reason why mining analysts calculate this value is to determine what a listed mining company's price is relative to other listed mining companies of the same commodity.

4.4.2 EV per ounce

One of the methods of determining the value of a company is by calculating the company's market capitalisation (Hoang, 2011). The basic calculation of the market capitalisation is to multiply the number of issued shares by the current share price at the time of the valuation. This value only considers the value to purchase the outstanding equity and excludes important factors that should be considered as outstanding debt that will become the responsibility of the new buyer.

A more accurate way of determining the value of a company is by calculating the EV which takes into consideration the liability component of the company. A company with a high market capitalisation might have significant debt obligations which could pose a problem; therefore, the EV is a more reliable way of determining the theoretical value a buyer should pay during a transaction. The EV can be calculated based on the following formula (Hoang, 2011):

EV = market capitalisation + market value of debt + market value of preferred equity + minority interest – cash and investments

Although the average EV per ounce is often also used as a technique to determine the unit value as part of a comparable market valuation there are some shortcomings. One of the weaknesses of the method is that not all listed companies are similar, because mining companies often diversify from producing only one commodity to producing multiple commodities. Another limitation is that companies have operations in various countries. The by-product of companies can also contribute to a large portion of the company's revenue as well as form a large portion of the actual attributable Mineral Resources.

Some of the South African gold mining companies that are examples of these limitations include:

- South Africa's Sibanye Gold which recently became a diversified miner investing in major platinum operations;
- AngloGold Ashanti which is predominantly based outside of South Africa;
- Harmony Gold which has mines situated in Papua New Guinea; and
- AngloGold Ashanti, Gold Fields and Sibanye-Stillwater which include in their asset portfolios, copper operations with gold being produced as a by-product.

Similar listed mining companies situated in different countries have dissimilar values attributed on a market capitalisation per ounce basis (Van Zyl, 2017). By comparing the market capitalisation per ounce of listed gold South African mining companies to that of Australian and American gold mining companies, the South African values per ounce are discounted due to the market perception of risk.

It is important to understand the limitations of calculating the EV per ounce of listed companies. Although the method is not deemed as effective as using comparable transactions it is still advisable to do the sanity check. It is recommended that the listed companies used in the method should be situated in the same country as the transactions used in the valuation transactions database to exclude market perception of risk associated with mining operations situated in different countries. The same concept applies that as the amount of listed companies used increase, the overall accuracy of the values should also increase. It is, thus, recommended that the valuator should as far as possible try to use the maximum number of comparable listed mining companies.

To construct a market capitalisation database six gold mining companies listed on the South African Johannesburg Stock Exchange (JSE) were identified. The first step was to determine the share code of each company as listed on the JSE and to then determine the market capitalisation by multiplying the number of issued shares by the current share price at the time of the valuation fixed at May 2018 as explained in Section 4.2.2. Table 4-12 indicates the identified listed gold mines as well as the market capitalisation calculated per company.

Table 4-12: Market capitalisation per listed gold mine

Gold producer	Share code	Share price	Issued shares	Market capitalisation[1]
	JSE	ZAR	Amount	(USDm)
AngloGold Ashanti	ANG	108.4	410 935 022	3 555
DRD Gold	DRD	3.1	431 429 767	108
Sibanye Stillwater	SGL	8.9	2 265 793 015	1 605
Gold Fields	GFI	46.2	821 532 707	3 028
Harmony Gold	HAR	23.9	445 189 731	848
Pan African Resources	PAN	1.3	2 234 687 537	237

Source: Moneyweb Limited (2018)

Note: 1. Exchange Rate: 12.5 ZAR/USD (Standard Bank, 2018)

After calculation of the market capitalisation, the EV per ounce of the companies can be determined. The information required to do the calculation was sourced from the various company annual reports. By using the EV calculation formula described in Section 4.4.2, the market value of debt, market value of preferred equity, minority interest and cash and investments were sourced from the financial statements produced in the annual reports. A part of the annual report also includes a Mineral Resource statement which was used to source the attributable Mineral Resources per listed company, in million ounces (Moz) as presented in Table 4-13. To be able to complete the sanity check, the EV per total ounce (Inferred, Indicated and Measured) as well as EV per Indicated and Measured Resource were determined. The calculated EV per ounce is presented in Table 4-13.

Table 4-13: EV per ounce

Share code	Market capitalisa-tion[1]	Net debt[2]	EV[3]	Attributable Mineral Resource (Moz)		EV/ounce (USD/oz)	
	(USDm)	(USDm)	(USDm)	M & I[4]	M, I & I[5]	M & I	M, I & I
ANG	3 555	2 025	5 580	164	238	34.0	23.4
DRD	108	-24	84	31	51	2.7	1.7
SGL	1 605	1 882	3 487	210	281	16.6	12.4
GFI	3 028	1 303	4 331	164	219	26.3	19.7
HAR	848	69	917	77	104	11.9	8.8
PAN	237	6	243	22	34	10.9	7.1
Average	**9 381**	**5 261**	**14 642**	**670**	**928**	**21.9**	**15.8**

Sources: Various integrated annual reports: AngloGold Ashanti (2017), DRD Gold (2017), Sibanye Stillwater (2017), Gold Fields (2017), Harmony Gold Mining Company Limited (2017a) and Pan African Resources PLC (2017).

Notes:

1. Exchange Rate: ZAR12.5/USD (Standard Bank, 2018)
2. Net debt = market value of debt + market value of preferred equity + minority interest – cash and investments
3. EV = market capitalisation + net debt
4. M & I: Measured and Indicated Mineral Resources
5. M, I & I: Measured, Indicated and Inferred Mineral Resources

Based on the results presented in Table 4-13, the weighted average EV per ounce were calculated to be USD15.8 per total Mineral Resource ounce and USD21.9 per total Mineral Resource ounce excluding Inferred Mineral Resources.

4.4.3 Results comparison

The mean unit value per Mineral Resource category calculated from the historical transaction database (Table 4-11), were compared to the EV/oz calculated for all the listed companies (Table 4-13).

Table 4-14: Comparison of adjusted mean value per Mineral Resource category versus average EV per ounce

Comparison	Unit	EV/oz	Comparable transaction average value	Variance
M, I & I	USD/oz	15.8	12.0	23.7%
M & I	USD/oz	21.9	17.2	21.2%

The results indicate that the unit values calculated from the historical transaction database are on average approximately 20% less than the EV/oz values calculated for the listed companies. Keeping in mind that mining companies will most likely trade at a market discount during a take-over or acquisition, the comparison improves the overall confidence in the unit values calculated.

4.4.4 Summary of sanity checks

The EV per ounce of a listed company indicates the total value of the company per Mineral Resource base. The average EV per ounce of the gold mines were within 30% of the average unit values calculated in Section 4.3. This is an indication to the valuator that the unit values determined are within a reasonable range when compared to overall market values, thus, improving the overall confidence in the unit values calculated from the historical transactions. The values are deemed justifiable as a trading company will most likely trade at a market discount during a take-over or acquisition. The listed companies all have operating mines with stated Mineral Reserves, processing plants and infrastructure in place. By applying a market discount of approximately 20% the values would match quite close to each other.

4.5 Step 5: Identify and apply sensible adjustments

4.5.1 Introduction to adjustment identification and application

According to Ellis (2016), a mineral valuator will seldom find a transaction that is exactly comparable to the mineral property being valued. Mineral properties are more complex to value since it is more difficult to obtain a true comparable.

Therefore, it is important to identify and apply sensible adjustments to the property being valued to improve the comparability to that of the industry standard.

As discussed in Section 2.3, the adjustment process can be broken down into five steps (Indiana Department of Local Government Finance, 2013). These steps can be adapted to form the framework on how to identify and apply sensible adjustments.

4.5.2 Methodology of Step 5

To identify and apply sensible adjustments, the steps identified by the Indiana Department of Local Government Finance (2013) were adopted and developed for this research study. The following steps are proposed as a guideline to be followed when identifying and applying adjustments:

- Step 5.1: Identify sensible adjustment factors that affect the value of the mineral property;
- Step 5.2: Rank the adjustments in order of sensitivity;
- Step 5.3: Determine the industry standards of the identified factors that can be compared to the mineral asset being valued;
- Step 5.4: Develop a strategic way to apply the adjustments to the mineral asset being valued; and
- Step 5.5: Apply the adjustments to the average unit values.

Based on the methodology set out above the following results were obtained for each of the subsequent steps and detailed in the results section below.

4.5.3 Step 5.1: Identify sensible adjustment factors that affect the value of the mineral property

The valuator should list adjustment factors which he/she typically considers (Ellis, 2011). The ranking of these adjustments should be applied by each valuator's individual preference. Some of the typical adjustment factors were listed in Section 2.4. Based on these typical adjustment factors, the valuator should determine what factors should be selected for the specific commodity being valued. The process of identifying adjustment factors is subjective in nature and it is the competent valuator’s responsibility to do the necessary research in determining the factors driving the economics of that specific commodity.

The nature of underground gold mining in South Africa is such that infrastructure constraints play a major role in a project (Van Zyl, 2017). Existing shaft infrastructure might be such that certain portions of a Mineral Resource cannot be extracted. This is often due to the location and design of the shaft system, which makes it uneconomical to access deeper or other portions of the orebody. Certain portions of the Mineral Resource could possibly be sterilised by pillars that were included in historical designs. This constraint of the position of the shaft also leads to increased cost and lower productivities because of the increased distance from the shaft to the working places. Van Zyl (2017) further emphasised that the depth of an orebody further increases the costs as it is often required that underground gold mines make use of refrigeration to cool down working places.

According to Van Zyl (2017), other key adjustments are the operating cost associated with a mine as it is one of the biggest drivers of value in an operation. The mining method and processing method largely drive the operating cost of a mine. Based on this information the infrastructure, depth and mining method were identified as appropriate adjustment factors.

The location of a new mining project is particularly important for mining companies (Gilroy, 2014a, 2014b). Mining projects situated close to existing mines can have access to already existing infrastructure like roads, water, and electricity that have a substantial capital cost associated with it.

