

Development of a capital investment framework for a gold mine.

M Clasen

Student number: 20104251

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Study leader: Prof M Oberholzer

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Contents

LIST OF TABLES	ix
LIST OF FIGURES	ix
ABSTRACT	x
ACKNOWLEDGEMENTS	xii
CHAPTER 1: INTRODUCTION	1
1.1 Introduction	1
1.2 Previous studies	2
1.3 Problem	5
1.4 Objectives	6
1.5 Research method.....	7
1.6 Assumptions	9
1.7 Limitations of the feasibility study	9
1.8 Contribution.....	10
1.9 Overview	10
CHAPTER 2: OPERATIONAL BACKGROUND AND INVESTMENT RISKS AND - OPPORTUNITIES	13
2.1 Introduction	13
2.2 Mining operation background.....	13
2.3 Operational activities	14
2.3.1 Operational risks of Mine X	15
2.3.2 Additional risks.....	17
(a) Forward-looking statement.....	17
(b) Operating costs	17
(c) Investment returns.....	18
(d) Mineral resource/reserve	18

(e)	Mining rates.....	18
(f)	Skipping steps.....	18
(g)	Modelling	19
(h)	Unrealistic time frames	19
(i)	Leadership	20
(j)	Contingencies	20
2.3.3	Operational risk management	20
2.4	Operational opportunities	21
2.4.1	Opportunities of the VCR below 120 reef (VCR B120)	21
2.4.2	Opportunities of the Carbon Leader Reef below 120 level (CLR B120)	21
2.4.3	Additional opportunities.....	22
2.5	Summary	22

CHAPTER 3: CAPITAL INVESTMENT EVALUATION TECHNIQUES AND SENSITIVITY

3.1	Introduction	23
3.2	Capital expenditures and cashflows	24
3.2.1	Discounted cashflow (DCF) definition	24
3.2.3	Critical evaluation of discounted cashflow.....	25
(a)	Advantages of discounted cashflow method	25
(b)	Disadvantages of discounted cashflow method	26
3.3	Net present value.....	28
3.3.1	Net present value definition.....	28
3.3.2	Net present value in decision-making	28
3.3.3	Discounting.....	29
3.3.4	The equation for net present value	30
3.3.5	Practical approach.....	31
3.3.6	Critical evaluation of the net present value technique.....	32
(a)	Advantages of net present value technique	33
(b)	Disadvantages of net present value technique	33
3.4	Internal rate of return	34
3.4.1	Internal rate of return definition.....	34

3.4.2	Net present value and internal rate of return compared	34
(a)	Independent versus dependent projects	34
(b)	Net present value versus internal rate of return: Independent projects	35
(c)	Net present value versus internal rate of return: Dependent projects.....	37
(d)	Differences in the scale of investment	39
3.4.3	Critical evaluation of the internal rate of return technique	40
(a)	Advantages of internal rate of return technique.....	40
(b)	Disadvantages of internal rate of return technique.....	40
3.5	Payback period.....	41
3.5.1	Payback period definition.....	41
3.5.2	Critical evaluation of the payback technique.....	41
(a)	Advantages of the payback technique	41
(b)	Disadvantages of the payback technique.....	42
3.6	Sensitivity analysis.....	42
3.8	Summary	44

CHAPTER 4: METHODOLOGY AND APPLICATION 46

4.1.	Introduction	46
4.2.	Research design	46
4.2.1.	Evaluation research	50
(a)	Measuring the success of investment feasibility projects.....	51
(b)	Evaluation planning: Background.....	51
(i)	Formative and summative evaluation	51
(ii)	Outcome and process-based evaluation	52
(iii)	Measuring the success of the feasibility study.....	53
4.3	Research method.....	53
4.3.1	Methodological issues and data sources.....	54
(a)	Data.....	54
(b)	Taxation and tax-break.....	55
(c)	Methodological limitations.....	56
4.4	Capital investment evaluation techniques	57

4.4.1	Net present value.....	57
4.4.2	Internal rate of return	59
4.4.3	Payback period.....	60
4.5	Sensitivity analysis.....	60
4.5.1	Sensitivities.....	60
4.5.3	Sensitivity analysis of internal rate of return	62
4.5.4	Sensitivity analysis of payback period	63
4.6	Summary	65
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS.....		67
5.1	Introduction	67
5.2	Capital investment evaluation techniques	67
5.2.1	Net present values	68
5.2.2	Internal rate of return	68
5.2.3	Payback period.....	69
5.3	Sensitivity analysis.....	69
5.3.1	Sensitivity analysis of net present value.....	69
5.3.2	Sensitivity analysis of internal rate of return	70
5.3.3	Sensitivity analysis of payback period	70
5.4	Summarise conclusions and recommendation	71
5.5	Framework including practical implications	72
5.6	Value of the study	75
5.7	Limitations of the feasibility study	76
5.8	Final conclusion.....	76
REFERENCE LIST		77
APPENDIX A		Error! Bookmark not defined.

LIST OF TABLES

3.1	Different net present value outcomes	29
3.2	Example net present value versus internal rate of return: Dependent projects	37
3.3	Example of the differences in the scale of investment	39
4.1	Summary of net present value	57
4.2	Summary of the internal rate of return	59
4.3	Summary of the payback period	60
4.4	Net present value sensitivity of current operations	61
4.5	Net present value sensitivity of the project that begins immediately	61
4.6	Net present value of a six month delay in the project	62
4.7	Internal rate of return sensitivity of current operations	62
4.8	Internal rate of return sensitivity of the project that begins immediately	62
4.9	Internal rate of return of a six month delay in the project	63
4.10	Payback period sensitivity of current operations	64
4.11	Payback period sensitivity of the project that begins immediately	64
4.12	Payback period of a six month delay in the project	64

LIST OF FIGURES

3.1	Cashflow model through risk analysis	27
3.2	Distribution for net present	32
3.3	Example of net present value versus internal rate of return: Independent projects	35
3.4	Net present value versus internal rate of return: Dependent projects	38
	Internal rate of return in risk analysis	44
4.1	Mapping designs (Level 1)	47
4.2	Mapping designs (Level 2)	48

ABSTRACT

This study was done against the backdrop that executives should carefully consider all the options to manage difficult periods before letting employees go, especially if they are going to rehire employees shortly after the economic recovery. Therefore, the study investigated whether investing in operational development of a plant can be used to increase feasibility, rather than to make across-the-board labour cuts. Two South African mining companies were chosen for this study. They are two investment centres at AngloGold Ashanti, Mine X Ltd. and Mine Z Ltd. The investigating project was done at Mine X to extract gold from the neighbouring Mine Z. Mine X will have access to the minerals 40 years in advance of Mine Z due to insufficient essential infrastructure at Mine Z. The life-time of the project is 18 years (estimated).

The main objective of this study is to investigate the feasibility, from Mine X's point of view, with a deepening project including Mine Z. The most significant aspect will be to determine which investment timeframe decision will gain Mine X a feasible position in terms of economic growth. This will be achieved by the following secondary objectives in making a capital investment decision:

1. To describe the nature and significance of investment decision making.
2. To recognise appropriate capital investment evaluation techniques in conjunction with sensitivity analysis.
3. To apply the techniques and sensitivity analysis in order to make a decision of a possible, feasible investment opportunity at Mine X.
4. To develop a framework to identify the project's components and associate and access difficulties for Mine X's project lifecycle.

The feasibility study undertakes multiple scenarios and provides recommendations and a final report, based on the scenario that is the most viable. The following techniques which were identified were used to analyse the feasibility of the project: Net present value, internal rate of

return and payback period. All these above techniques will be analysed in three different scenarios, namely:

1. Mine X will stay with its current operations without any new projects.
2. The development project will begin immediately.
3. A six-month delay in development of the project.

The study found that the net present value was positive, the internal rate of return was more than the discount rate and the payback period was shorter than the project's life-time regarding to all three above-mentioned scenarios. The highest net present value is calculated in case the project starts immediately. Both the internal rate of return and the payback period indicated that a six month delay in the project is the most viable.

After considering all the facts, the study concluded due to the highest net present value the best feasible recommendation would be to start the project immediately.

The value of this study is that it is the first study to investigate the relationship between the viability to delay or to start the investment project immediately in the South African mining industry. This study is also unique, since it takes into account how mining industries world-wide can achieve long-term success through development projects without losing key players, due to impulsive short-term downsizing decisions.

Keywords: Capital evaluation techniques, internal rate of return, net present value, payback period, sensitivity analysis, feasibility study

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The majority of mining firms globally share a general understanding that their productivity is a volatile commodity. Organisations can effectively administrate this by using a proper set of instruments. Most importantly, organisations in the gold mining industry identify their risks and manage these in great detail. The majority of mining companies were affected by volatile effects of devastating events that forced them to slow down production and either decrease or abandon major expenditures on capital-intensive projects (Hill, 2007:31). Nevertheless, to support future corporate growth and retain talent, organisations should be making strategic changes (Romer, 2005:220-221; Scein, 1985:4-5).

With the economy in a potentially extended recession, increased investment is the best way to stimulate and increase economic growth. Executives should carefully consider all the options to manage difficult economic periods before letting employees go, especially if they are going to rehire employees shortly after the economic recovery. Most successful organisations make sure that they deal with the correct matters in the right ways before they decrease their employment rate (Brain, 1999:14). Remuneration, however, depends not only on the quantity of investment, but also the circumstances of the existing market and productive effectiveness of existing and new organisations (Deyer, 1993:160). As an outcome, a group of African countries are formulating policies and strategies to increase the private sector's involvement and to bring new capital investments into their mining industries (Basu, 2006:54). These policies and strategies cause a number of prosperous African countries to unite and support world peace and to address domestic conflicts. This has resulted in enhanced competition for mining investments in Africa (Giller, 2006:45).

Therefore, South Africa recognises that it must be globally competitive in order to magnetise and preserve mining investments (Oman, 2000:156). Several interventions have been proposed to increase the international competitiveness of the mining industry. This involvement guarantees

that the mining industry maintains a substantial contribution to the sustainable growth of the economy. For this reason, an organisation must cautiously think about its options and measure the feasibility and applicability of cost reducing alternatives before making a decision to rationalise (Ezzy, 2002:24). This is essentially the basis for discussion of this study which will lead to recommendations and an innovative strategy to manage downscaling in South Africa's gold mining industry.

This study will therefore investigate whether investing in operational development of a plant can be used to increase feasibility, rather than to make across-the-board labour cuts. Two South African mining companies were chosen for this study. They are two investment centres at AngloGold Ashanti. To maintain anonymity and objectiveness, these companies will be referred to as Mine X Ltd. and Mine Z Ltd. The investigating project was done at Mine X to extract gold from Mine Z. The life-time of the project is 18 years (estimated). The project development area is east of the shaft at Mine Z. Mine Z had to abandon more than a million ounces of gold out of the life-of-mine production ~~to~~ due to safety apprehensions. Mine X is presently mining at the neighbouring development block of Mine Z. Mine X will have access to the minerals 40 years in advance of Mine Z due to insufficient essential infrastructure at Mine Z. Meaningful synergies and feasible advantages can be created by combining the operations of neighbouring Mines X and Z into one business unit. By doing this, Mine Z would be able to attain a reasonable value for the natural resources, carry its value forward and be able use these funds in its existing operations. At the same time, Mine X can utilise the mineral rights for the removal of its raw materials in the near future to support its value-adding growth strategy.

1.2 Previous studies

As previously mentioned, earlier studies have shown that an organisation must cautiously think about its options and measure the feasibility and applicability of cost reducing alternatives before deciding to rationalise (Dyer, 1993:169).