Fellows (2010) identified certain major drivers for gold mine economics (Figure 4-9). The operating costs were already identified as an appropriate adjustment factor while the macro-economic factors like exchange rate and gold price are already accounted for in the price adjustments. It is, thus, recommended that focus should be placed on the Mineral Resource quality and other factors described in Figure 4-9.

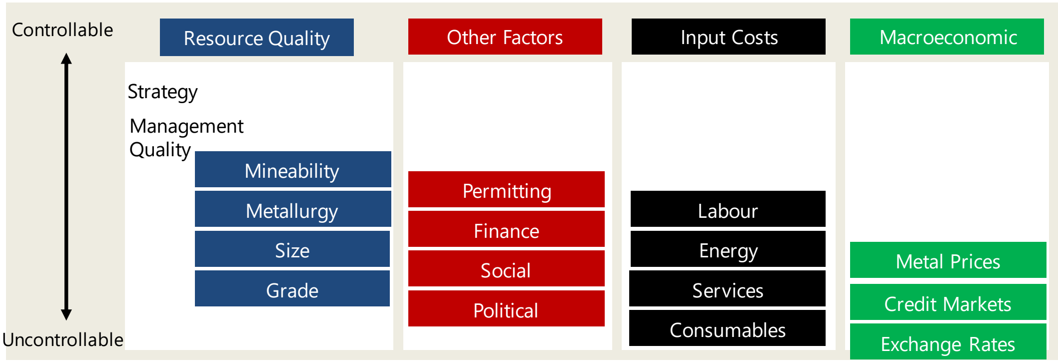

Figure 4-9: Drivers of gold mine economics (Fellows, 2010, p. 3)

Based on Figure 4-9, factors such as mineablility, metallurgy, size, grade, permitting, social and political factors are drivers of gold mine economics. Each of these factors was individually investigated.

The mineability of an orebody is already considered by investigating factors identified previously such as depth and infrastructure. One of the other factors influencing the mineability of an orebody is the geological complexity associated with the mineral property. If an orebody has high geological complexity with major faults and dykes, then parts of the orebody might be considered un-mineable. The mineability of a Mineral Resource also gets proven by the stage of development of an operation. The confidence of a project increases as the stage of development increases; therefore, it was also identified as an important factor to consider. The size of a Mineral Resource is important but additionally the ability to increase the Mineral Resource is also important.

Other factors identified such as political and social factors are deemed necessary to consider although the environmental component is also important. The factor was, therefore, named as a 'socio-economic and environmental' factor.

The resource grade of the orebody, that can possibly be converted to a reserve grade, is one of the major drivers of a gold mine's economics. No additional adjustment to the grade of the property being valued is deemed necessary as the grade of the historical transactions and the grade of the current valuation already take the grade into account to determine the ounces. The valuation gets done by multiplying the adjusted unit rates (USD/oz) with the Mineral Resource ounces per Mineral Resource category. Therefore, the grade adjustment is considered in this way and by adding grade to the adjustment factors will lead to double accounting.

Based on the preceding explanation the following adjustment factors were deemed as appropriate to apply to the gold mine unit values calculated:

- Infrastructure and location;
- Depth;
- Mining method;
- Geological complexity;
- Metallurgical complexity;
- Mineral Resource size;
- Ability to increase the Mineral Resource;
- Socio-economic and environmental factors;
- Licensing; and
- Stage of development.

4.5.4 Step 5.2: Rank the adjustments in order of sensitivity

Each of the adjustment factors described in Step 5.2 influences the economics or risk of the project in some way. To determine the factors that rank more sensitive to a gold mine, it is important to understand the impact that each factor has on a mining project. The purpose of the ranking is to determine a valuation parameter matrix by weighting the appropriate adjustments determined during Step 5.2. One of the methods that mining companies often use to assess the risk of a project is by conducting a sensitivity analysis to determine the variables that affect a project the most. This method is mostly conducted on the net present value (NPV) calculated employing the DCF method. It is important that central characteristics that attribute to the value in the DCF can be realised.

According to a sensitivity analysis conducted by Lattanzi (n.d.), a mining project is often most sensitive to factors that directly influence the direct revenue line. Figure 4-10 illustrates a typical high-level sensitivity analysis of a gold mine.

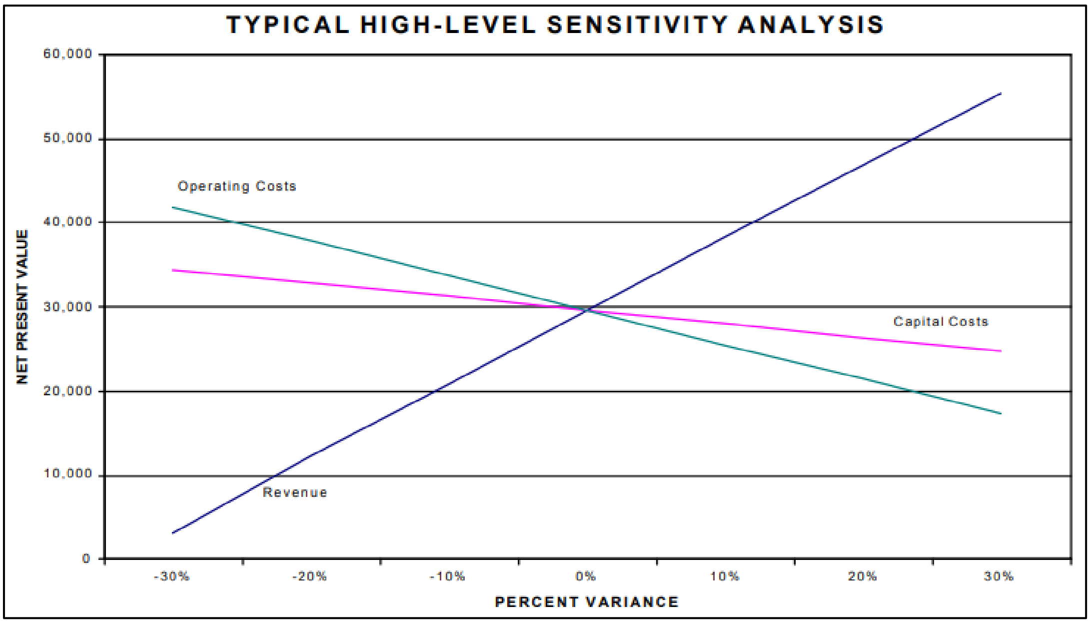

Figure 4-10: Typical mine sensitivity analysis (Lattanzi, n.d., p. 11)

The NPV of a project will change differently to a similar percentage change in operating cost, capital cost and revenue. A gold project is most sensitive to revenue followed by the operating cost and capital cost, respectively. According to Lattanzi (n.d.), the key factors that contribute to revenue are the following:

- Ore tonnes mined and processed;
- Grade;
- Metallurgical recovery; and
- Commodity price.

The commodity price is already considered in the valuation by adjusting the historical transactions to real terms. The grade is also considered in the comparable market valuation as calculated unit rates (USD/oz) get applied to the current project

Mineral Resource ounces. The ore tonnes mined and processed is a design criterion determined during the study phases of a project. Based on the identified adjustment factors a gold project will, thus, be most sensitive to the metallurgical complexity in terms of the ranking order.

A DCF, in simplest terms, discounts annual cash flows at a determined discount rate every year. A gold project is also sensitive to timing constraints associated with a new project that materially impact the final project NPV (Lattanzi, n.d.). If a project requires a long lead time to get a mine into production, the cash flow that gets generated only occurs later in the life of the project and discounted more aggressively, and thus, impacts the NPV of a project.

Adjustment factors identified that can influence the timing of a project are infrastructure, location, and the depth of an orebody. If a project is situated in a remote location then a considerable amount of capital and time are usually required to provide access, power, water, infrastructure and other services to the project site. Similarly, the depth of the orebody determines the mining access to the orebody. Shallow orebodies situated close to surface are usually mined using a surface mining method that can usually produce ore quicker that an underground mine. When the orebody geometry is such that it requires underground access either through a vertical shaft or a decline shaft, then the mining will most probably be delayed compared to surface operations. The depth, infrastructure and location are factors that influence both capital and timing delays that have direct effects on the value of a project.

As presented in Figure 4-10, a mining project's NPV is also sensitive to the operating and capital cost. From the identified adjustments the processing method and mining method generally contribute to the bulk of the operating cost. Underground mining is, in general, more expensive than surface operations due to the effect of depth. The capital expenditure, as well as the operating costs, are normally more than those of surface operations because of the depth factor. Safety of underground mines also adds additional cost as the ventilation; refrigeration;

support and other factors must be included that are not necessary for surface operations.

The other identified adjustment factors other than the ones described above are risk factors rather than aspects directly influencing the economic viability of a mine. These risk factors are important and need consideration, but do not carry the same weighting as the previously mentioned factors. Based on the information regarding the project sensitivity to each of the factors the adjustments were ranked in the following groups as presented in Table 4-15.

Table 4-15: Adjustments ranking methodology

Ranking/weighting	Adjustment factor
Very high	1. Metallurgical complexity
High	2. Infrastructure and location 3. Depth
Medium	4. Mining method
Low	5. Mineral Resource size 6. Licensing 7. Geological complexity 8. Stage of development
Very low	9. Ability to increase the Mineral Resource 10. Socio-economic and environmental factors

Each of the factors identified are furthermore broken down into three categories namely; medium-risk, regarded as the industry average risk, low-risk or high-risk as further detailed in Table 4-17. The principle on which the very low-ranking factors were weighted was by giving it the minimum numerical value to be able to rank it into three categories which is one, two and three, with two being the industry average. Based on the arguments described in Sections 4.5.3 and 4.5.4, as well as experience gained from sensitivities conducted in DCF analysis, the other ranking groups were subsequently weighted more than the very low-risk group to determine the weighting. The industry average values as well as the low-risk and high-risk weight of each weighting group are indicated in Table 4-16.

Table 4-16: Risk group weighting criteria

Risk group	Industry average	Low-risk	High-risk
Very low	2	1	3
Low	4	2	6
Medium	6	2	8
High	8	2	15
Very high	15	2	20

Metallurgical complexity is the only factor weighted in the very high group and has a range wider than any other group. The reason for this is that metallurgical complexity directly influences the revenue stream of a project through recovery and influences the capital and operating cost. Based on the mine sensitivity analysis displayed in Figure 4-10, the risk associated with metallurgical complexity, therefore, weights approximately twice compared to the high and medium risks.

The industry average weighting percentages used to determine a risk-associated weighted index for a gold project is presented in Figure 4-11. The valuator must ultimately determine the ranking based on research and then attribute a weighted percentage to each factor. The principles used to determine the weighting is subjective in nature. It is advisable that experienced engineers could be involved with the ranking and weighting criteria to ensure that the process is not influenced by personal opinions.

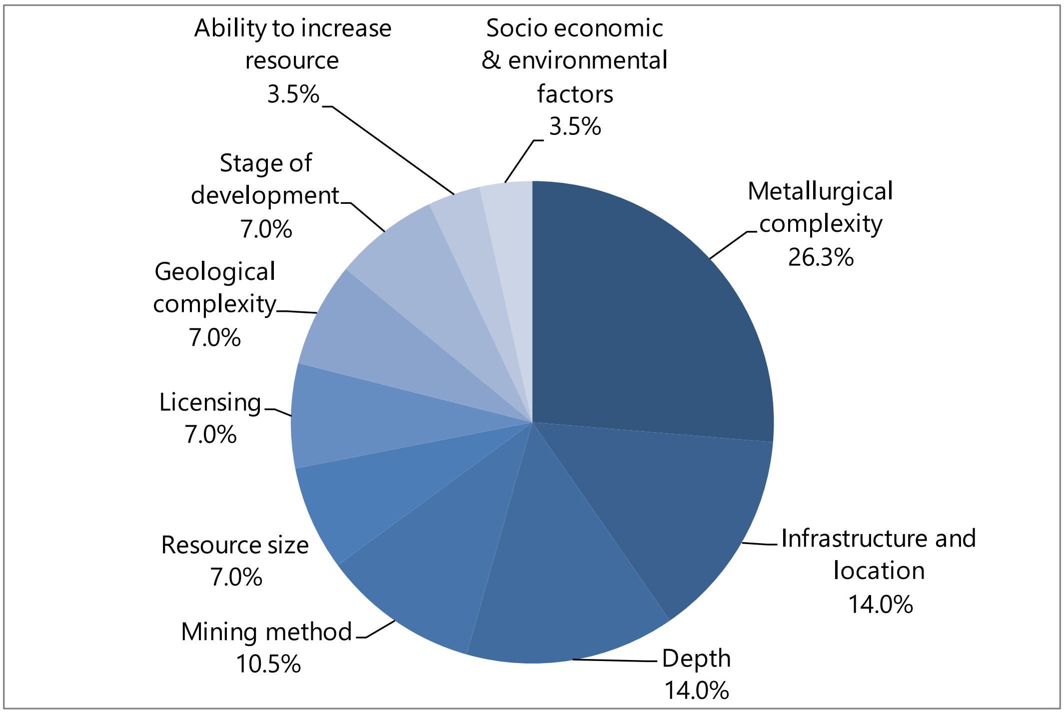

Figure 4-11: Adjustment factors weighting

4.5.5 Step 5.3: Determine the industry standards of the identified factors that can be compared to the mineral asset being valued

To determine the industry standards of each of the adjustments identified the valuator must determine and research industry standards for each of the adjustment factors identified. It is also important to determine what would render the factor identified as having a lower or higher risk in comparison to the industry average. This knowledge enables the valuator to apply appropriate adjustments to the project being valued.

1. Metallurgical complexity

Understanding the gold ore mineralogy of a project, through metallurgical testing, is crucial to determine the maximum amount of gold that can be recovered at the lowest cost. According to Eugene and Mujumdar (2009), gold can be recovered in several ways and the process is usually dependent on the mineralisation of the orebody. The metallurgical process is different from each other and the difficulty of each process is important. Some of the most common methods include gravity concentration, flotation, panning, pyro-metallurgy and cyanidation. A flowsheet indicating the different methods of gold recovery from ore is presented graphically in Figure 4-12.

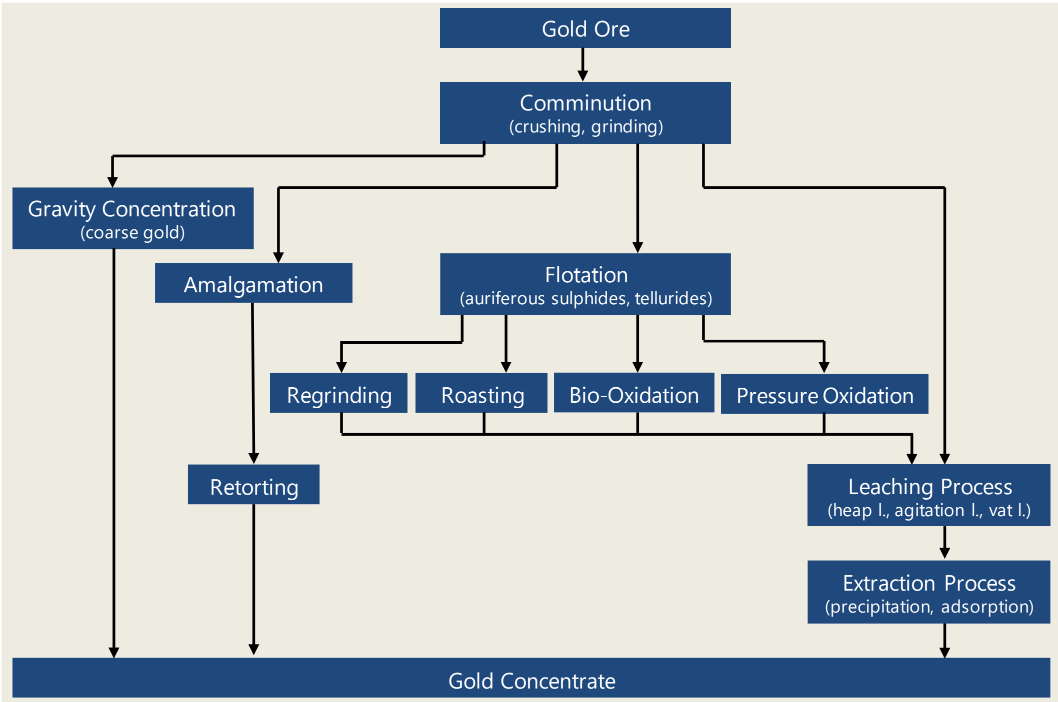

Figure 4-12: Gold recovery flowsheet (Eugene and Mujumdar, 2009, p. 5)

Gold gravity concentration has been used for several centuries and exploits the different density of gold to that of the other minerals in the ore (Adams, 2016). This method is considered one of the simplest and cost-effective gold processing methods.

Some gold ores are amenable to gold recovery using mercury which allows the forming of an amalgam of gold with the mercury. The gold can then be separated from the mercury by distillation in retorts. This process is not often used in the current industry although it is used by artisanal miners.

Cyanidation is a common method for leaching gold from ore in the mining industry. Cyanide is used for gold leaching because of its relatively low cost and good recoveries. One of the simplest processes is a carbon-in-pulp (CIP) process where leaching takes place followed by adsorption onto carbon in tanks. Carbon-in-leach

(CIL) is a gold extraction process where carbon is added to the leach tanks so that leaching and adsorption take place in the same tanks. CIL is slightly more complex than CIP.

Figure 4-12 shows that for refractory ores such as sulphide ores and carbonaceous ores which are not susceptible to direct cyanide leaching, various methods such as pressure oxidation, roasting, chlorination and bio-oxidation are available to treat these ores before cyanidation. Due to the additional costs to expose the gold particles before cyanidation, the processing methods are more complex and costlier.

Based on this research with regards to the metallurgical complexity, the average industry standard for gold mines was identified as cyanidation in the form of either CIP or CIL. A project will be advantaged if gold gravity concentration can be performed. If the project contains refractory ore, it will be disadvantaged from the industry due to the increase in metallurgical complexity.

2. Infrastructure and location

A project's risk can be ranked according to the available infrastructure surrounding a project. According to Keith (2018), mining infrastructure has increased significantly in the past few years since the easier, higher grade ore has been mined out. Most of the new mining projects are situated in further, undeveloped geographies. Due to the remoteness of a project, the infrastructure costs can become about 75 - 80% of the total capital expenditure (Keith, 2018).

A remote project situated far from available infrastructure such as roads, power, water, ports and rail lines, is regarded as having a high risk due to substantial capital that might need to be spent upfront. In South Africa, most gold mines have access to readily available infrastructure outside of the mining and processing infrastructure requirements. An operating mine that already incurred its mining and processing capital is considered less risky and will have an advantage compared to new development projects.

3. Depth

Some of the deepest mines in the world are South African gold mines with more than six of the country's gold mines operating at depths greater than 3.0 km below the surface (Crowley, 2016). According to Ranjith *et al*. (2017), South Africa's average depth of metal mines has reached approximately 2.0 km below the surface. Deep level gold mines have more risk associated with them when compared to shallow operations operating below 2.0 km. Some of the disadvantages are high temperatures usually requiring refrigeration to cool down working places, large inrush of water and gas, and increased *in situ* stress which can lead to rock bursts.

All these factors are difficult to control and lead to higher operating costs to mitigate the risks in the form of more complex rock support strategies, higher pumping costs and refrigeration. Mines deeper than 2.0 km are regarded as riskier and should accordingly be discounted due to the higher operating costs and risks compared to the industry average mines.

4. Mining method

There are two types of mining methods employed globally. These are surface and underground mining methods. Surface mining refers to the extraction of minerals from open pits which are usually situated close to the surface. If an orebody cannot be mined using a surface mining method or is situated too deep to be mined using a surface mining method, the mining is usually done using an underground method. Several mining methods exist for underground mining.

Daniels (2018), stated that surface mines offer some distinct advantages compared to underground mines. The most significant advantages are that surface mines are usually more cost-effective, safer and mechanically easier to mine. On average, surface mines usually, also provide profit sooner than underground mines because of the long time it takes to develop and equip an underground mine. According to the U.S Global Investors (2016), the top 10 producing gold mines in the world are all surface operations. If a project can be mined utilising surface mining method it can therefore, be advantaged compared to underground mines.