Further studies (Haines, 2000) have identified increased employment as a key contribution to decrease deficiencies and achieving development goals. Public investment makes extensive contributions in terms of economic growth, employment and trade competitiveness to the residents. Such investments can develop into a key driver in developing a 'clean-energy' economy (Artís, 2002:102). Organisational rationalising as a changed management strategy has been implemented for decades (Gandolfi, 2007:13). This strategy was first implemented in the 1980's and early 1990's, by organisations that experienced complicated economic periods (Gandolfi, 2007:16). However, since the mid 1990's, rationalisation has developed into a foremost strategy for the majority of organisations around the globe (Mirabal & De Young, 2005:469-470). The main force behind most rationalised efforts is the longing for an instant decrease of expenses and to improve levels of competence, productivity, effectiveness and competitiveness (Farrell & Mavondo, 2004:390).

In 1999 there was an investigation conducted by the mining involvement of Canada. According to *Innovation in the Canadian Mining Industry*, most international mining companies have research and development programs in their organisations focused on increasing competitiveness. They perform research and development activities to decrease expenses and improve efficiency through developing new and improving accessible processes. To increase the production of assorted merchandise's value, is a major business opportunity in the Canadian industry. Canadian companies constantly try to find innovative technologies that would increase feasibility and add additional value to their merchandise. A single method to find these technologies is to invest in research and development (Kellogg, 2002:103). A strategy in Canada was therefore presented to enhance innovation to encourage economic and social growth. Through encouraging the debate of this nationwide attempt, the government released two complementary documents: "*Achieving Excellence: Investing in People, Knowledge and Opportunity and Knowledge Matters*". In 1999, the Mining Association of Canada (MAC), launched an investigation on innovation and established that about two-thirds of outlays are allocated for research and development expansions. Only three percent is allocated to general research and development. The mining sector therefore, places a great deal of emphasis on the late phases of research insertion and development as opposed to the first phases of pure research (McKinley, 1999:198).

In the most recent studies, according to the Global Competitiveness Report (2009) policymakers currently struggle with methods of managing multiple shocks, and at the same time arranging their economies to achieve good results during periods characterised by increased volatility. In an unbalanced financial environment worldwide, it is essential for countries to establish the basics underpinning economic growth and development (Bohm, 2006:56-60).

The mining sector was recognised as the most important economic sector in South Africa, but studies revealed that in current years it has slid back from pole position to being merely the fifth or sixth largest supplier of total Gross Domestic Product (Wright, 2000:147). Research has revealed that the mining sector is still regarded as a keystone of the economy, but in current years the mining sector has been at the receiving end of a couple of crises and negative developments, some that are listed in the Bank of America as part of the fundamental causes of its pessimistic insights (Lynch, 2009:109). The uncertain economic background reinforces the significance of optimising capital project plans and outcomes. The challenges of capital investment and capital projects are still better when there is a need for improvement in the environment. Throughout the market segment, organisations are expected to change their strategies by decreasing outlays and evaluating risks versus returns on new and existing projects. The inputs for innovation of a capital-intensive industry like the mining industry will be founded in a positive investment environment. Disregarding the difficulties of investments will allow the mining industry to carry on making a considerable contribution to the national economic growth, innovation, regional development, performance, exports, employment and enhanced quality of living. Delay or annulment, however, can increase outlay and can expose organisations to market share losses in an economic recovery (Hurley, 2009:214). Due to the above factors, the South African mining sector has time and again changed direction towards becoming less competitive in the global market (Glynos, 2008:55). This has been aggravated by the increased competition of new global mining countries that are showing to be more competitive, for example, China who surpasses South Africa as a major gold producer (Lynch, 2009:789).

This study will therefore aim to optimise capital project deliverance in guiding mines to be better positioned to increase feasibility. This is similar to the approach Mentzer (1996), used in his study. This study will thus seek to provide the mining sector with knowledge to guide the project management team in making the most feasible decisions. This will form the foundation of the

study to determine if the mining industry needs to invest in order to be feasible and in turn contribute to the global economic growth. This decision may assist South Africa to become the major global gold producer again.

1.3 Problem

The previous studies have shown that the mining sector has slid back from pole position (Wright, 2000) due to a number of catastrophes and negative developments evident in previous studies (Lynch 2009:109). The difficulty however is that delays or annulments can increase expenses and cause companies to be exposed to market share losses when the economy recuperates (Hurley, 2009:214). Mine X's profitability depends partly, on real profitable returns and real costs of development, which may fluctuate considerably from its existing estimates. The expansion project at Mine X may be subjected to unforeseen difficulties and delays.

Mine X's decision to expand its operations, will be broadly based on the outcomes of this feasibility study. A feasibility study predicts the estimated project's profitable returns. There are a number of suspicions about the expansion and production of an extension to an existing or new mine. Uncertainties include the following together with those identified above (Singer, 2011:375):

- timing and costs, substantially to the construction of mining and facilities;
- accessibility and costs on skilful employees, electricity, water and transportation services;
- accessibility and costs of suitable smelting and enlightening activities;
- requirement to consult essential ecological and other law-making authorities as well as the timing; and
- accessibility of resources to finance creation and development activities.

Innovating mining operations might experience unforeseen difficulties and delays throughout expansion, and construction. This can cause postponement of mineral production. Finally, estimates of operating and capital expenditure might vary significantly as an outcome of variation in the prices of merchandise consumed in the mining operations. Accordingly, Mine

X's expansion operations may not affect the development or replacement of the existing production with new production, or new production sites. Therefore, the operation may not be as feasible as presently predicted or may not be feasible at all.

If only some of the above factors occur, it can cause Mine X to close down its operations and will lead to rationalisation. This can also cause Mine X to lose the opportunity in making a contribution to the economic growth in order to become a major global gold producer. This problem leads to the following research question:

Research question: Will Mine X's investment project in extracting the gold from Mine Z, be feasible?

1.4 Objectives

The main objective of this study is to investigate the feasibility, from Mine X's point of view, with a deepening project including Mine Z. The most significant aspect will be to determine which investment timeframe decision will gain Mine X a feasible position in terms of economic growth. This will be achieved by the following secondary objectives in making a capital investment decision:

1. To describe the nature and significance of investment decision making.
2. To recognise appropriate capital investment evaluation techniques in conjunction with sensitivity analysis.
3. To apply the techniques and sensitivity analysis in order to make a decision of a possible, feasible investment opportunity at Mine X.
4. To develop a framework to identify the project's components and associate and access difficulties for Mine X's project lifecycle.

1.5 Research method

In this study, inductive research approaches are used to establish whether investing in a development project can generate a competitive advantage rather than to rationalise Mine X. Therefore the purpose for using an inductive approach is to summarise extensive and diverse raw text information into a short, outline layout; to create clear associations combining the research objectives with the outline conclusions resulting from the raw information and to develop a model or theory about the fundamental structure of knowledge arising from the raw information. Therefore, the inductive approach is used for qualitative data analysis (Ezzy, 2002:13). The research design is based on evaluation studies, because it aims to evaluate and answer the questions of whether the methods used, have been efficient and effective. This includes short-term outcomes, as well as long-term outcomes (Mouton, 2002:160).

A feasibility study was performed to determine whether the investment project of Mine X will be feasible and have a positive effect on employment in order to contribute to the economic growth by making a sensible decision. This evaluation is a feasibility study, which is identified as an analysis of the possible outcome of a future project. Its purpose is to support managers in deciding whether or not to realise a specific project. This study is based on widespread research on current exercises and the anticipated projects and its reactions to the organisation's competitive advantage. The study will also contain extensive data, related to financial and operational impact and include advantages and disadvantages of both the current situation and the proposed investment project (Gartignon, 1986:305).

Furthermore, it assists decision-makers in making decisions that will be in the best interest of the organisation's operations. The extensive research will be conducted in a non-bias manner, and will provide data upon which to base a decision. In simple terms, a project is financially feasible if a firm can make sufficient money out of the project to:

- reimburse the loan (including interest and principal debt); and
- pay dividends to shareholders.

The feasibility study undertakes multiple scenarios and provides recommendations and a final report, based on the scenario that is the most viable. The following techniques which were identified were used to analyse the feasibility of the project:

1. Net present value
2. Internal rate of return
3. Payback period.

All these above techniques will be analysed in three different scenarios, namely:

1. Mine X will stay with its current operations without any new projects.
2. The development project will begin immediately.
3. A six-month delay in development of the project.

If there is a delay in the project it means that the normal current operations at the mine will still take place. The current operations at the mine cause high stress conditions that is typically a combination of the natural pre-mining stress and the stress changes induced by the current mining conditions. This high stress levels cause seismic events to take place. Seismic events are a normal response of a rock mass to stress readjustments near an excavation. This damage can vary in intensity from minor rock spilling to catastrophic rock mass fracturing. The dynamic nature of rockburst damage means that there is the potential for extensive damage to or complete destruction of supported and unsupported underground excavations. Therefore the deepening project can result in a high safety risk environmental area that would cause the mining operations to slow down as well as production. The delay may also result in lower gold production. Therefore it would probably be the best to stop with the current operations and begin immediately with the deepening project without a delay.

Each of the above techniques was used in the analysis in order to shed light on the project from as many different angles as possible. Information was obtained from the actual plant, and where necessary, estimations were made. The information obtained is used to determine future costs and revenue if the plant will be developing through its neighbouring Mine, Z.

Furthermore, sensitivity analysis will be used to coping with changes if variables change. Since sensitivity analysis is not to quantify risk (Drury, 2011:250), risk is essential to take into account, because it may influence the variables' estimates. The focus of sensitivity analysis is to determine how results will change if the original estimates of the underlying assumptions change (Drury, 2011:223).

1.6 Assumptions

For the purposes of this study, it is assumed that net present value will be estimated at 18 years for all three scenarios and this study furthermore evaluates what the long-run impacts of such a development project would be in terms of productivity and overall economic growth.

1.7 Limitations of the feasibility study

The supplementary projection and analyses are based on estimates and assumptions of using existing economic information, project specific information and earlier applicable information. It is the nature of forecasting, that some assumptions may not occur and unexpected events and circumstances may occur. Such changes are liable to require review or revision of this document. The following illustrates the limitations of the documentation and information used in this study (Flynn, 2002:450):

- The analyses contained in the documents are based, in part, on information from secondary sources such as financial managers, planning managers and third parties. While Mine X believes that these sources are reliable, their accuracy is not guaranteed.

- The development cost information for the analysis of the capital-investment project obtained by the local sources of Mine X, is deemed reliable, but has not been separately verified. Note that the uncertainty includes the preservation and reprocessing of historic structures. Note also, that supplementary allowances are needed to reflect this uncertainty.

1.8 Contribution

This project can be a great example for mining industries world-wide to accomplish long-term success through development projects without losing key employees because of impetuous immediate decisions.

The contribution of this study within the mining sector is the establishment of a capital investment management framework to evaluate and identify project components and related issues for each method used in this study. These identifications will aim to accomplish feasibility together with economic growth in South African mining industries to become the major gold producer globally. Therefore the framework will help the mining sector understand that strategic thinking contributes to world-wide economic growth. The mining investment growth is expected to increase economic growth, because the mining sector can bring in investment that is promising for South Africa's economic growth.

The findings may serve as a preliminary point for further, more profound evaluation, to eventually result in a firm knowledge base and to commence efficient and effective strategic development decisions.

1.9 Overview

Chapter 1: Introduction

This chapter illustrates the relevance of the research topic and includes the problem statement. A review of the project can help stakeholders understand the questions asked and the results

generated. Using uncomplicated conditions eliminates uncertainty about a project for stakeholders, who might be unfamiliar with the information represented by the study.

Chapter 2: Operational background and investment risk and -opportunities

Chapter 2 mainly consists of a technical background of Mine X. The operational information this chapter provides will help to evaluate the risks and uncertainties and recommend how the risks and uncertainties can be reduced. This helps decision makers to focus on the overall picture in decision making. Some managers of organisations may not want to approach a new market except if they can dominate it. Other companies favour increased returns, instead of market share. Either way, the challenges faced should be defined, together with the consequences of disappointment, which are provided in this chapter.

Chapter 3: Capital investment evaluation techniques and sensitivity analysis

Chapter 3 consists of a theoretical foundation of the three main techniques in evaluating the capital investment project. This information will help Mine X to stay clear, focused, and unbiased about a project's real requirements. Project managers that understate the substantial and fiscal resources essential for a new product often end up with unsuccessful projects or disappointments. Therefore, sensitivity analyses with regard to the three techniques are also explained.

Chapter 4: Methodology and applications

This chapter is based on two main aspects, namely research design and research methodology, followed by an investigation of the application of the three investment appraisal techniques, namely net present value, internal rate of return and payback period. Increasingly, investors and management pore over the financials in a feasibility study to make sure that projects can produce the kind of profits that permit their approval. Specialists in project management emphasise the timeline outlook of when a project can reimburse itself.

Chapter 5: Conclusions and recommendations

This chapter draws conclusions and recommendations are made based on the research conducted. The conclusions provide a capital investment management framework to identify project components and related issues for each phase of the project's lifecycle. By summarising all of

the previous feasibility study steps, the recommendations and findings can shape the outcome of a project proposal. Instead of simply stating a “yes” or “no” answer to the question of project approval, this section offers an opportunity to enhance a project by pointing out areas of opportunity.

CHAPTER 2: OPERATIONAL BACKGROUND AND INVESTMENT RISKS AND -OPPORTUNITIES

2.1 Introduction

This chapter firstly consists of a technical background of the mining operations of Mine X, the explorer mining company. In this chapter quarterly reports of the two investment centers at AngloGold Ashanti were investigated and summarised to form the technical background and provide numerical values. Secondly, an overview of the operational risks and uncertainties together with a recommendation of how these risks and uncertainties can be managed through a risk management plan. The third part of this chapter identifies the opportunities of the project to put the project under investigation into perspective. The challenges faced are clearly defined, along with the consequences of failure. Therefore this chapter will contribute to the framework that provides clear supporting knowledge for this feasibility study's recommendation in achieving the objectives referred to in Chapter 1. This contribution will help decision-makers in circumventing the limitations of investment and thus enabling the mining industry to continue to make a contribution to the country's national economic growth.

2.2 Mining operation background

Mine X is an open pit mine that visually gives the impression of a patio. Holes are made into the mining surface. The mining area at the depth is occupied around the edge of Mine X. Once the raw materials and waste have been separated from the outcropping, the excavation moves a surface level downwards and the mining operations starts once more. This type of surface mining is recognised as solid rock mining and removes metal material, like gold, copper, aluminium and iron, and other minerals (Mackey, 2003:26-100).

In the West Wits area there are two efficiently feasible reefs that are mined there. The first reef is the shallower Ventersdorp Contact Reef (VCR), and second reef is the deeper Carbon Leader

Reef (CLR). These reefs have been comprehensively mined at Mine Z whereas Mine X has mined the Ventersdorp Contact Reef. The two reefs can presently be accessed through Mine X down to level 120 with no infrastructure presently capable to facilitate stopping below level 120, though a big area of the Carbon Leader Reef below level 120 remains unreachable for miners. Therefore the investment project considers methods together with the potential risks and returns associated of entering through mining from Mine X. This forms the scope of the investment project in this study. The reasons for the changed interest and study are due to two major factors (Pijing, 2007:51):

- A considerable raise in the gold price has occurred since the previous studies conducted.
- An extension project of the current Mine X at the Ventersdorp Contact Reef area was also approved. This extension can extend the life of the mine for a couple of years or more.

The extension will result in increasing returns and possible opportunities that allow the implementation of the project and production increase without any major “gold-gap”. These opportunities will be examined in more detail later in this chapter. Firstly, the operational activities will be explained and examined in order to identify the certain risks and uncertainties. This identification will lead to the clarification in decision making of this investment project.

2.3 Operational activities

There is an extensive selection of categories that can be grouped as ‘operational’ activities. These activities each have a different set of risks that have the possibility to stop the progress of operations, which could be expensive for Mine X. Both of these should be scrutinised, as both are responsible for different areas of the organisational activity. Mine X must also think about the existing positions of every area and transmit risks to each area. For example, does the organisation rely on one contractor? What will the risk management strategy be if this contractor goes out of business? When there is no risk management strategy in place, the outcome for Mine X could be very negative. If the support of an investment project is committed in the first two or three years, the possibility that a major project could be unsuccessful will be revealed in these

first three years (Madic, 2011:201). Therefore, companies try to maintain as much managerial control as possible in the first couple of years. This implies that when the costs are available and the investment is made, then the investment project is past the most uncertain stage. Although, organisations will face many uncertainties when they make risk decisions in order to identify the feasibility of a project (Chen, 2007:85-86). These uncertainties can lead to a variation between the actual result and the expected result, decrease the return rate of investment and expand the investment payback period. Therefore, identifying these risks and uncertainties will help decrease the deviation between the actual and the expected result. This reorganisation will result in an improved point of view of whether the project will be feasible or not in terms of the mining circumstances.

2.3.1 Operational risks of Mine X

Mine X faces many risks associated with its operations that may influence the cashflows and in general, profitability of the investment project. Therefore the risks will be identified in an aim to minimise these negative influences and to identify if the project would be feasible (Spekman, 2004:79; AngloGold Ashanti, 2001:80):

- The level of liability at Mine X could unfavourably influence the business operations.
- Mine X uses gold hedging instruments and has entered into continuing sales contracts. These continuing contracts may prevent Mine X to recognise possible cash inflows from subsequent commodity price increases in the future. Therefore, Mine X reported that because of the need for reasonable value, the financial conditions could be unfavourably affected.
- Fluctuations, power stoppages and energy expenditure increases could unfavourably influence the Mine X outcome of operations and financial position.
- Contracts for sale of uranium at fixed prices could affect Mine X's operational results and financial position.

- Foreign exchange fluctuations could have a material unfavourable effect on Mine X's operational results and financial position.
- Inflation may have a material unfavourable effect on Mine X's operational results.
- Mine X's latest order mining rights in South Africa could be cancelled or suspended, should Mine X violate, and be unsuccessful to its obligations in respect of the acquisition of these rights.
- The preamble of the South African State of royalties, where a significant portion of the Mine X's mineral reserves and operations are located. This can have an unfavourable effect on Mine X's outcomes of operations and its financial position.
- Certain factors may affect Mine X's ability to maintain the deliverable value of its property, equipment and plants, acquired properties, investments and goodwill on the statement of financial position.
- The diversity of the mining industry in interpretation and submission of accounting literature may impact Mine X's reported financial results.
- Mine X's mineral reserves, deposits and mining operations are situated in countries implying political, economic and/or security risks.
- Labour disruptions and/or increased labour costs could have an unfavourable outcome on Mine X's operating outcome and financial position. The use of mining contractors at Mine X's operations may cause delays or suspensions in the mining activities and increases in mining costs.
- Mine X is predisposed to certain risks in dealing with malaria and other tropical disease outbreaks, mostly the operations located in Africa, which may have an unfavourable effect on operations.

These risks can now be assigned to individual team members of Mine X for the project development process and for risk allocation purposes. Multifaceted, uncertain, high-cost projects

can influence the accurate processes of analysis, assessment, mitigation and planning, allocation, monitoring and updating. These risk identification processes promote creative thoughts and increase the knowledge and understanding of Mine X's teams. In application, risk identification and risk evaluation are often finished in a solitary stage, called risk assessment (Mascitelli, 2000:180-181).

2.3.2 Additional risks

All projects are advised to concentrate on the technical issues and risks, each of which can contribute to the failure of projects. However, without taking into consideration the aspect of all these technical risks, high-quality management procedures should administer a process that minimises technical risk. These general issues relating to the project management procedures (which can manifest failure to recognise technical risks) are identified below:

(a) Forward-looking statement

Forward-looking statements are based on a number of assumptions and estimates. Though considered practical, these statements are subject to considerable economic, competitive and business uncertainties. Therefore the risks and contingencies may not be executed as intended (Dobler, 2007:93).

(b) Operating costs

Foreign exchange estimations, mineral prices and operating expenses may fluctuate from management's outlook. Mine X cautions the reader that such forward-looking statements absorb familiar and unfamiliar risks, uncertainties and former factors. These uncertainties cause the real financial results of Mine X to be different from the estimated future outcome or implied by the forward-looking statement. These forward-looking statements are not guarantees of the future performance (Vraniali, 2010:167).

(c) Investment returns

In the long term, investment returns are at risk due to the principle that mining is a cyclical sector of market downturn, higher taxation and project delays (Potvin, 2008:206).

(d) Mineral resource/reserve

Difficulties of mineral resources are the main technical difficulty of incorporating failure of mining investment projects. Mineral resources should be audited and defined. These resources then, needs to be reported according to the relevant code and placed into practice prior to each applicable stage of the investment project. Modifying the supply because of geological information received throughout the course of a revision phase is often the cause of modifications and setbacks. This happens because there are no solid and quick rules to the resource requirements of each mining phase (Shillabeer & Gypton, 2003:101-102).

(e) Mining rates

Difficulties occur when the mining rate forecast model is not clear and established before initiation of the investment project. There can be a persuasion to ‘crank up’ the mining rate to impractical levels in order to surpass the financial difficulty for the project (Smith, 1997:48-54; McSpadden & Schaap, 1984:217-220). If a demanding but attainable objective is incorporated in the feasibility study, the chance of failure possibly exceeds 50 percent (McCarthy, 2003:23).

(f) Skipping steps

Skipping the pre-feasibility study can lead to expensive delays in the final feasibility study. Scoping studies are comparatively, diminutive and reasonably priced when compared to pre-feasibility and final feasibility studies. If the scoping study proves that a selection or the total

project is not feasible, considerable expenses in pursuing a non-feasible option or project through the final feasibility study can be avoided. A common result from scoping studies is that more metallurgical data is needed to guarantee that there is adequate information to slim down the selected operating scenarios. As this information can be costly and lengthy to obtain, the scoping study can rapidly assess these requirements. This is an essential outcome to guarantee rational budgets and schedules are developed for the complete project (Noort, 2006:58).

(g) Modelling

The primary difficulty in the premature phases of a mine development project is oversimplifying the level of complexity implied. While the accuracies at the stage are not constantly high, each stage of the mining process involves an abundance of series and iterations. The mine shell's characteristics in turn produce information to decrease costs or risks. These innovative ideas are then priced and mineral resources re-optimised in every scenario. The question needs to be asked as to whether by doing a replication will result in a specific option being excluded or included in the shortlist of options to continue to the next phase. Additional refinements of a viable option may not be efficient until later phases, when the response to the question is "no" (Bessis, 2001:87).

(h) Unrealistic time frames

Technical studies that require bringing mining operations into production are expensive and lengthy. The total mining project from scoping to completion of the final feasibility study may take up to ten years. If the requirements of the organisation propose shorter time frames than what is most favourable, this is essential. Thereafter the related increase in the risk profile needs to be understood and communicated. Impractical time frames and budgets frequently result in projects being swift to the finishing point and failing the objectives achievements. This consequence may result in a delay in recognition of major difficulties until after the obligation of capital expenditure (Beck, 2007:23).

(i) Leadership

It should be realised that the majority of mine feasibility studies demonstrate that projects are most sensitive to ‘uncontrollable’ elements such as taxation, commodity price and inflation, than ‘controllable’ elements such as capital, recoveries and operating costs. It is possible to surpass any financial difficulty without changing the technical information of the project but merely changing the economic factors. Therefore it is difficult to locate project teams to deliver positive project outcome. Frequently, projects experience iteration to deliver a solitary estimate of project value. The outcome may conceal the reality that projects are limited to produce a feasible project outcome. Projects need physically powerful management to oppose pressure and ensure the project team is paying attention on presenting the project reasonably rather than to be satisfactory (Smith, 1997:54).

(j) Contingencies

Project cost estimates have previously revealed a strong inclination to increase as the project moves ahead. This is usually the outcome of bad information and submission of contingencies (McKie, 2002:136).