5. Geological complexity

The distribution of faults and lithological boundaries as a function of scale can be measured by the geological complexity. The geological complexity can influence numerous aspects including losses of portions of an orebody that cannot be mined or might be more difficult to mine and support due to highly complex structures. A mine's geological complexity usually gets described in detail in a project's geological report. It is recommended that projects with highly complex geological structures should, therefore, be discounted when compared to projects with minor geological structures.

6. Mineral Resource size

The Mineral Resource size of a project determines the potential mining life as well as the annual production capacity of a mine. Gupta (2013), identified the top 10 biggest gold mines based on contained gold Mineral Reserves and noted that all had Mineral Reserves of more than 25 Moz. Mining projects containing more than 5 Moz of gold Mineral Reserves can be classified as massive resource deposits with the industry average having approximately between one and five million ounces of gold. Several small-scale gold mining operations operate around the world with Mineral Resources less than approximately 1 Moz. It is recommended that a mining project with a small resource size (< 1 Moz) should be discounted compared to the industry average gold mines, while a massive resource (> 5 Moz) should be advantaged compared to the industry average gold mines.

7. Licensing

Governments around the world have certain rules and regulations with regards to mining licensing. Globally, a mining project would start with an exploration permit which is valid for a certain period. During this time a company has the legal right to do exploration for the applicable Mineral Resources that they applied for. This period is often also associated with studies, such as studies on a conceptual level, that take place to determine if the Mineral Resource could potentially be economically viable to extract. There can be no assurance that any further mining and exploration approval would be received by the applicable government. The duration of a valid mining right is typically for a longer time than the validity of an exploration permit. The licensing of a mining project, thus, always carries an inherent risk. A mine already in operation must have all their licenses awarded to be able to perform mining operations and is seen as having a lower risk than a project that has been awarded a mining right. A project with a mining right is, however, regarded as having a lower risk than a project that has only been awarded an exploration permit.

8. Stage of development

The project lifetime valuation methodology curve (Figure 4.2) indicated the different stages of a mining project before it can start production. The figure gives an indication of the project initiation stages from exploration through to mine production and the associated studies and Mineral Resource confidence that are normally accompanied by the stage. A mining project will start with exploration and if the drilling campaign is successful the project can declare a compliant Mineral Resource. The next stage of development involves the study phase which is often associated by more drilling to increase the geological confidence of the compliant Mineral Resource. The study phases usually start with a concept study subsequently followed by a pre-feasibility study and feasibility study. When proven to be economically viable it could then proceed to the construction stage followed by mining production, considering that the project finance required can be secured.

The overall confidence level increases as a project advances through the different stages of development and hence the risk associated with the project decreases. A pre-feasibility study including Indicated and Measured Mineral Resources which prove economically viable to mine could also state Mineral Reserves. It is recommended that an operating mine should have a premium to it when compared to a project that is in its study phase as it is regarded as being less risky. In the same way, a project in the study phase is regarded as being less risky compared to a project only having a compliant Mineral Resource and, therefore, the valuation can be adjusted accordingly.

9. Ability to increase the Mineral Resource

As discussed above the Mineral Resource size of a project determines the potential mining life as well as the annual production capacity of a mine. An alternative factor that influences the potential future of a mining project is its ability to increase its current Mineral Resource in the future. The ability to increase the Mineral Resource could be because of depth extensions of the orebody which could not clearly be captured during initial drilling or because of potential lateral extensions not yet explored but believed to have potential as a future drilling target.

It is important for a valuator to understand the geology and Mineral Resource of a project to be valued. An area on which a compliant Mineral Resource has been declared usually have and should have a report associated with the Mineral Resource detailing the geology and Mineral Resource estimation process used. The ability to increase the Mineral Resource is often also described in the Mineral Resource section. It is recommended that a project with a proven ability to increase its Mineral Resource should receive a slight premium compared to a project that a slight or no ability to increase the current Mineral Resource in the future.

10. Socio-economic and environmental factors

The mining industry has played an important role in the global economies of countries around the world. Although the mining of minerals has improved the living standards and development of human civilisation it also generates negative environmental and social impacts. According to Singh and Singh (2016), historical mining focussed more on the economic benefits of mining and little emphasis was placed on the socio-economic and environmental impacts. The emphasis has shifted over the years and most often mining companies globally are required to provide governments with social and environmental action plans on the strategy to be followed as well as detailed closure plans and costs associated with the closure of mines.

The environmental impacts often lead to the associated social impacts. Some of the most common environmental and socio-economic impacts are listed below (Singh and Singh, 2016):

- Water, air and noise pollution;
- Fauna and flora losses;
- Erosion, contamination and leaching;
- Movement of local people from ancestral lands;
- Socio-political conflicts; and
- Waste generation.

Each of the listed potential impacts are project dependent and could have significant financial impacts on a project. A project that has a low socio-economic and environmental impact as determined by studies completed has an advantage compared to projects having potential unfavourable impacts that should accordingly be adjusted. If a project has not done any social and environmental studies, it should also be regarded as risky. The movement of cultural villages situated on the mining area or near a mining area which need to be relocated can have a significant cost associated with that as well as a time-constraint on the total project.

A summary of the industry averages of each of the 10 adjustments identified above as well as the identified factors rendering a gold project as either having a lower or higher risk in comparison to the industry average is detailed in Table 4-17.

Table 4-17: Industry averages and identified risk ranges for gold projects

Adjustments	Industry average	Low-risk	High-risk
Metallurgical complexity	Semi-refractory ore treated by either CIP or CIL. CIL regarded slightly more complex than CIP	Separation by gravity methods	Refractory ores using methods like pressure oxidation, roasting, chlorination and bio-oxidation
Infrastructure and location	Available access to mine site with available basic infrastructure for example roads, power, water and railway	Operating mine that already incurred all costs	No access or available infrastructure
Depth	Approximately 2.0 km below surface	Close to surface < 200 m below surface	Deeper than 2.0 km below surface
Mining method	Underground shafts and declines	Surface mines	Underground shafts
Geological complexity	Complex	Minor structures	Highly complex
Mineral Resource size	Between 1 and 5 Moz	More than 5 Moz	Less than 1 Moz
Licensing	Mining Right	Operating mine	Exploration right
Stage of development	Feasibility stage	Operating mine	Compliant Mineral Resource
Ability to increase the Mineral Resource	Medium possibility of increasing Mineral Resource	Strong chance of increasing Mineral Resource	Low possibility of increasing Mineral Resource
Socio-economic and environmental factors	Approved environmental management and social and labour plans with certain impacts identified	No problems associated with project	Environmental as well as social impacts imminent

This knowledge enables a valuator to apply sensible adjustments to the gold mining project being valued. The methodology of applying the adjustments to the valuation of a Mineral Resource is described in detail in Step 5.4.

4.5.6 Step 5.4: Develop a strategic way to apply the adjustments to the mineral asset being valued

The actual percentage weighting used to determine a risk-associated weighted index for a gold project is discussed in detail in Step 5.2. As discussed previously the valuator must determine the ranking based on research and then attribute a weighted percentage to each factor. The weighted average is based on the most sensitive factors determined of the 10 adjustments to be considered. Based on the information regarding the sensitivity of each of the factors the adjustments were ranked in the groups as presented in Table 4-15. Each weighting group previously identified were assigned a numerical value to it having a range between low-risk, industry average and high-risk as determined in Step 5.3.

The higher the weighting of each factor the higher the range, thus, having a larger influence on the adjustment to be applied. The numerical value applied to the very low weighting group were assigned a range of between 1 - 3 with one being the highest risk and three being the lowest risk. The weighting groups ranges for each of the adjustments are presented in Table 4-18, with the higher weighting groups carrying more sensitivity to adjustments than the lower groups.

Table 4-18: Adjustments ranking ranges

Weighting group	Adjustment factor	Numerical range applied
Very high	1. Metallurgical complexity	2 - 20
High	2. Infrastructure and location 3. Depth	2 - 15
Medium	4. Mining method	2 - 8
Low	5. Mineral Resource size 6. Licensing 7. Geological complexity 8. Stage of development	2 - 6
Very low	9. Ability to increase the Mineral Resource 10. Socio-economic and environmental factors	1 - 3

The results of the weighting that the industry average adjustment factors carry are presented in Figure 4-11. The percentages presented in Figure 4-11 indicate the sensitivity that each of the adjustments could have on the total value adjustment of the project to be investigated. Figure 4-13 graphically indicates the range identified for each adjustment factor as per Table 4-18.

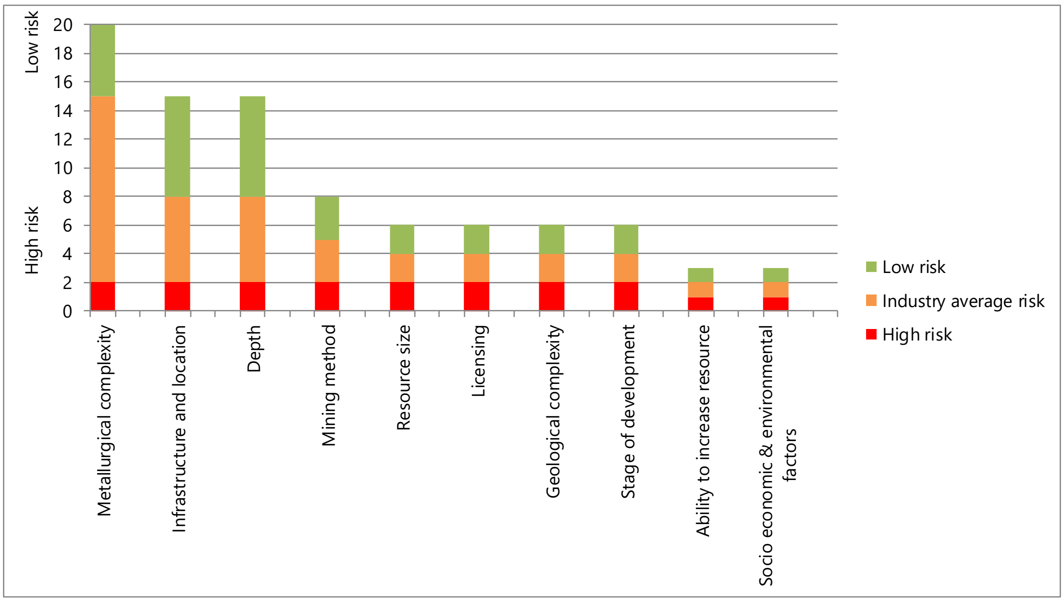

Figure 4-13: Adjustment factors ranges

The bars presented in Figure 4-13 can be more clearly defined by the research completed in Step 5.3 and summarised in Table 4-17. If a project's metallurgical complexity, for example, is for refractory ores using methods like pressure oxidation, roasting, chlorination and bio-oxidation, the project's metallurgical complexity are regarded as high-risk (red bar) having a weighting of two applied to it. If the metallurgical complexity is similar to the industry average having a treatment process that could use either CIP or CIL, the ranking would be within the industry average range (orange bar). A project will, however, be advantaged if gold gravity concentration can be performed and the numerical value similar to the green bar would be applied to the project. The higher the value applied for each adjustment factor, the lower the risk associated with the project and, hence, the higher the adjustment would be compared to the industry average USD/oz. The method of applying adjustments to the average unit values by means of investigating and ranking a project to the industry average is discussed in Step 5.5.

4.5.7 Step 5.5: Apply the adjustments to the average unit values

The next step of the process is to determine the impact that the adjustments of a project could potentially have on the average unit values calculated from the historical transactions. The weighted adjustments identified in Step 5.4 can now be applied to the unit values calculated, and the methodology is described in more detail in the section below.

The mean values per Mineral Resource category were calculated by determining the average unit values of each category. The mean unit values calculated per Mineral Resource category in Section 4.3.3 are presented in Table 4-19.

Table 4-19: Mean value per Mineral Resource category

Mean value	Value (USD/oz)
Inferred	2.3
Indicated	13.3
Measured	21.7

A problem previously identified in finding comparable mining transactions is that every mining project is unique in its own sense and differs from any other mining project in many ways. The unit values presented in Table 4-19 are representative of the industry average unit values in real terms that would typically be applied to a gold mining project when conducting the comparable market valuation.

If a gold mining project were to be exactly similar to the industry average gold mines detailed in Table 4-17, the unit values per Mineral Resource ounce presented in Table 4-19 could effectively be applied to the project comparable market valuation. As each project is unique in one or more ways, the risk associated with each project can either be higher or lower than the industry average. Therefore, the unit values calculated becomes the starting point for every project and the 10 identified adjustments in Table 4-18 are then individually worked through for the applicable gold project and adjustments are made accordingly. The unit values can either increase or decrease compared to the industry average because of its associated risk.

The numerical values applied per adjustment factor detailed in Table 4-18 indicates what the lowest and highest possible risk of a gold mining project could be. If a gold project is associated with all the lowest risks associated with a mining project, (thus, gravity separation, all infrastructure available, surface operation at shallow depth, etc.), the unit values would be adjusted upwards to be used in the valuation of the specific project. The exact opposite would apply if the gold project is associated with the highest risks associated with it. The lowest possible risk has a numerical value of 88 associated with it, while the highest possible risk has a numerical value of 18 associated with it. The industry average numerical value based on the orange bars presented in Figure 4-11 were estimated to be 57.

The formula for the comparable sales method, according to the IAAO (2003), was summarised in Section 2.3. In the same way, the formula for adjusting the comparable market valuation unit values can be determined by multiplying the adjustment factor with the industry average unit values for each Mineral Resource category. The equation to be used is described below.

Unit value adjustment equation

*Project unit value (USD/oz) = Industry average unit value (USD/oz) * Adjustment factor*

Where the adjustment factor:

Adjustment factor = Project numerical value / Industry average numerical value

The lowest possible project risk which has the maximum numerical value of 88 would, therefore, have an adjustment factor of 1.54 as calculated below:

Adjustment factor = 88 / 57 = 1.54

The highest possible project risk which has the minimum numerical value of 18 would, therefore, have an adjustment factor of 0.32 as calculated below:

Adjustment factor = 18 / 57 = 0.32

By applying the highest and lowest possible risk adjustments to the industry average unit value the range of possible values per Mineral Resource category were determined by using the unit value adjustment equation. The results are presented in Table 4-20.

Table 4-20: Maximum unit value range per Mineral Resource category

Mean value	Unit	Industry average	Lowest risk	Highest risk
Inferred	USD/oz	2.3	3.5	0.7
Indicated	USD/oz	13.3	20.5	4.2
Measured	USD/oz	21.7	33.6	6.9

A graphical representation of the ranges is presented in Figure 4-14 with the lower risk projects having unit values higher than the industry average and the higher risk projects having lower unit values.

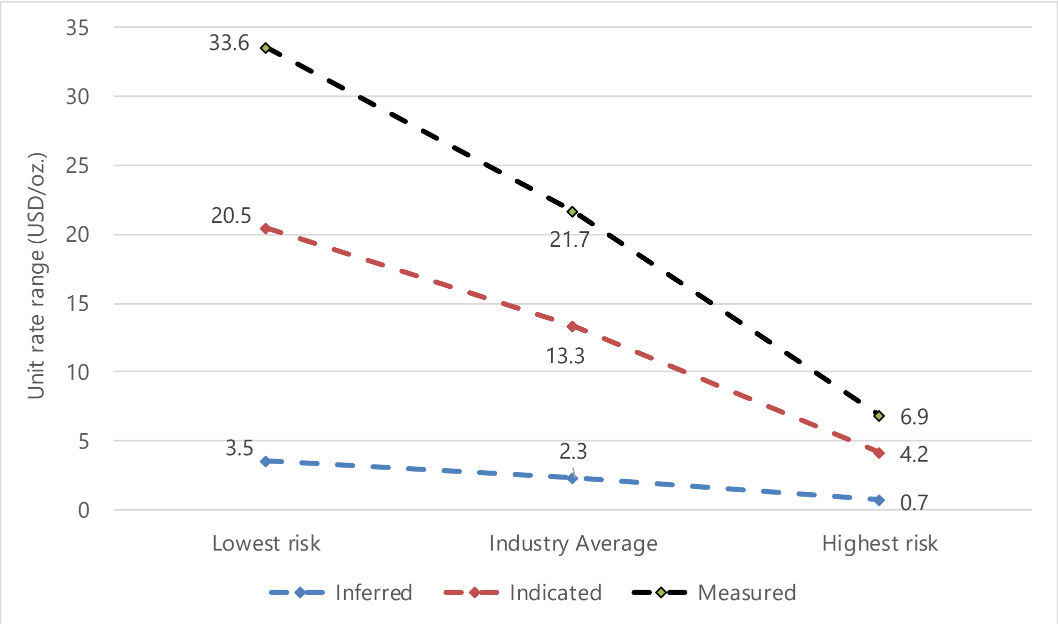

Figure 4-14: Range of unit values per Mineral Resource category

A gold mining project to be valued would have unit values applied that falls within the ranges indicated in Figure 4-14. The unit value would either be similar, lower or higher than the industry average values depending on its risk profile.

4.5.8 *Summary of adjustment identification and application*

Five steps were proposed as a guideline to be followed when identifying and applying adjustments to valuing a gold project. The first step involved the identification of sensible adjustment factors that affect the value of the gold project. This was followed by ranking these adjustments in order of how sensitive each adjustment is to a gold project. The adjustment factors were ranked according to sensitivity ranging from very sensitive to very low sensitivity factors contributing to the economic viability of a gold mine by investigating typical sensitivities of gold mines. Ten factors were identified as described in Table 4-17 ranking form metallurgical recovery being the most sensitive factor to socio-economic and environmental factors being the least sensitive.

The industry average or norms of each of the identified factors were subsequently determined as well as the factors rendering a project as either having a lower or higher risk in comparison to the industry average. This resulted in the 10 adjustment factors that enable a valuator to apply sensible adjustments to the project being valued as having a higher, lower or similar adjustment compared to the industry average gold mines.

To develop a strategic way to apply the adjustments to the mineral asset being valued each weighting group identified were assigned a numerical value to it having a range between low-risk, industry average and high-risk as determined by the research. The application of numerical values allows the valuator to apply the adjustments to the average unit values calculated based on the historical transactions database. By applying the highest possible and lowest possible risk ratings based on the numerical values a possible range per Mineral Resource category were determined in which a gold project valuation would likely fall.

A graphical representation of the ranges is presented in Figure 4-14 with the lower risk projects having unit values higher than the industry average and the higher risk projects having lower unit values. A gold mining project to be valued would have unit values applied that fall within the ranges indicated in Figure 4-14. The unit value would either be similar, lower or higher than the industry average values depending on its risk profile. The formula to be used to adjust the unit value for the specific project is presented below.

*Project unit value (USD/oz) = Industry average unit value (USD/oz) * Adjustment factor*

This information gathered could subsequently be applied to the gold case study and the risks associated with the case study could be compared. The following chapter investigates the results of a case study comparable market valuation that was done, using the guideline presented in Chapter 4.

5 CONDUCT COMPARABLE MARKET VALUATION METHOD ON CASE STUDY

5.1 Introduction to conducting the comparable market valuation

This chapter applies the best practice guideline to a gold mining company case study. Based on the available literature reviewed in this report (Section 2.3), the estimated market value of an asset determines the validity of any valuation. The same approach was used in this research study to test the validity of the comparable market valuation method. This was done by calculating a comparative value for an existing gold mining company's stated Mineral Resources and comparing it to the enterprise value of that company.

For the comparison to be realistic, the company had to be a listed gold mining company domiciled in South Africa. The company chosen for the case study had to be a non-diversified company not investing in operations producing other commodities to avoid skewing the valuation comparison. A suitable gold mining company was Pan African Resources PLC (PAR) that divested of its platinum group elements (PGE) business during 2017. The EV calculated in Section 4.4.2 for the company was estimated to be USD243 million as displayed in Table 5-1.

Table 5-1: Ran African Resources EV

Share code	Market capitalisation	Net debt	EV
	(USDm)	**(USDm)**	**(USDm)**
PAN	237	6	243

Source: Pan African Resources PLC (2017).