2.3.3 Operational risk management

The operational risk management will show how Mine X can manage its risk identified in supporting the best feasible decision. These risk management techniques will recognise the considerable risk challenges to the project and will initiate a suitable management response to management improvement at Mine X (Fox, 2006:99):

- Observe the condition of the stage and kibble ropes.
- Make sure no individuals will be exposed to the elements of blasting fumes while travelling in the shaft.

- Increasing the expansion rate on 113 level and 116 level. The accomplishment of this goal is fundamental to the feasibility of the project. An achievement plan has been established to make sure this goal will be achieved.
- The augmentation of stopping intensity will increase mining levels to a maximum of level 120 (25 percent higher than at 109 level). This will increase emitted seismic power as well as pressure driven breakage and deformation of the underground excavations. The operation of the rock mechanic strategies and recommendations will guarantee that the risk will be minimised.

2.4 Operational opportunities

Identifying Mine X's operational opportunities will help the management of Mine X seize the opportunities and bring them into consideration when the recommendations of this feasibility study will be made.

2.4.1 Opportunities of the VCR below 120 reef (VCR B120)

Mine X has a business plan set at the quarterly reports of AngloGold Ashanti's accounts. The VCR below 120 level project can increase Mine X's raw materials and life span if Mine X starts with its operations immediately. The VCR below 120 project furthermore creates the opportunity to access additional operation areas within Mine X's current operations as well as additional operations south into the Western Ultra Deep Level area (WUDLs). These opportunities will enhance the current project and can contribute to it becoming more feasible (Alshawi, 2000:47).

2.4.2 Opportunities of the Carbon Leader Reef below 120 level (CLR B120)

This project area lies underneath the existing infrastructure within Mine X's lease border line and may be accessed by deepening the existing sub shaft operation or by sinking a tertiary shaft system. The Deepening project will also extend the life of mining operations of Mine X due to an

increase in the production profile and the promising gold price (Staff, 2007:12). The increased production was due to higher quality grade than estimated obtained on the eastern side of Mine X. This increase of mining operations can contribute to a positive net present value of the project (Damarupurshad, 2005:40-42).

2.4.3 Additional opportunities

At complete production, the project will increase employment at Mine X. This opportunity takes an encouraging approach to create opportunities for underprivileged South Africans (Hamann, 2004:280-281). Extending the mining area at Mine X will guarantee that the neighbouring communities maintain prosperity. The neighbouring community will also continue to provide housing and neighbourhood activities for the employees and staff, helping the local economy to develop and grow (Porter, 2000:15).

2.5 Summary

In evaluating the organisation's risks and uncertainties it is found that the timing, cost and complexities of mine expansion and production can increase, because of the isolated position of many mining properties. Innovative mining operations could experience unpredictable difficulties and delays throughout expansion, construction, operations and mine activation. Therefore, the information provided in Chapter 2 about the operational risks, background and opportunities together with a well established risk management framework can reduce the variation between the actual result and the anticipated result. With setting this risk management system in place, the life of the mining operations can be extended and the organisation's objectives can be accomplished. This can contribute to getting a better perspective to the project's feasibility in terms of the operational knowledge provided by this chapter. This valuable knowledge can lead to minimising unpredicted difficulties and delays throughout the expansion, construction, operations and mine activation. This can set a high standard of appropriateness to evaluate the feasibility of the project using the three main techniques as defined and evaluated in the forthcoming chapters.

CHAPTER 3: CAPITAL INVESTMENT EVALUATION TECHNIQUES AND SENSITIVITY

3.1 Introduction

In Chapter 2, the operational background, investment risks and -opportunities were discussed. This can help organisations to recognise risks and uncertainties beforehand and can minimise the risks in focusing on the bigger picture in terms of the investment decision making process. The overview in Chapter 2 forms the basis of this chapter and assists in the description and function of each technique in determining if Mine X can be feasible.

The chapter has been divided into two main sections. The first section discusses the theoretical foundation to the attributes and defects of each of the three techniques in evaluating the capital investment project. The second section discusses the sensitivity of the project through a risk analysis verified in Chapter 2. The three capital investment evaluation techniques are the net present value, internal rate of return and payback period. The discounted cashflow method supports the net present value technique as well as the internal rate of return. How the decision rules are derived, is also described. Different sets of circumstances are introduced to show how the net present value approach can cope with the situations met in an imperfect world, (e.g. taxation, inflation, different interest rates, repeat investments, mutually exclusive investments, capital rationing).

This information will help the firm to stay clear, focused, and unbiased about a project's real needs. Project managers, who understate the physical and fiscal resources required for a new product or service, often end up with failed projects or unfulfilled promises. Therefore, the sensitivity analysis in this chapter is used to coping with changes if variables change.

3.2 Capital expenditures and cashflows

Capital expenditures are creating potential remuneration. A capital expenditure is incurred when a business spends money either to buy fixed assets or to add value to an existing fixed asset with a useful existence that extends past the taxable year (Stone, 2011:129). Capital expenditure is used by a company to obtain or improve physical assets. In accounting terms a capital expenditure is added to an asset account ("capitalised"), thus increasing the asset's basis (the cost or assessment of an asset as adjusted for tax purposes). Capital expenditure is usually initiated on the cashflow statement as "Investment in Plant, Property and Equipment" or something similar in the investing section (Bresnahan, 2002:79-89).

Capital expenditures for taxation purposes cannot be deducted in the year in which the expenditures are paid or incurred and must be capitalised. The common rule when cost must be capitalised is when an asset has a useful existence longer than the taxable year. The capital expenditure costs are then depreciated over the life of the asset. Therefore, adjusted capital expenditures generated or added basis to the asset or property will determine taxation liability in the occurrence of a sale or transfer (Drury, 2011:200).

3.2.1 Discounted cashflow (DCF) definition

This measures the change in shareholder wealth as an outcome of accepting a project in terms of decision making. Then again, the investment project is considered to be feasible when the net present value is positive. The feasibility of projects is evaluated, through a comparison of the internal rate of return to the financial or economic opportunity of cost of capital. Discounted cashflow techniques are used to calculate the net present value of a series of cashflows. (Olsson, 2000:1).

The mining industry is full of risks and uncertainty, and although there might be the assurance of funds to appear in the future, it can never be definite that the funds will be established until it has

essentially been remunerated. This is an essential dispute, therefore risks and uncertainty must constantly be considered in investment appraisal. But this argument does not explain why the discounted cashflow technique should be used to reflect the time value of money. Therefore, the following example will be used to explain this important aspect in investment decision making.

The discounted cashflow technique is a project appraisal technique, based on the concept of the time value of money through the following example (Drury, 2011:169): Spending or earning R1.00 now is worth more than R1.00 earned in the future. Since there could be several different reasons why a current R1.00 is worth more than a future R1.00 (Horngren & Foster, 2011:180), the time value of money should be taken into consideration when making an investment decision.

3.2.3 Critical evaluation of discounted cashflow

Discounted cashflow method is not based upon accounting profits but rather on the cashflows of a project. Cashflows are measured because they demonstrate the benefits and cost of a project when it actually transpires. For illustration, the original cash expenditure will form part of the capital cost of an investment project, and not the estimated cost of depreciation which is used to extend the capital cost over the asset's existence in the financial account (Drury, 2011:306). Therefore, discounted cashflow factor will be evaluated through discussing its advantages and disadvantages in the following.

(a) Advantages of discounted cashflow method

One of the principal advantages of the discounted cashflow appraisal method is that it takes the time value of money (by discounting) into account. Other advantages incorporate the following (Akalu, 2001:375-383; Hongren & Foster, 2011:123; Drury, 2011:46):

- All cashflows that relate to the project are used in this method.
- This method allows the timing of cashflows.

- There are generally established methods to calculate the net present value and internal rate of return.
- The method is a functional method to evaluate a business as a whole, as well as individual business components of a company or firm.
- The method is straightforward in understanding and application and can also be personalised to deal with compound situations.
- The method can be used in support of equity shareholders because on the basis of discounted cashflow valuation, it can value two companies and help make an investment decision of to invest or not to.

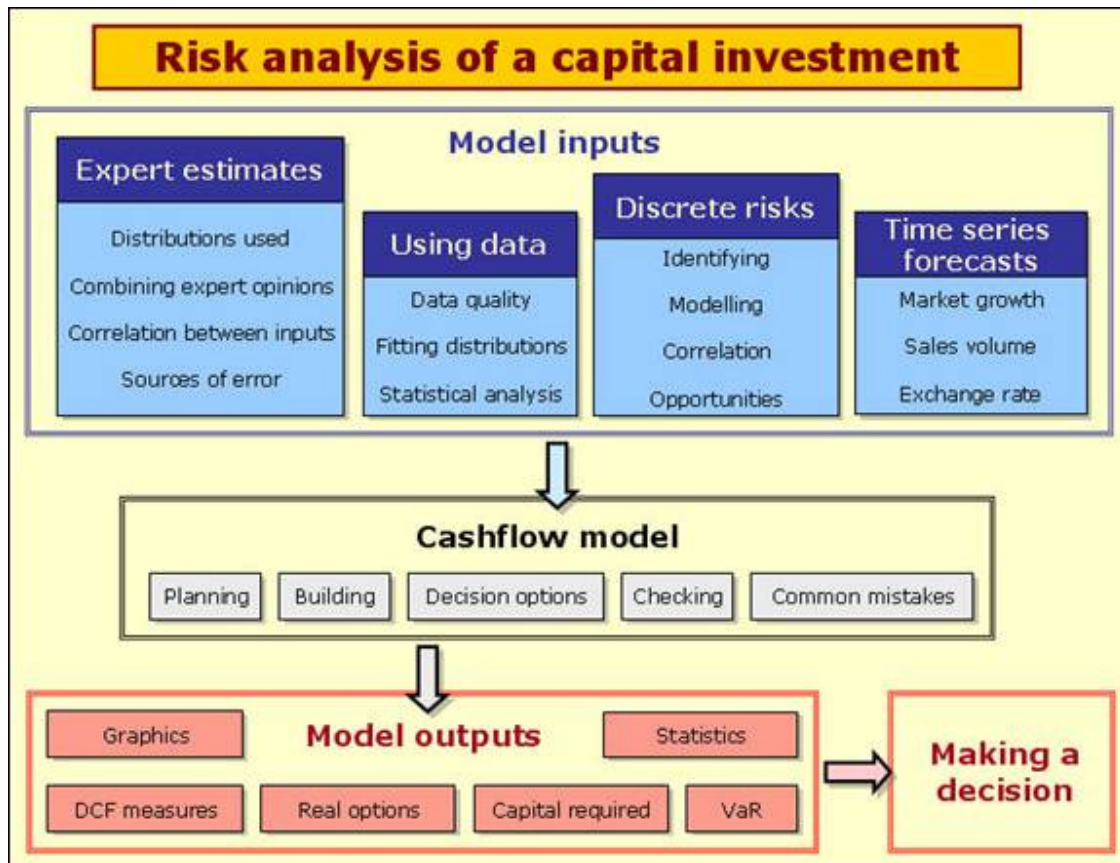
(b) Disadvantages of discounted cashflow method

The discounted cashflow analysis has its merits, but also has its shortcomings. Firstly, the discounted cashflow method depends on its input assumptions. The assumptions depends on what the management believes about how a company will operate and how the market will unfold. This means that the discounted cashflow valuations could fluctuate wildly, which enormously influences the input assumptions. If the inputs of free cashflow forecasts, discount rates and eternity growth rates, are extensively off mark, the reasonable value generated for the company won't be accurate. Thus, when stock prices are assessed, the reasonable value will not be functional. Following the "garbage in, garbage out" principle, if the inputs into the model are "garbage", then the outcome will be alike. Therefore the following will explain the discounted cashflow disadvantages (Akalu, 2001:376; Doreen, 2007:276):

- Since it is an evaluation instrument, it is greatly dependent on the inputs used for evaluation purposes. Therefore, if the inputs changed to some extent there can be huge changes in the value of a company.
- The method makes use of future cashflows as an input. Therefore, the success of discounted cashflow is directly related to whether management can predict the future cashflows accurately or not and these are very difficult to predict.