All the information regarding PARs' resource statement for the year ended 30 June 2018, as well as the technical information associated with the operations and projects, were sourced from reports available in the public domain. The background of the company is discussed briefly including the stated Mineral Resources. The adjustment factors were then investigated and compared to the industry standards to determine the adjusted case study unit values. The adjusted case study unit values could then be applied to the stated Mineral Resource ounces to determine the best-estimated value of the mineral assets.

5.1.1 Background

PAR is an African-focused precious metals producer that had a production capacity of approximately 170,000 oz gold per annum in financial year 2018. The company's operating gold mines are split between Barberton Mines and Evander Mines, both situated in the Mpumalanga province of South Africa.

The Barberton Mines are "located in a greenstone belt, this is a low-cost, high-grade operation comprising three underground mines: Fairview, Sheba and New Consort" (Pan African Resources PLC, 2018, p. 10). The mine also has a tailings retreatment plant situated at Barberton Mines. Evander Mines is "located in the Witwatersrand basin, comprising 8 Shaft (operations ceased in 2018) and several potential development projects – Egoli, Poplar, Evander South and Rolspruit" (Pan African Resources PLC, 2018, p. 11). As part of Evander Mines there are also two tailings retreatment projects that the company was investigating for the possibility of exploiting historically generated gold tailings.

Evander Mines' underground operations stopped production at the end of May 2018, which is the effective date that this research study was chosen and fixed at. Evander Mines' operating mine was, thus, treated as an operating mine at the time of the valuation. Both Barberton and Evander operating mines are situated in the same province, but there are major differences between the two operations and the project risks and adjustment factors were determined for each of the operating mines. Evander Mines' projects are at a development stage that is not comparable to the operating mines and were therefore, treated separately from the operating mines.

The adjustment factors were, thus, applied to three different areas being:

- Barberton mines;
- Evander mines; and
- Evander projects.

PAR has a SAMREC compliant Mineral Resource statement including Inferred, Indicated and Measured Mineral Resources dated 30 June 2018. The summarised Mineral Resource statement for the company is illustrated in Table 5-2 containing a total of 331.2 million tonnes at an average gold grade of 3.13 g/t. The Mineral Resources are inclusive of Mineral Reserves and resulted in total contained gold of 33.3 Moz.

Table 5-2: Case study Mineral Resource statement

Mine	Mineral Resources	Metric tonnes (Mt)	Gold grade (g/t)	Contained gold ounces
Barberton mines	Measured	6.7	5.68	1 220 000
Evander mines	Measured	2.6	14.78	1 250 000
Evander projects	Measured	46.2	0.32	480 000
Combined Measured Resources		**55.6**	**1.65**	**2 950 000**
Barberton mines	Indicated	17.5	2.63	1 480 000
Evander mines	Indicated	5.0	11.70	1 870 000
Evander projects	Indicated	196.5	2.65	16 760 000
Combined Indicated Resources		**219.0**	**2.86**	**20 110 000**
Barberton mines	Inferred	14.5	3.86	1 800 000
Evander mines	Inferred	13.0	10.66	4 450 000
Evander projects	Inferred	29.1	4.26	3 990 000
Combined Inferred Resources		**56.6**	**5.63**	**10 240 000**
Total combined Mineral Resource		**331.2**	**3.13**	**33 300 000**

Source: Pan African Resources PLC (2018).

The total project Mineral Resource ounces were subsequently used to complete the case study valuation. Most of the total resources (>60%) are in the Indicated Mineral Resource category with approximately 64% of the total resources being related to the Evander projects. The following section describes the project-specific adjustments that were made, compared to the industry average.

5.2 Project-specific adjustments

Table 5-3 summarises the project-specific risk criteria that were used in the comparable market valuation for the total contained gold Mineral Resource ounces. The description column serves as a project background justifying the risk criteria adjustment from the research summarised in Table 4-17.

A description is provided for each of the three identified areas being Barberton mines, Evander mines and Evander projects. Where certain of the information of Evander mines and projects were the same, it was described in this manner. The technical information of the areas was sourced from independent Competent Persons' Reports (CPR's) that were done on Barberton and Evander Mines by SRK Consulting (South Africa) (Pty) Ltd (2007) and Venmyn Rand (Pty) Limited. (2012), respectively.

The bars presented in Figure 5-1 indicate the project-specific risk summary of each adjustment factor as compared to the industry average risk profile. The higher the number on the bar, the lower the risk and therefore the willingness of a buyer to place a premium on the project.

Table 5-3: Project principal risk criteria

Risk criteria	Description

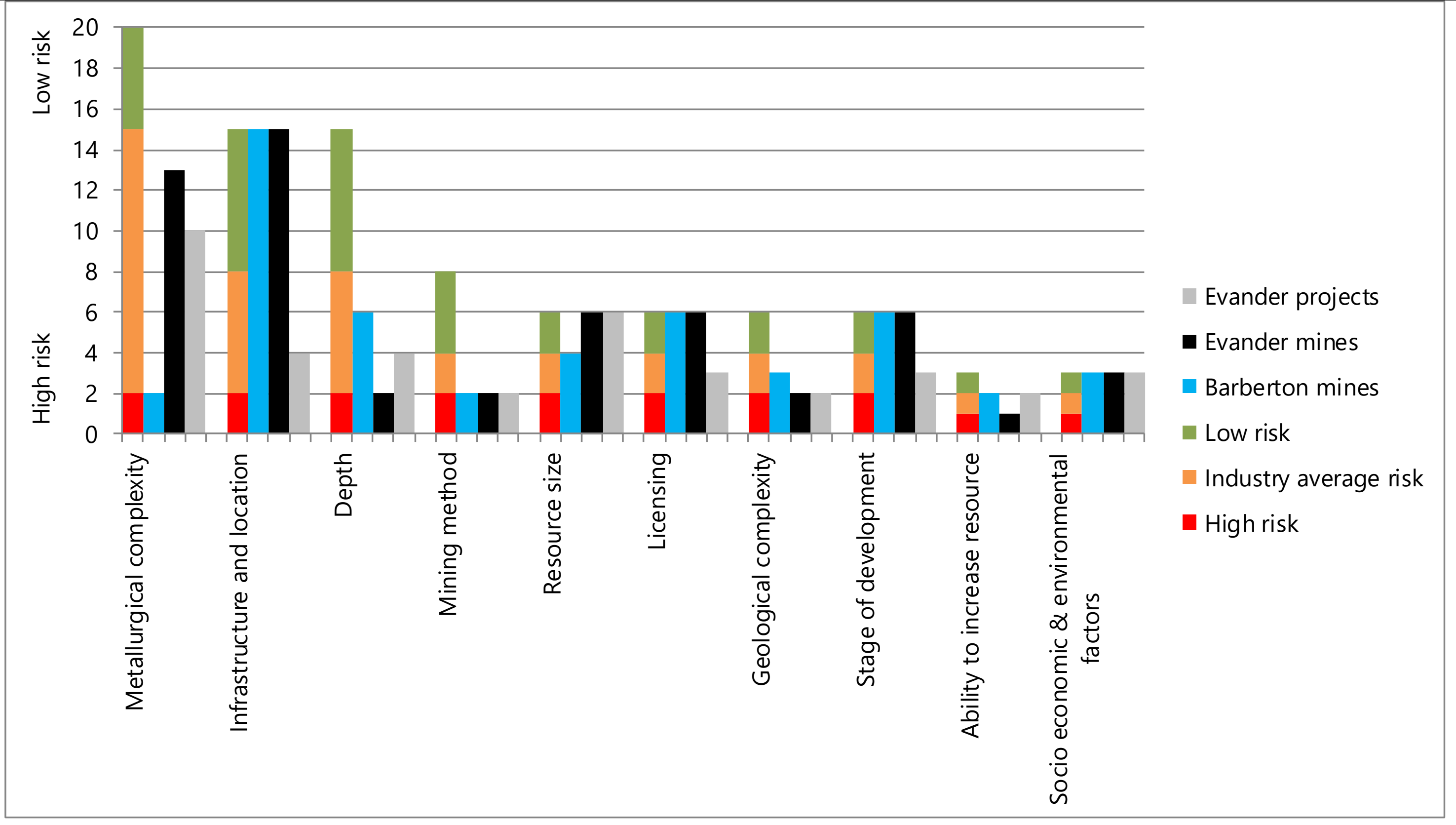

Figure 5-1: Project-specific risk criteria summary

Note: The bars are indicative of the risk of each item compared to the industry. The higher the bars the lower the risk.

Risk criteria	Description
Metallurgical complexity	**Barberton mines:** Due to the refractory nature of the orebodies the extraction methods are complex as a significant portion of the orebody is contained within sulphide and arsenic minerals. This process requires either biological oxidation (‘BIOX®’) or roasting to remove the Sulphur and arsenic. Compared to the industry, refractory ore is more difficult to process and have a higher risk compared to the industry average gold processing plants. **Evander mines:** Ore was processed at the existing Kinross Metallurgical Plant. The historical plant recovery of approximately 94% at a head grade of 3.5 g/t were achieved by using both CIP and CIL. The metallurgical complexity is similar to the industry average gold mines in South Africa. **Evander projects:** The metallurgical complexity of the projects is expected to be similar to what was experienced at Evander mines. Most of the studies have proposed that the existing Kinross Metallurgical Plant could possibly be used to treat the ore, although upgrades to the plant would be required as well as additional costs associated with transporting the ore to the plant. This ranks the projects at a slightly higher risk compared to Evander mines.
Infrastructure and location	**Barberton mines:** Each of the mines have access to underground workings as well as processing facilities in place. Infrastructure on site is generally in a good condition. Since the mine has access readily available as well as most infrastructure requirements it is regarded to be less risky than the industry average. **Evander mines:** Each of the mines have an existing shaft with the infrastructure required to support mining on a continuous basis, as well as processing facilities in place. The infrastructure requirements it is regarded to be less risky than the industry average. **Evander projects:** The location of the projects is well positioned taking into consideration of the existing Evander mines surrounding the projects. Access to the orebodies will however be required by means of shafts and no project-specific infrastructure has been constructed at this stage. This is time consuming and expensive, ranking the projects’ infrastructure as high-risk.
Depth	**Barberton mines:** The mineral deposit is mined at maximum depths of approximately 1 060 - 1 600 meters below surface which is similar to industry average depths of gold mines in South Africa. **Evander mines:** Mining takes place at depths of approximately 2 100 meters to 2 300 meters below surface. This depth is considered as high-risk compared to the industry average depth. **Evander projects:** Approximately 50% of the project’s resources are at an average depth extension of between 300 meters in the west and 1 200 meters in the east, below surface, which is similar to industry average depths of gold