- Companies using the discounted cashflow method should combine the use of other methods of valuation, in order to make accurate decisions concerning the investment decisions in companies.

Figure 3.1: Cashflow model through risk analysis



(Source: Settergren, 2004:106)

Figure 3.1 is a representative discounted cashflow model for any potential investment. This model forecasts costs and revenues over the existence of the investment project and discounts those revenues back to a present value. The majority of analysts commence a 'base case' model and incorporate uncertainty into the essential elements of the representative model. Figure 3.1 emphasises the processing and nature of the information used together with detailed combinations of the variables, like cashflow, return on investment, and risk to calculate the

approximate probability for each probable outcome. Managers can use the model to rate the chances of considerable increase in their ventures more accurately (Brooks, 2003:12-22).

3.3 Net present value

3.3.1 Net present value definition

Net present value is the present value of cashflows, discounted at the cost of capital, less the investment outlay. This is a popular technique for investment decisions because it is a financial measure that ascertains the time value of money invested in a business (Diacogiannis, 2008:89). An understanding of various project evaluation techniques provides the investor with valuable tools for determining which projects, if any, should be accepted or rejected (Gowthorpe, 2005:497). Therefore, the net present value analysis is the process of taking a current investment and projecting the future net income from the investment.

3.3.2 Net present value in decision-making

Net present value is an indicator that determines the value an investment adds to the organisation. If the outcome of the investment project's net present value is positive, the investment project is in the position of cash inflow. But if the project outcome is a negative value, the project is in the position of cash outflow. In theory, if the risked investment project's net present value is positive, the project could be accepted. This does not essentially mean that these risk investment projects should be undertaken since net present value at the cost of capital may not account for opportunity cost, e.g. in comparison with former accessible investments. Where there is a choice between only two equally limited alternatives, the one with the higher net present value should be selected (Drury, 2011:58). Table 3.1 (p. 29) will show different outcomes of the net present value and how the organisation should react in terms of the investment decision.

Table 3.1: Different net present value outcomes

If...	It means...	Then...
Net present value > 0	The investment would add value to the firm	The investment project may be accepted
Net present value < 0	The investment would deduct value from the organisation	The project should be abandoned
Net present value = 0	The investment would neither increase or decrease value for the organisation	There is thus indifference in the decision whether to accept or abandoned the project. This project adds no financial value. Decision should be based on additional criteria, e.g. strategic positioning or additional factors with no factors explicitly incorporated in the estimates.

(Source: Drury, 2011:156)

3.3.3 Discounting

Discounting is to establish the present value of a potential amount (i.e. today's amount) would accomplish the potential value predicted if invested at the rate of interest (r). The incremental cash can be forecast through discounting with the potential new investments.

In this study a discount rate has been used for the different scenarios of the investment project, on the assumption that the cost of capital will remain the same over the life of the project. There is a range of factors that influence the cost of capital. These factors can be identified as inflation and interest rates that fluctuate widely over moderately short periods of time. Therefore, organisations usually use different discount rates, at different points over the life of a project to bring these factors in consideration. This is possible if the net present value and discounted payback methods are being used. Though, the internal rate of return (see Section 3.4: p. 34) and

accounting rate of return techniques are based on a single rate. Deciding on the acceptable rate is difficult in the first year of an investment project's existence (Hongren & Foster, 2011:34).

3.3.4 The equation for net present value

Net present value is the present value of cash inflows less the present value of cash outflows. The frequently used calculation for the net present value of a cashflow series over a total of periods (n) is as follows (Jo, 2000:35-50; Yilmazer, 2010:169):

$$NPV(r) = \sum_{i=1}^n \frac{\bar{C}_i}{(1+r)^i}$$

Where C_i is the expected (i.e. average) values of the cashflows in each period and r is the risk-adjusted discount rate.

The net present value calculations are presented as a distribution of the cashflow values that were selected. This is theoretically inaccurate. The net present value does not contain any uncertainty. The concern is that the risk has been counted twofold by firstly discounting, at the risk-adjusted discount rate, r, and secondly presented in the net present value as a distribution (i.e. uncertain) (Slottje, 2009:560-567). However, if the organisation is aware of this problem, the outcome can become very valuable in determining the probability of achieving the essential discount rate. The actual net present value to use in decision making would be the distribution of the expected value of the net present value. In considering the above information the two theoretical approaches together with the practical approach will be discussed in the following (Gallo, 2008:524):

- **Theoretical approach 1:** The first correct theoretically calculation is the discount cashflow distributions at the risk free rate (risk free rate = r_f). The risk-free rate produces a distribution of net present value at r_f and ensures that the risk is not counted twice. However, this distribution is not simple to understand, because decision-makers will certainly not have dealt with risk free rate net present value and therefore have nothing to evaluate the model output with.

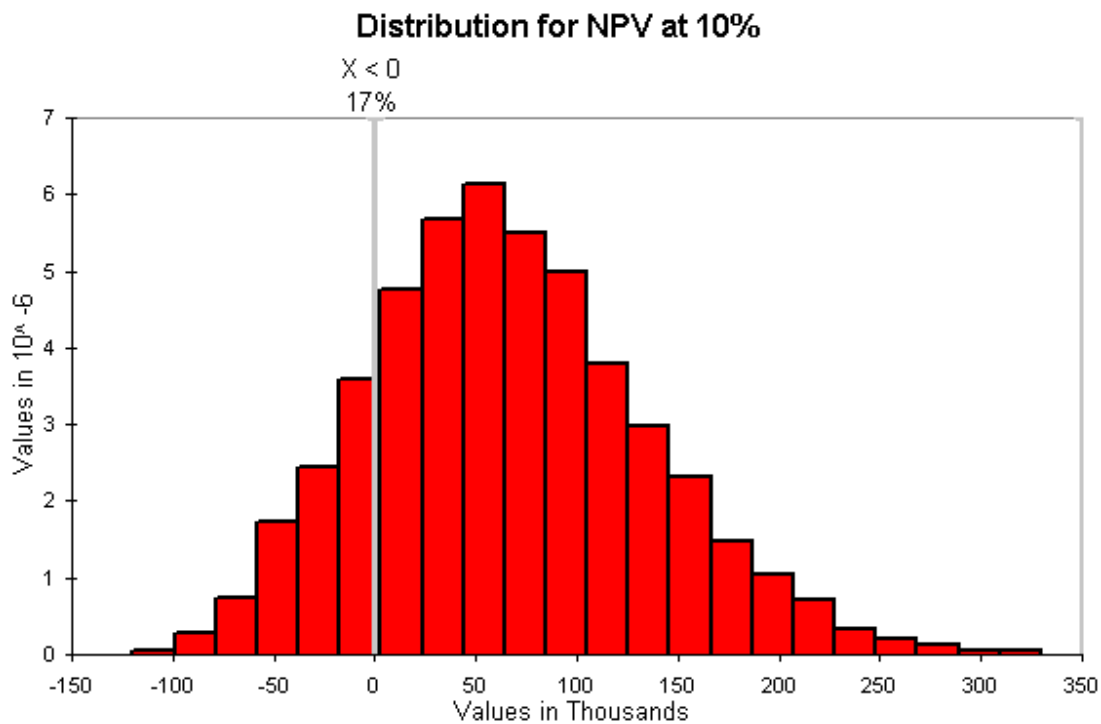
- **Theoretical approach 2:** The second theoretically accurate calculation is to discount the expected value of the investment project at the risk-adjusted discount rates. This approach results in a solitary number for the net present value of the investment project. A risk analysis is done to establish the expected value and extent of the cashflows in each period. The discount rate is frequently determined by comparing the risk related with the investment project's cashflows against the risk of other projects in the organisation's portfolio. The company can then allocate a discount rate greater than or lower than its standard discount rate. This depends whether the investment project discount rate exhibits more or less risk than the standard discount rate.

The main problem of calculating the net present value with these two theoretical approaches is that it assumes the cashflow distributions are symmetric and that no relationship exists between the cashflows. Distributions of costs and returns frequently exhibit some form of irregularity. In an investment project, there is constantly some form of relationship between cashflow periods; for example, a capital insertion in one period often means that it doesn't transpire in the next period (e.g. expansion of a mining area). If there is a strong positive relationship between cashflows, this method will miscalculate the net present value. On the other hand, a strong negative relationship between cashflows will produce an underestimated net present value (Zimmermann, 2000:426-432).

3.3.5 Practical approach

The two above mentioned theoretical approaches are complicated in application and understanding as well as to request a substitute. It is easier in practice to apply to the cashflow distributions, a risk-adjusted discount rate, r , to create a distribution of net present value. This method routinely incorporates a relationship among distributions and can directly compare with past net present value analyses (Ruijgrok, 2001:401-408).

Figure 3.2: Distribution for net present at 10%



(Source: Slottje, 2009:564)

Figure 3.2 is an example of a net present value at a discounted factor of ten percent. It demonstrates that there is only a 17 percent probability that the project will have a negative net present value.

3.3.6 Critical evaluation of the net present value technique

While net present value calculations are functional when valuing investment opportunities, the procedure is by no means ideal. This is why the following advantages and disadvantages need to be explained to provide the decision-maker with optimal information in order to make the most feasible decision for the company.

(a) Advantages of net present value technique

The advantages of the net present value technique are as follows (Drury, 2011:425; Bohm, 2006:138):

- It is directly connected to the implicit objective of maximising shareholder wealth as it measures, in absolute terms, the effect of present investments in the project, i.e. year 0.
- It takes into account the time value of money, i.e. the further away the cashflow the less the cashflow is worth in present terms.
- It considers all applicable cashflows, so that it can be unchanged by the accounting policies which mystify profit-based investment appraisal techniques such as the accounting rate of return.
- Risks can be integrated into the decision making by adjusting the organisation's discount rate.
- It provides understandable, explicit decisions, i.e. if the net present value is positive, accept the investment decision; if it is negative, reject it.

(b) Disadvantages of net present value technique

The disadvantages of the net present value are the following (Drury, 2011:802; Doreen, 2007:149):

- It can be difficult to recognise a suitable discount rate.
- Various managers are unfamiliar with the perception of the net present value.
- Cashflows are frequently believed to transpire at the end of a year, but in practice this is overly simplistic.

3.4 Internal rate of return

3.4.1 Internal rate of return definition

Internal rate of return is a capital budgeting technique which uses discounted cashflows in order to identify and to make a decision of the feasibility of long term investments (Karathanassis, 2004:69-71). If the internal rate of return is greater than the project's cost of capital the investment project will add value to the company. The rate which equates the present value of the future cash inflows to the present value of the cash outflows is the internal rate of return (Fox, 2006:102).

The present work indicates the resulting internal rate of return of investments, where uncertainty is integrated and that it should be measured in the calculations of economic analysis, otherwise an unfeasible project could eventually be considered feasible.

For appraising capital projects another discounted cash follow technique involves calculating the internal rate of return. The internal rate of return is a comparative measure (expressed as a percentage) in contrast to the fixed Rand value calculation resulting from the net present value calculations. The internal rate of return is the discounted cashflow rate of return that an investment project is estimated to accomplish. If the internal rate of return exceeds a target rate of return, the project would be significantly viable and should be accepted (Cambell, 2005:64-69).

3.4.2 Net present value and internal rate of return compared

(a) Independent versus dependent projects

An independent project is a project where selecting one project does not prohibit the choosing of the supplementary. A dependent project does prohibit the choosing of the supplementary

(Jacoby, 2005:104). Net present value and internal rate of return methods are directly interrelated because (Doreen, 2007:45):

- i) both are time-adjusted measures of profitability; and
- ii) their mathematical formulas are almost impossible to tell apart.

Subsequently internal rate of return and net present value will be examined more in depth to determine which method leads to an optimal decision.

(b) Net present value versus internal rate of return: Independent projects

With predictable cashflows where the net present value is positive (negative) and the internal rate of return is larger (smaller) than the discount rate, no argument in decision arises. That implies that both net present value and internal rate of return lead to an equivalent (accept/reject) decisions (Slotje, 2009:566).