Risk criteria	Description
	mines in South Africa. The remaining 50% of the resource (Rolspruit) is, however, situated at depths deeper than 2 000 meters that is considered as high-risk compared to the industry average depth. The average ranking of the projects was, thus, considered to be between the industry average ranking and high-risk ranking.
Mining method	**Barberton mines:** The mines all have shafts in place that employ a semi-mechanised cut and fill mining method that is similar to underground gold mines in South Africa and regarded as high-risk compared to declines and surface mines. **Evander mines:** The majority of the mining is done by means of conventional underground mining methods with shaft systems and can be regarded as high-risk compared to declines and surface mines. **Evander projects:** The primary access to the orebodies of both the Rolspruit, Poplar and Evander South projects is through shaft systems with similar mining methods employed at Evander mines. The mining methods employed can, thus, be regarded as high-risk compared to declines and surface mines.
Geological complexity	**Barberton mines:** According to the technical report, "The ore bodies all occur in the vicinity of a complex, refolded, arcuate, south-dipping shear/fault system, the Sheba Fault Zone developed between the Ulundi and Eureka synclines. The locations and geometries of the ore bodies themselves are structurally controlled and, due to the complex deformational history of the host rocks, have variable strikes, dips and widths." (SRK Consulting (South Africa) (Pty) Ltd, 2007, p. 55). Based on this information, the complexity of the geological structures was regarded as being slightly more complex than other operating mines in the industry but not highly complex. **Evander mines and projects:** According to Venmyn Rand (Pty) Limited. (2012, p. 38), "The structure of the goldfield is complex and characterised by basin margin faulting". The complexity is further emphasised in the report that "The actual mining region displays structural complexity, with normal and minor reverse faulting, which result in reef losses and potential mining instabilities." (Venmyn Rand (Pty) Limited, 2012, p. 38).
Mineral Resource size	As per Mineral Resource statement presented in Table 5-2: **Barberton mines:** Total Mineral Resource size is approximately 4.50 Moz which is similar to the industry. **Evander mines:** Total Mineral Resource size is approximately 7.57 Moz which is more than the industry average, thus, ranking the resource size as low-risk. **Evander projects:** Total Mineral Resource size is approximately 21.23 Moz which is more than the industry average, thus, ranking the resource size as low-risk.

Risk criteria	Description
Licensing	**Barberton mines:** The mines are in operation with new order mining rights in respect of Fairview Mine, New Consort Mine and Sheba Mine (Business Report, 2010b), which ranks its licensing risk as being low-risk. **Evander mines:** The mines are in operation mining rights in place, which ranks its licensing risk as being low-risk. **Evander projects:** Projects are not operational, although, all Mineral Resources stated in Table 5-2 are located within the existing Evander Mines mining right. This ranks its licensing risk as being similar to the industry average.
Stage of development	**Barberton mines:** The mines are in operation ranking it as low-risk. **Evander mines:** At the time of the valuation the mines were in operation ranking it as low-risk. **Evander projects:** Mineral assets comprise of a set of Mineral Resources that are from early pre-feasibility studies to a bankable feasibility study. The average projects can be ranked as being between high-risk and industry average risk when comparing the projects to the industry average.
Ability to increase the Mineral Resource	**Barberton mines:** All the ore bodies are open at depth that provides the potential to increase the current resources (Pan African Resources PLC, 2018). This ranks the ability to increase resource as similar to industry average. **Evander mines:** Identified growth projects within the existing mines which can further increase the existing resource is already included in the resource statement. No real potential exists to further increase resource. **Evander projects:** Further exploration of the projects' resources could improve the geological confidence of the resources (Venmyn Rand (Pty) Limited, 2012). It is also expected that planned future exploration could potentially also increase the current resource. This ranks the ability to increase resource as similar to industry average.
Socio-economic and environmental factors	**Barberton mines:** "Fairview, New Consort and Sheba mines all have established an Environmental Management programme. Each operation has an approved Environmental Impact Assessment, Environmental Management Programme and Water Use License." (Pan African Resources PLC, 2018, p. 55). Due to these reports the mines' socio-economic and environmental factors can be regarded as low-risk. **Evander mines and projects: "**Evander Gold Mines has established an approved Environmental Impact Assessment, Environmental Management Programme and Water Use License which include the Elikhulu Tailings Retreatment Plant. A rehabilitation strategy and implementation plan has been compiled and updated in 2017 to rehabilitate dormant and nonproductive areas." (Pan African Resources PLC, 2018, p. 69). Due to these reports the mines' socio-economic and environmental factors can be regarded as low-risk.

The analysis above rates both the PAR operations as well as the Evander projects at a higher risk in comparison to industry criteria. The risk criteria numerical values of each of the areas are presented in Table 5-4. Evander mines have the lowest risk rating of 56 with Evander projects having the highest risk rating of 39 of the three identified areas.

Table 5-4: PAR adjustments ranking

Adjustment factor	Barberton mines	Evander mines	Evander projects
1. Metallurgical complexity	2	13	10
2. Infrastructure and location	15	15	4
3. Depth	6	2	4
4. Mining method	2	2	2
5. Mineral Resource size	4	6	6
6. Licensing	6	6	3
7. Geological complexity	3	2	2
8. Stage of development	6	6	3
9. Ability to increase the Mineral Resource	2	1	2
10. Socio-economic and environmental factors	3	3	3
Total	**49**	**56**	**39**

As discussed in Section 4.5.7, the industry average risk criteria numerical value is 57. The industry average unit values must be adjusted accordingly by calculating the project adjustment factors and applying them to the industry average unit values for each of the areas.

Based on the PAR project risk criteria, numerical values of 49, 56 and 39 were calculated compared to the industry average of 57. The adjustment factors for each of the areas were calculated below.

Barberton mines adjustment factor = 49 / 57 = 0.86

Evander mines adjustment factor = 56 / 57 = 0.98

Evander projects adjustment factor = 39 / 57 = 0.68

Evander mines have a risk rating similar to the industry average and will, therefore, only have a slight downward adjustment to the unit values of 0.98. This risk profile indicates that a willing buyer is likely to buy the Evander mines at the industry average price.

Due to the higher risk identified for Barbeton mines in comparison to the industry average, it is expected that a willing buyer is likely to place a discount on the mines when compared to the industry average range. The biggest reason for the discount is due to the complexity of the metallurgy which has been identified.

Evander projects have the highest risk rating of the three areas identified with a calculated adjustment factor of 0.68. The expected unit values for Evander projects will, thus, be the lowest of the three areas. This risk profile indicates that a willing buyer is likely to pay a discount for the Evander projects when compared to the industry average price. The biggest driver of the discount is the fact that the projects is in the study phase with no available access and infrastructure to the underground orebody.

By applying the risk adjustments factors to the industry average unit values, the PAR values per Mineral Resource category were determined for each area by using the unit value adjustment equation. The results are presented in Table 5-5.

Table 5-5: Average project unit values per Mineral Resource category

Resource category	Industry average (USD/oz)	Barberton mines (USD/oz)	Evander mines (USD/oz)	Evander projects (USD/oz)
Inferred	2.3	1.9	2.2	1.5
Indicated	13.3	11.4	13.0	9.1
Measured	21.7	18.7	21.3	14.9

By applying the project-specific risk adjustments, the average unit values were determined per Mineral Resource category which was used to determine the final mineral asset value as detailed in the next section.

5.3 PAR mineral asset value based on the comparable market valuation method

The PAR mines and project values per area based on the comparable market valuation method are presented in Table 5-6.

Table 5-6: PAR mineral asset values per area

Barberton mines Mineral Resources	Contained gold ounces	Unit values (USD/oz)	Value (USD million)
Measured	1 220 000	18.7	22.8
Indicated	1 480 000	11.4	16.9
Inferred	1 800 000	1.9	3.5
Combined	**4 500 000**	**9.6**	**43.2**
Evander mines Mineral Resources	**Contained gold ounces**	**Unit values (USD/oz)**	**Value (USD million)**
Measured	1 250 000	21.3	26.7
Indicated	1 870 000	13.0	24.3
Inferred	4 450 000	2.2	9.9
Combined	**7 570 000**	**8.0**	**60.9**
Evander projects Mineral Resources	**Contained gold ounces**	**Unit values (USD/oz)**	**Value (USD million)**
Measured	480 000	14.9	7.1
Indicated	16 760 000	9.1	152.0
Inferred	3 990 000	1.5	6.2
Combined	**21 230 000**	**7.8**	**165.3**

Based on the comparable market valuation method the following values were calculated per area. Barberton mines have a total estimated value of USD43.2 million with the highest average unit value of 9.6 USD/oz. The majority of Barberton mines' resources are in the Measured and Indicated category resulting in the average unit value being the highest of the three areas. Evander mines have a total estimated value of USD60.9 million with an average unit value of 8.0 USD/oz. Evander projects have a total estimated value of USD165.3 million which is by far the highest value compared to Barberton and Evander mines, because of its significant resource of 21.23 Moz of which 79% is in the Indicated Mineral Resource category. The combined PAR mineral asset value is presented in Table 5-7.

Table 5-7: PAR combined mineral asset value

Combined Mineral Resources	Contained gold ounces	Unit values (USD/oz)	Value (USD million)
Measured	2 950 000	19.2	56.6
Indicated	20 110 000	9.6	193.2
Inferred	10 240 000	1.9	19.6
Combined	**33 300 000**	**8.1**	**269.4**

Based on the comparable market valuation method, PAR have a total estimated value of USD269.4 million. This results in a combined project average unit value of 8.1 USD/oz. The combined unit value of 8.1 USD/oz is the expected average value per ounce that the PAR mineral assets are worth and what a willing buyer could potentially purchase the Mineral Resource for.