Figure 3.3: Example of net present value versus internal rate of return: Independent projects

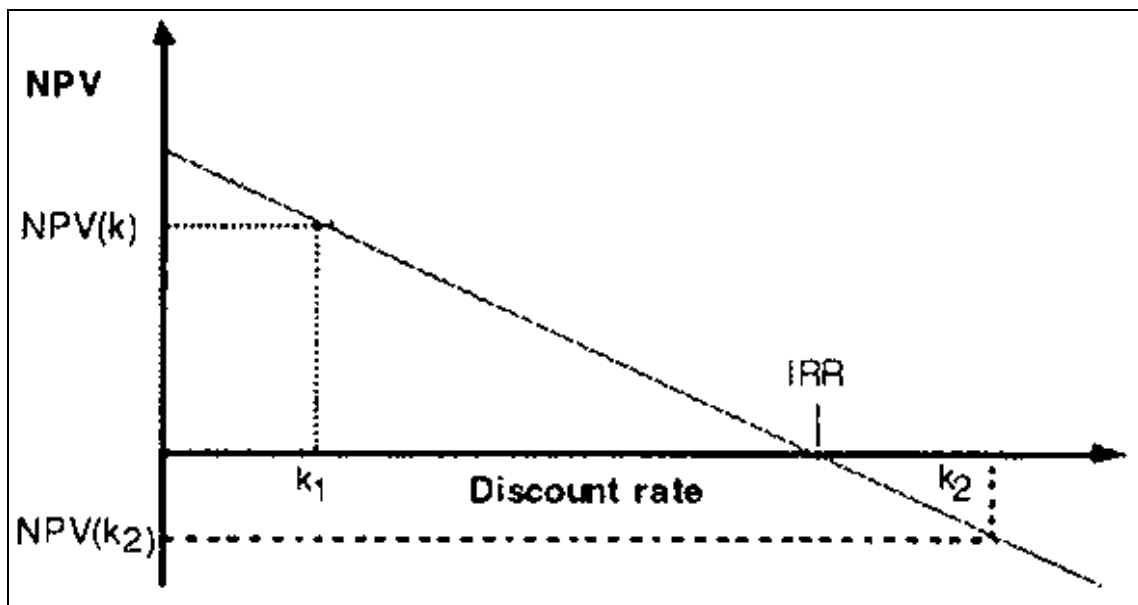


Figure 3.3 demonstrates the following in terms of independent projects (Doreen, 2007:67):

- If the cashflows are discounted at k_1 , the net present values are positive and internal rate of return $> k_1$: Accept the investment project.
- If cashflows are discounted at k_2 , the net present values are negative and internal rate of return $< k_2$: Reject the investment project.
- It is mathematical demonstrated that for an investment project to be acceptable the net present value needs to be positive, i.e.

$$\sum_{t=1}^n \frac{C_t}{(I+k)^t} - I_o > 0 \text{ or } \sum_{t=1}^n \frac{C_t}{(I+k)^t} - I_o > I_o$$

where:

C_t = the net cash is deliverable at the end of year t

I_o = the original investment expenditure

r = the discount rate/the required minimum rate of return on investment

n = the project/investment's extension in years.

The following equation is used to determine if identical projects will be acceptable:

$$\sum_{t=1}^n \frac{C_t}{(I+R)^t} = I_o$$

Where R is the internal rate of return.

Since C_t , is the determination of indistinguishable and affirmative in similar instances:

- Absolutely/intuitively R must be greater than k ($R > k$).
- The organisation is indifferent in such a project if the net present value = 0 then $R = k$.

- Therefore the internal rate of return and net present value will lead to a similar decision in this scenario.

The above demonstration indicates that the calculations show the cost of capital is a more practical reinvestment rate than a computed internal rate of return, because the cost of capital is the opportunity cost of capital for the organisation.

(c) Net present value versus internal rate of return: Dependent projects

The following example will demonstrate the difference between the net present value and internal rate of return of dependent projects:

An organisation is considering building either a two-storey (Project A) or four-storey (Project B) block of offices on a prime site demonstrated in Table 3.2. The following information is available:

Table 3.2: Example net present value versus internal rate of return: Dependent projects

	Primary investment expenditure	Net inflow at the year-end	Net present value	Internal rate of return
A	(R9 500)	R11 500	R954.55	21%
B	(R15 000)	R18 000	R1 363.64	20%

Table 3.2 demonstrates which investment decision should be made in terms of the above example. The net present values and internal rates of return are calculated where it is assumed that k equals ten percent discount factor. Table 3.2 reveals the following:

- Net present value of Project A and net present value of Project B are both positive.

- For both projects the internal rate of return $> k$.

Therefore a further question needs to be asked because both projects are acceptable:

Which project is a "better choice" in making the most feasible decision for the organisation?

i) If the net present value method is used:

If the net present value of project B $>$ net present value of Project A, then the organisation should choose Project B.

ii) If the internal rate of return method is used:

If the internal rate of return of Project A (21%) $>$ Internal rate of return of Project B (20%): The organisation should choose Project A. See figure 3.4.

Figure 3.4: Net present value versus internal rate of return: Dependent projects

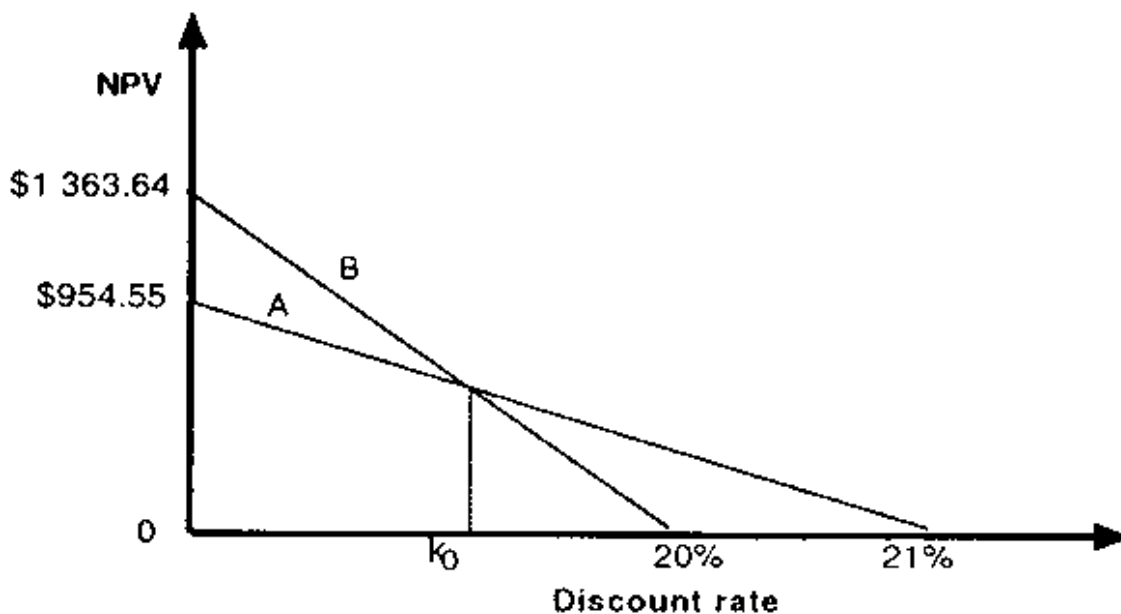


Figure 3.4 demonstrates the following of dependant projects: (Doreen, 2007:47)

- Up to a discount rate of k_0 : Project B is superior to Project A, Project B is therefore the first choice and will be the most feasible.
- Beyond the point of k_0 : Project A is superior to Project B, therefore, in that situation, Project A will be the first choice and will be the most feasible.
- Be informed that the two methods do not grade the projects as identical.

(d) Differences in the scale of investment

The net present value and internal rate of return may give incompatible decisions where projects fluctuate in the scale of investment shown in Table 3.3:

Table 3.3: Example of the differences in the scale of investment

Years	0	1	2	3	Net present value	Internal rate of return
A	(R2 500)	R1 500	R1 500	R1 500	R3 730.50	36%
B	(R14 000)	R7 000	R7 000	R7 000	R17 400.00	21%

Table 3.3 demonstrates which investment decision should be made in terms of the above example. The net present values and internal rates of return are calculated where it is assumed that k equals a ten percent discount factor. Table 3.3 reveals the following:

Net present value prefers Project B to Project A, and the internal rate of return prefers Project A to Project B. These calculations explain the advantage of the net present value technique that ensures the organisation reaches the most favourable scale of investment. The calculations also emphasise the internal rate of return's disadvantage as the return forms a percentage term rather than a term of absolute Rand returns (according to Table 3.3).

3.4.3 Critical evaluation of the internal rate of return technique

The advantages and disadvantages of the internal rate of return technique are only meaningful when they are relatively compared to the net present value technique (Zaheer, 2005:750-752). The following sections explain the advantages and disadvantages:

(a) Advantages of internal rate of return technique

The advantages of the internal rate of return technique are (Drury: 2011:241; Sunley, 2003:33; Ries, 2002:98):

- The foremost advantage is that the information the technique provides is simple and easily understood by managers. The example of its simplicity will be demonstrated in the following example: A project with an initial capital outlay of R100 that earns a yield of 25 percent when the target yield is only 15 percent. This is in excess for the investment with the target yield of 15 percent, therefore it is easier to understand than a project with a cost of R100 and a net present value of R30 when discounted at the minimum required rate of 15 percent.
- A discount rate does not have to be identified before the internal rate of return can be calculated. A hurdle discount rate is required, which is then compared with the internal rate of return.

(b) Disadvantages of internal rate of return technique

The disadvantages of the internal rate of return technique are (Drury, 2011:243; Navarra, 2003:20; Ries, 2002:98):

- The technique ignores the virtual size of investments. When discount rates are expected to fluctuate over the existence of the investment project, such variations can be integrated

effortlessly into the net present value calculations, but not into internal rate of return calculations.

- There are difficulties when the investment project has non-conventional cashflows or when deciding between equally exclusive projects.

3.5 Payback period

3.5.1 Payback period definition

CIMA (2010:256) defines payback period technique as the time it takes the cash inflows from a capital investment project to equal the cash outflows. The typical decision is to accept the one project with the shortest payback when a decision needs to be made between two or more competing projects. This technique is often used as a "primary screening method". This implies that when a capital investment project is acceptable, the foremost question to raise is: "What the timeframe will be to pay back its expenditure?" (Stone, 2011:560). Therefore, the payback period technique is a measure indicating the time required for an investment project to recuperate its original capital expenditure.

3.5.2 Critical evaluation of the payback technique

(a) Advantages of the payback technique

Except for the main advantage of using the payback technique, an initial screening device technique, there are several other advantages (Drury, 2011:102):

- Focus on early payback can improve liquidity.
- Shorter-term forecasts are probable to be more trustworthy.
- The estimation is immediate and straightforward.
- Payback is a simple to understand concept.

(b) Disadvantages of the payback technique

There are a number of severe drawbacks to the payback technique (Drury, 2011:103):

- The technique ignores the timing of cashflows within the payback period.
- It ignores the cashflows after the closing stages of the payback period and therefore the total project return is inaccurate.
- It ignores the time value of money.
- The method is incapable of differentiating projects with identical payback periods.
- The option of any cut-off payback period by an organisation is subjective.
- It may lead to undertaking unnecessary investments in deciding upon short-term projects.
- It takes account of the risk of the timing of cashflows but does not take account the changeability of the cashflows.

3.6 Sensitivity analysis

Following the discussion on the three main techniques for the analysis of investment proposals, organisations need to take note that in actuality, the outcomes will most likely not occur as predicted. Managers need to estimate the effects of these possibilities in their initial calculations. There is a range of ways in doing this. One way is to use a sensitivity analysis. This requires an approximate effect on the predicted outcome. Outcomes due to changes in combinations of variables can also be evaluated. Most of these estimates that brings change in variables that might manipulate the outcome of the investment decision can be identified. By recognising these estimates, managers can assess the probability of the variable changing, and it can be subjective through managerial efforts. The general impact on the concluding outcome of the probable changes can be evaluated and can assist in the decision as to whether or not the proposal should be accepted (Kates, 2003:8-15). The purpose of sensitivity analysis in this study is to:

- help identify the key variables which influence the project cost and benefit streams;
- investigate the consequences of likely adverse changes in these key variables;
- assess whether project decisions are likely to be affected by such changes; and,
- identify actions that could mitigate possible adverse effects on the project.

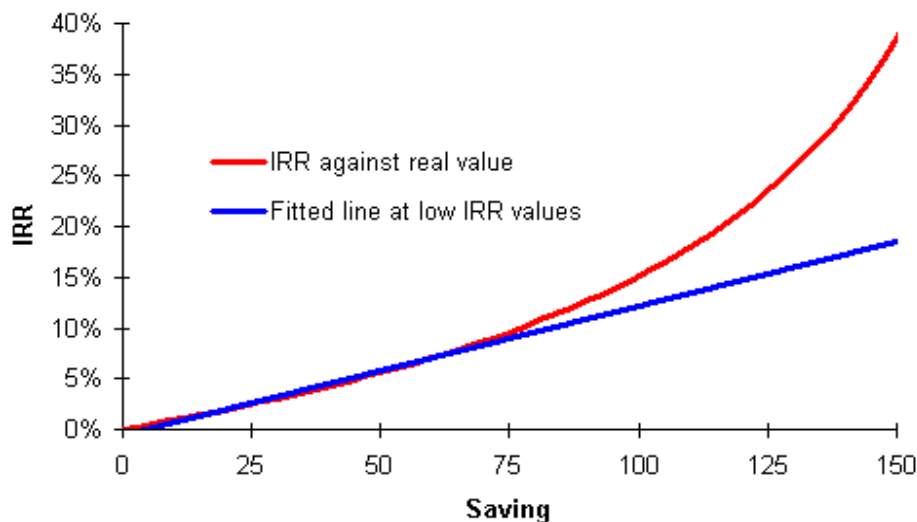
As mentioned earlier, the focus of sensitivity analysis is to determine how results will change if the original estimates of the underlying assumptions change (Drury, 2011:223). The variables of the net present value and internal rate of return techniques are the same (see Sections 3.3 and 3.4: p. 28-40). Therefore, the outcomes of these techniques can be influenced by changes in variables such as the initial investment amount, cashflows from revenues and costs, the timing of these cashflows, the discount factor and the life-time of the project.

Furthermore, there is no accurate formula for calculating the internal rate of return of a cashflow series (Sabel, 2004:247-258). There is more than one valid answer to the internal rate of return, if the cumulative cashflow position of the project passes through zero more than once (Jones, 2000:123; Yeung, 2002:75). However, a risk analysis model is dynamic, making it difficult to appreciate its exact behaviour. Therefore, the cumulative cashflow position may pass through zero and back in various risk analysis iterations and not be identified. This can produce quite inaccurate distributions of possible internal rate of return. To stay clear of this difficulty, the organisation should include a couple of spaces in the model that calculate the cumulative cashflow position and the amount of times it passes through zero. If this is identified as the model output the organisation will be able to establish whether this is a statistically significant difficulty and modify it to compensate for in Figure 3.5 (p. 44)

The rationale for investing money is to raise its buying authority as demonstrated in Figure 3.5 (p. 44). Invested money only interprets an increased buying authority if the discounted cashflow yield is greater than the inflation rate. The real rate of return or the real yield is arrived at by dividing one plus discount cashflow yield by one plus the inflation (Jenssen, 2001:23-25). Evidently there is no direct association between internal rate of return and the true value.

Therefore, it is very complicated to compare the value of two projects in terms of the distributions the internal rate of return distributions offers (McMurdo, 2004:122-130).

Figure 3.5: Internal rate of return in risk analysis: (Kates, 2003:14).



Finally, regarding the payback period technique, a change in variables such as the initial investment amount, cashflows from revenues and costs and the timing of these cashflows may influence the time it takes to repay the initial investment (see Section 3.5: p. 41-42).

3.8 Summary

This chapter, in essence, makes an effort to cover and evaluate the textbooks and recent academic articles associated to the three main techniques of investment appraisal techniques. In addition, sensitivity analysis was also explained.

This chapter showed that the net present value of the three techniques will be more accurate in helping investors understand the actual figures to evaluate if a project is concerned. The internal rate of return will give percentages, which can be better understood by managers. The simple decision rule is to accept projects with a positive net present value and reject those with a

negative net present value. As much as discrepancies in discounts will most likely lead to similar recommendations from both techniques, it is important to note that the net present value technique can evaluate big long-term projects better as opposed to the internal rate of return which gives better accuracy on short term projects with consistent inflow or outflow figures.

The use of the internal rate of return technique for determining the relative profitability is questionable due to the problem of the reinvestment assumption (e.g. it is assumed that cashflow surpluses can be reinvested anytime at the internal rate of return (r)). If this represents the perfect capital market interest level, the investment project would not be absolutely profitable, as only a net present value equals zero would be achievable (It is generally preferable to use net present value to internal rate of return to make investment decisions). The decision to accept or reject the investment depends on whether the internal rate of return is higher than the discount rate. The decision criteria for these projects are straightforward, accept the investment project if the internal rate of return is higher than the discount rate or the cost of borrowing.

This chapter also showed that a shorter payback period is preferable in organisational circumstance where the investment costs are recovered sooner and are available again for further use. A shorter payback period is viewed as less uncertain. It is assumed that the longer the payback period, the more uncertain the positive returns are. For this rationale, payback period is often used as a determination of risk, or a risk-related criterion that must be met before the funds are established. For example an organisation might decide to undertake no major investments or expenditures that have a payback period over say for three years.

This chapter has focused on investment appraisal techniques, but this is not the full story when it comes to evaluating projects. Mine X must take great care in identifying relevant cashflows and also need to consider other factors – for example, tax, inflation, risk and qualitative issues – to assess a proposal through a sensitivity study. Therefore this chapter will form a theoretical foundation for Chapter 4 to evaluate the techniques in making the most optimal decisions.

CHAPTER 4: METHODOLOGY AND APPLICATION

4.1. Introduction

In Chapter 3, the importance of the three main techniques of the investment appraisal was discussed. The theory discussed in Chapter 3 will provide a theoretical foundation to support each calculation in Chapter 4.

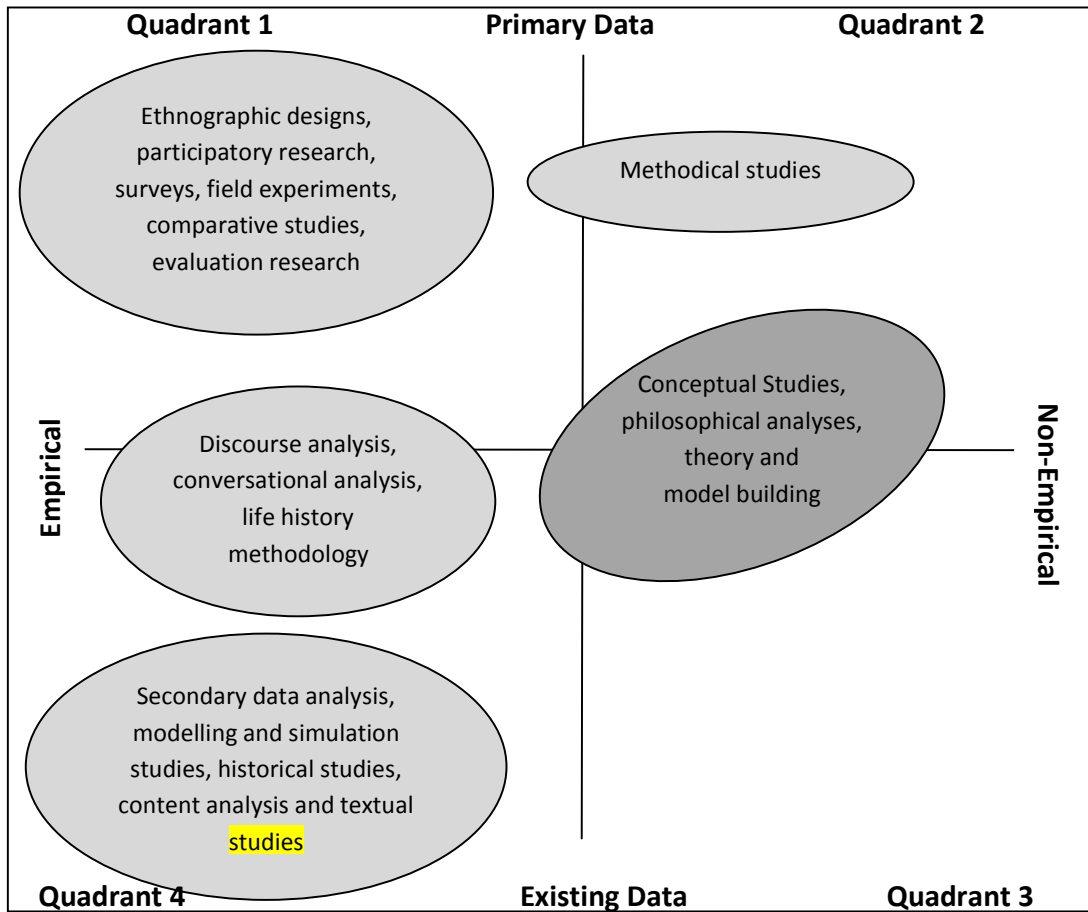
This chapter is divided into four main sections. The first section covers research design. The second section discusses the methodology. The third section is the application of the three investment appraisal techniques: net present value, internal rate of return and payback period. The last section is the application of sensitivity analysis related to the results of the project referred to in Chapters 2 and 3.

The results of the techniques and sensitivity analysis will be used to determine whether Mine X would be feasible and gain a competitive advantage with a new investment. The three scenarios (Chapter 1: p. 8) will be evaluated, based on a feasibility study. Attention will be given to the different parameters that can affect the decision making process used to measure the feasibility of this investment project.