5.4 Project value comparison

To justify the estimated value of USD269.4 million based on the comparable market valuation method, the value was compared to the estimated EV of the asset as detailed in Table 5-1. The comparison of the values is presented in Table 5-8.

Table 5-8: Project value comparison

Estimated value	Industry average (USD million)
Enterprise value	242.7
Comparable market valuation	269.4
Variance	+26.6

Based on the results displayed above the comparable market valuation method has a value of USD26.6 million more than the EV. This results in a variance of 11.0%. The effective date of the valuation is May 2018 at which time the PAR share price was 1.3 ZAR/share (Table 4-12). The historical share price for three months preceding and six months after the effective date of the valuation is displayed in Figure 5-2.

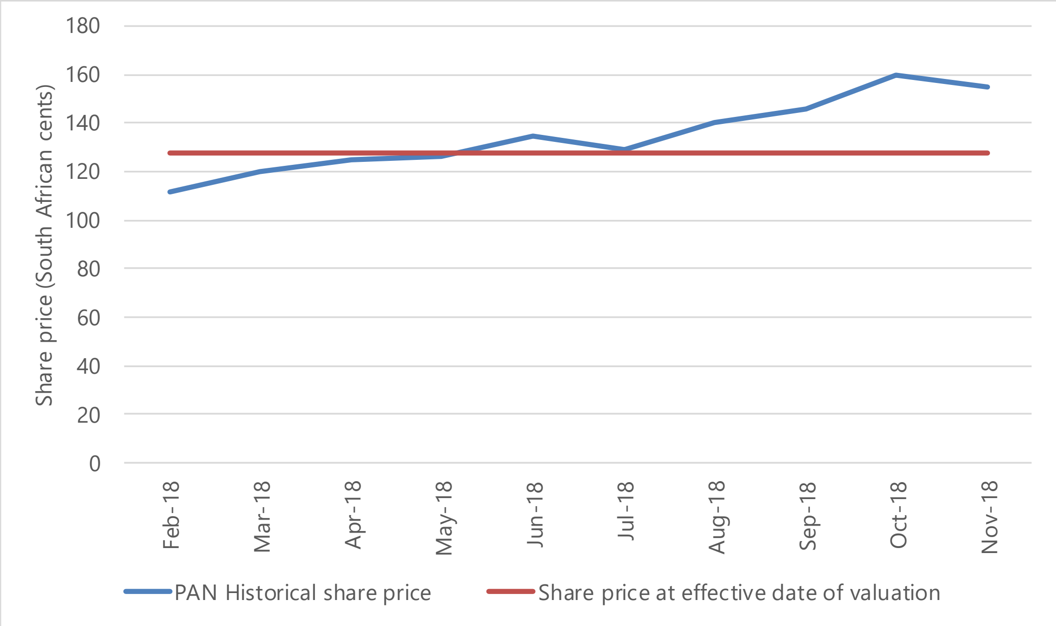

Figure 5-2: Historical share price (Moneyweb Limited, 2018)

The actual variance of the historical share price preceding and succeeding the date of the valuation is approximately 15% to 17% higher or lower. The variance of 11.0% calculated from the comparable market valuation method can, thus, be deemed as acceptable. It can, therefore, be concluded that the value determined based on the comparable market valuation method can be considered as justifiable and reliable under the assumptions made and applied to the project valuation.

5.5 Summary of conducting the comparable market valuation

The best practice guideline as developed in this research study was applied to a gold case study by calculating a comparative value for an existing gold mining company's stated Mineral Resources and comparing it to the market value of that company. The non-diversified listed gold mining company used was PAR which has a compliant Mineral Resource statement containing gold ounces of 33.3 million.

PAR has operating gold mine split between Barberton Mines and Evander Mines, with Evander Mines also associated with gold projects not yet in operation. By investigating the project-specific risk parameters of each of the three areas identified, (Baberton mines, Evander mines and Evander projects), each areas' risk parameters could be adjusted accordingly. The industry average unit values were, therefore, adjusted by applying the calculated adjustment factors of 0.86, 0.98 and 0.68 respectively. The adjustment factors of the areas resulted in an average unit values per Mineral Resource category for each of the three areas as indicated in Table 5-5.

The adjusted unit values per Mineral Resource category were subsequently applied to the Mineral Resource ounces to determine the full value of PAR mineral assets. The value was estimated to be USD269.4 million which results in a combined project average unit value of 8.1 USD/oz. To justify the estimated value based on the comparable market valuation method, the value was compared to the estimated EV of the company at the time of the valuation. The results varied by approximately 11.0% compared to the EV. By investigating the actual historical preceding and succeeding share price of PAR it varied by approximately 15% to 17% higher or lower in less than 12 months. By having calculated a variance of 11% based on the comparable market valuation method, following the proposed guideline using gold deposit case study transactions, the method can, thus, be deemed as reliable and justifiable.

Chapter 6 summarises the research study work completed in the form of conclusions and recommendations reached in writing a best practice guideline for conducting the comparable market valuation by benchmarking from gold deposit case study transactions.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction to conclusions and recommendations

The primary focus of this research study was to determine a best practice guideline for mining companies and independent valuators when using the comparable market valuation method to value a mineral project. The similarity of conducting the comparable market valuation for the real estate and mineral industry were identified and adopted where possible. This research study used gold deposit case study transactions to develop this guideline that can be used by valuators when conducting the comparable market valuation. The guideline is presented in such a way that it can be applied and adjusted to value any mineral and is not only applicable to gold mine valuations. This section will deal with the research study's conclusions, recommendations, and future studies.

6.2 Conclusions

The literature suggests that most mineral property valuators have neither a training guideline nor a detailed framework for reference in conducting the comparable market valuation method. Due to the lack of guidance it is often not used or when it is used it may be used incorrectly. This emphasises the importance of establishing a best practice guideline that valuators can use as a basis in conducting mineral valuations employing the comparable market valuation method. This can leave investors with a certain degree of uncertainty as to what the methodology was that finally determined the value of a mineral property.

Five steps were introduced that form the best practice guideline for conducting the comparable market valuation. A database was constructed by benchmarking from historical gold deposit case study transactions that occurred over a period of 12 years. After validating and analysing the historical transactions certain outliers were removed from the database which could potentially skew the valuation because of various reasons. A total of 20 transactions were finally included in the database and adjusted to current terms by using the ratio between the spot gold price at the time of the transaction and the current proxy gold price at the time of the valuation. No additional inflationary adjustments were made to the historical transactions because the gold price adjustment also adjusts and offsets an inflationary adjustment.

Mineral property transactions occur at an agreed transaction price for a stake of the total project including all its Mineral Resources. Mineral Resource classification separates a resource between Inferred, Indicated and Measured Mineral Resources based on its geological confidence. The project lifetime valuation methodology curve (Figure 4-4), indicates that the project value is usually expected to increase as the geological confidence of a project increases. To gain a better understanding of this, the relationship between the average adjusted unit values (USD/oz) and the percentage distributions of the specific Mineral Resource category (Inferred, Indicated or Measured) to the total Mineral Resource were determined. Based on the results it was calculated that an Inferred Mineral Resource would trade at approximately 10% of the price of a Measured Mineral Resource and an Indicated Mineral Resource at approximately 70% of the price. The mean industry values of all the transactions per Mineral Resource category as at May 2018 were subsequently determined as:

- Inferred: 2.3 USD/oz;
- Indicated: 13.3 USD/oz; and
- Measured: 21.7 USD/oz.

A sanity check, based on the weighted average EV per ounce of six listed gold mining companies, concluded that the values determined above appear to be reliable and justifiable, thus, improving the credibility of the valuation.

Through the review of the literature, it is evident that mineral properties are complex to value since it is difficult to obtain true comparable transactions. Therefore, it is important to identify and apply sensible adjustments. These adjustments were identified by investigating the common economic drivers of a gold mine as well as investigating certain factors that could affect gold projects in other ways. The valuator needs to determine the ranking of each identified factor. The risk associated with each factor were identified through research. During this research the standard norm of each factor in the gold mining industry was determined as well as what makes the factor riskier, or less risky compared to the industry.

The best practice guideline was applied to a gold project case study by calculating a comparative value for an existing gold mining company's stated Mineral Resources. Project-specific adjustments were applied to the gold companies mines and projects which ranked all the mineral assets at a higher risk in comparison to industry criteria. The industry average unit values were therefore adjusted accordingly by calculating the adjustment factors and applying it to the industry average unit values. A best-estimated value of USD269.4 million was calculated which equates to a project average unit value of 8.1 USD/oz that is the expected value that the mineral assets is worth and what a willing buyer could potentially purchase the Mineral Resource for.

According to research, the estimated market value of an asset determines the validity of any valuation. To justify the estimated value based on the comparable market valuation method, the value was compared to the enterprise value of the listed gold mining company. The results differed by only 11%. The value based on the comparable market valuation method following the proposed guideline using gold deposit case study transactions can, thus, be deemed as reliable and justifiable.

6.3 Recommendations

It is recommended that mineral property valuators should make use of the guideline or develop a similar guideline when conducting the comparable market valuation. It is ultimately the valuator's responsibility to construct an adequate database of arms-length transactions and to determine the adjustments to be applied in a justifiable manner. It is recommended that the valuator should consult with industry specialists as far as possible when determining and weighting the adjustments to be applied.

It is further recommended that the three generally accepted mining valuation codes (SAMVAL, CIMVAL and VALMIN), adopt a similar guideline to ensure that mineral property valuators conducting the comparable market valuation method use a clear and understandable methodology. A valuation report based on the comparable market valuation should also have a report structure ensuring that the methodology, conversions, the database used, and adjustments are transparent and understandable. This will safeguard investors from the uncertainty of how and why the comparable market valuation was estimated at a certain value.

6.4 Future studies

This research study has supported the case for a guideline to be developed by benchmarking from gold deposit case study transactions. The focus of this study was on developing a guideline. The guideline can be adapted for use to value any mineral. Perhaps, future studies can look at the application of the guideline to other commodities.

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