4.2. Research design

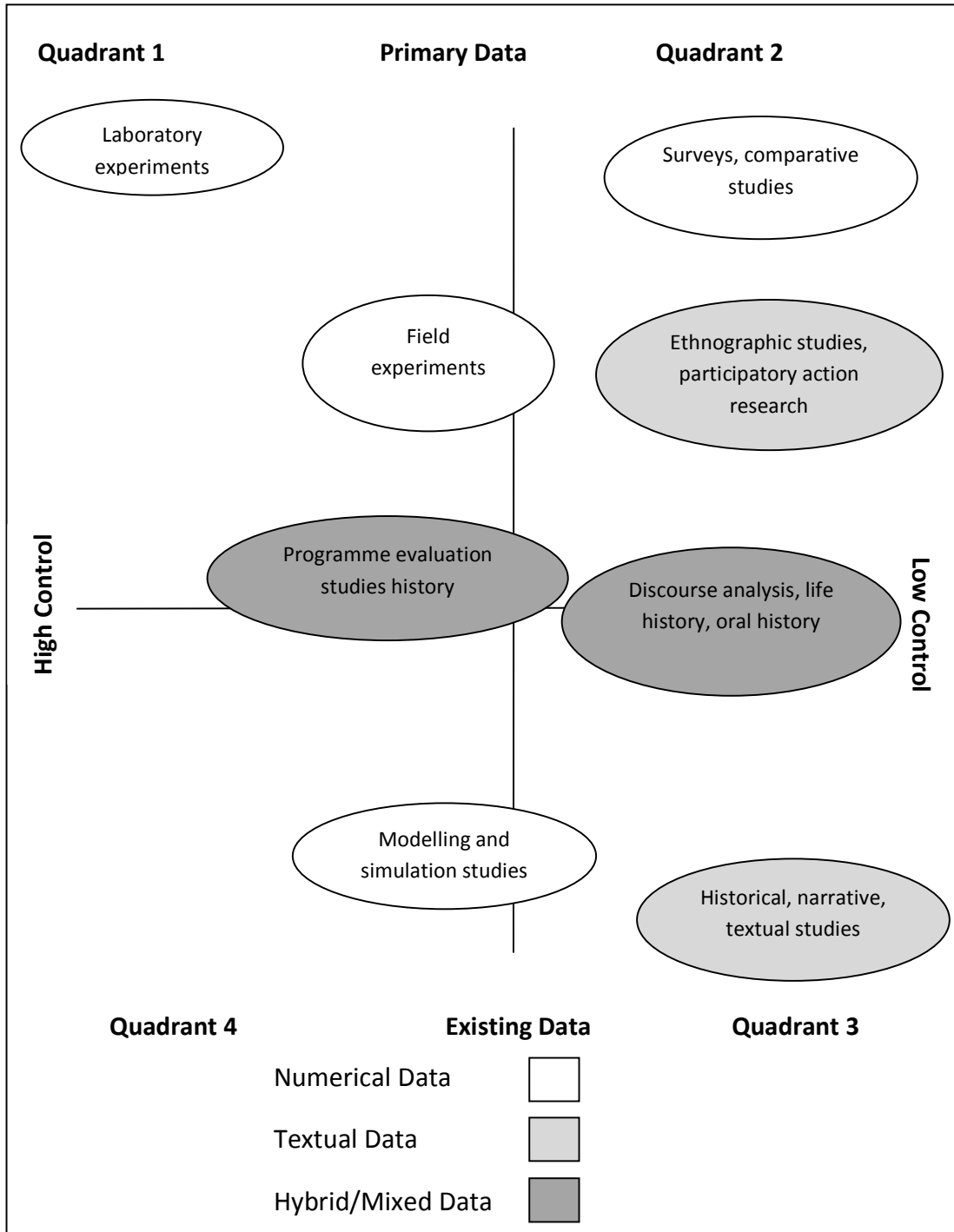
According to Mouton (2002:55), the research design is how the researcher plans to execute the research in order to unravel the research question, while the methods, techniques and actions of implementing the research design are called the research methodology. The research design will be discussed in this section while the methodology of this study will be explained in the subsequent section.

Figure 4.1: Mapping designs (Level 1)



(Source: Mouton, 2002:144)

Figure 4.2: Mapping designs (Level 2)



(Source: Mouton, 2002:145)

Figure 4.1 and Figure 4.2 were used to recognise the type of research design that's going to be used in this study. The dimensions in Figure 4.1 (p. 47) specify empirical studies versus non-empirical studies and also using primary data versus existing data, while Figure 4.2 (p. 48) is limited to empirical studies only and is mapped according to primary/existing data and the degree of control. Figure 4.2 also indicates whether the research design focuses on numerical data or textual data (Mouton, 2002:145). Figure 4.1 and Figure 4.2 were used to classify the research design of this study. According to Figure 4.1 the design classification falls under quadrant one: Evaluation research. This is because the study aims to explain the question of whether an intervention has been successful. One functional definition of program evaluation is consequently provided, with an analysis of its components: "Evaluation is the systematic assessment of the operation and/or the outcomes of a program or policy, compared to a set of explicit or implicit standards, as a means of contributing to the improvement of the program or policy" (Weiss, 1998:59). Weiss highlights the specific nature of evaluation through a breakdown of the definition into key elements.

The key element used here, is systematic assessment. Weiss (1998:60) emphasises the research nature of evaluation, highlights that it should be conducted with severity and formality, according to accepted research procedures. Therefore, an evaluation of investment feasibility should follow precise, well-planned research strategies. Scientific severity can be more time consuming and be more expensive than informal methods, but is still a crucial element of successful evaluations. In education this is where outcomes are multipart, difficult to examine, and made up of many fundamentals that counter in miscellaneous ways.

According to Figure 4.2, the design classification falls under the first and fourth quadrant: Programme evaluation studies and modelling and simulation studies. This is because numerical data is used and because there is a medium degree of control. The numerical data (or quantitative data) is the data measured on a numerical scale in this study. This data analysed the results and displayed the results using tables, charts, and graphs

The research design is categorised as evaluation research and computer simulation studies (Mouton, 2002:161). In this study the type of reasoning of programme evaluations are

completely a-theoretical and are intended to determine whether the outcomes have materialised. Structured and semi-structured methods were used in this study. The achievement of this design is to measure casual outcomes and impact, while its restraint and main cause of inaccuracy are the context effects, namely the operational and measuring outcome indicators (Mouton, 2002:161).

It is important to combine the research design with the literature review and explain the evaluations and findings to review the critical points of the current knowledge as how it contributes to the particular research study.

4.2.1. Evaluation research

The first step of project evaluation is to calculate approximately the future values of the projected variables. Commonly, information concerning an explicit occurrence of the past is utilised to forecast a potential future outcome of the identical or related occurrence. The approach is frequently used in investment appraisals to determine a “pre-eminent estimate” based on the existing information and use that as an input in the evaluation model. In using a solitary value however, a variety of other feasible outcomes for each project variable is not incorporated in the analysis. It is assumed that the values used in the appraisal are certain when relying absolutely on solitary values. The conclusion of the project is, therefore, also presented as a certainty with no potential variance or margin of inaccuracy connected to it. The reality is that the values estimated are not definite. The appraisal statement is usually supplemented to implement sensitivity and scenario analysis tests. Sensitivity analysis, in its simplest form, involves altering the value of a variable, in an array to examine its impact on the final conclusion. It is therefore used to categorise the project's most important, extremely sensitive, variables. A scenario analysis remedy is to allow the transformation of values for a quantity of key project variables, thereby constructing an alternative scenario for the project. Pessimistic and optimistic scenarios are frequently presented. Sensitivity and scenario analyses compensate to a great degree for the systematic constraint of having to strait-jacket a lot of possibilities into solo figures. However, tests are fixed and rather subjective in nature (William, 2006).

Evaluation should not be measured in a vacuum. This study considers evaluation as entrenched within an outsized Planning-Evaluation Cycle. Therefore, the next paragraphs will discuss several evaluation steps in order to give a greater perspective on the evaluation endeavour (Paterson, 2009:78):

(a) Measuring the success of investment feasibility projects

The actual focal point of the evaluation research is the activities and outcomes, while other studies examine outcomes and effects. The feasibility study would look at both the activities and its outcomes and compare the two with each other. The standards for comparison are a set of prospects or criteria to which is compared. This comes from the project's individual goals, mission statement, objectives of program sponsors and managers. The ultimate intention is the improvement of the organisation's feasibility. The evaluation should not be done to cause bias, but to provide a positive contribution, to help investments work better by allocating resources correctly in order to improve feasible investment decisions.

(b) Evaluation planning: Background

Evaluation has become very popular and forms an important instrument for program funding, decision-making, organisational learning, accountability, program management and improvement (Curtis, 2008:160-170). Evaluation planning can be a multifaceted and recurring process. It is therefore important to identify the main questions for this study. In identification, choose the best measurements and techniques to answer these identified questions. Determine the best way to assemble the data. Develop a suitable research design. Implement the research design and endorse suitable use of the outcome. Here are some evaluation definitions and descriptions to provide some background (Friedman, 2003:271-272):

(i) Formative and summative evaluation

Two conditions were introduced (Scriven, 1991:19). These conditions were called formative and summative conditions. These conditions describe the evaluation of educational curriculums. Formative evaluation produces information that is revised during the course of a study for improvement. After the study is completed, summative evaluation is done. This summative evaluation provides information about the study's efficiency. Scriven simplified this distinction, as follows: "When the cook tastes the soup, that's formative evaluation; when the guest tastes it, that's summative evaluation" (Weiss, 1998:31). Feasibility studies are seldom "finished;" they maintain becoming familiarised and transform over time, in response to internal and external conditions. This concludes that the need for "formative" information continues. It must be reviewed by management and staff for improvement.

(ii) Outcome and process-based evaluation

The study focuses on an outcome of a certain project. This focus is still a major feature for the majority of evaluations. Outcomes refer to the end results of a study for the individuals it was intended to serve – students, management, and volunteers. The term "outcome" is often used interchangeably with end result and consequence. The results of some of the outcomes of studies are what the project planners and management anticipated. Other outcomes are effects that nobody estimated but still gives significant information for the improvement of the investment project. Therefore change is a key word in outcome and process-based evaluation.

A systematic assessment is also important to evaluators of this feasibility project. The evaluators need to be acquainted with the actual operations of the project. Process is the key element of success or failure of this feasibility study. Studying the process of the programme helps to recognise outcome information. Initially, there is a lot of similarity between formative-summative and process-outcome evaluations. However, the two sets of terms have quite diverse implications. Formative and summative refer to the intentions of the evaluator to help improvement and evaluation. Process and outcome does not relate to the evaluator's responsibility, but relates to the stage of studying the feasibility project. There is often a combination of evaluations that forms the consequences for the participants (Riba, 2005:1242-1245).

(iii) Measuring the success of the feasibility study

Reporting the evaluation results forms the measuring of the success of the feasibility study. The level and scope of information in the report depends upon the intended persons involved, e.g., funders, board, staff and managers (Bonen, 1997:137-138).

The most essential part of an evaluation is determining what was learned from it and integrating it into the project management decision. This determination forms the real value (Gallogly, 2002:1269-1273).

4.3 Research method

An estimate was prepared for the project with a base date as “current operations”. The estimate was compiled using the areas and summary work packages as determined by the WBS (Work Breakdown Structure) of AngloGold Ashanti. All of Chapter 4’s inputs were extracted from the following source: Financial planning guidelines as per the latest received from the AngloGold Ashanti business planning office.

The estimate was made using prices obtained from the quantity surveyors contracted to the project, as well as from equipment suppliers. Mining costs are rate based and obtained from historic mining figures at Mine X. The financial evaluation for the various options was approved according to AngloGold Ashanti’s standards, using suitable financial parameters. The received gold price, escalation factors and exchange rates used, are as per those approved by AngloGold Ashanti Executive for project evaluation. Mining only to level 109 refers to the Base Case (current operations) of Mine X on the Ventersdorp Contact Reef horizon, with the capital expenditure requirements restricted to “stay in business”.

The Rand/US\$ exchange rate, spot prices and consumer price index were extracted from the Business Plan of AngloGold Ahanti. These exchange rates were used to convert Dollars into Rand. The capital price index is an economic index that measures the change in capital-asset

prices in the economy from one period to another. The index helps indicate the change in costs for capital assets, which are used by companies to produce other goods. The spot prices indicate market expectations of future price movements. For a security or non-perishable commodity (e.g. silver), the spot price reflects market expectations of future price movements.

4.3.1 Methodological issues and data sources

(a) Data

Information will be obtained from the actual plant. The information obtained will be substituted by estimations, where necessary. The information obtained will be used to establish future costs and revenue if Mine X is going to be developed through its neighbouring mine, Mine Z. Mine X will use a single discount rate as an estimator for all the periodic changes in the market rates that take place during the life of the investment project, which may either overestimate or underestimate the net rate of return on the investment project. Identical results for the present value of the future net cashflows will be achieved if the rates remain constant or if they change in a neutralising fashion. The standard measure to review performance in the capital industry is the internal rate of return of fund (Han, 2004:127). This takes into consideration the cash-on-cash returns from the sale of shares and disbursements (e.g. dividend payments), and also the share of the residual value of the fund's holdings in cash and investments in portfolio companies that have no publicly traded shares (Morgan, 2003:57-58; Hisrich, 2000:67-70; Wallsten, 2000:83). This method is inappropriate for evaluating the performance of investments of the informal capital market, because companies do not invest by means of dedicated funds and therefore do not have 'redundant cash', as capital funds do. Companies consider investment performance in terms of capital gains multiples on each investment (Kenney, 2000:1145). The connotation is that the assessment of the investment performance of companies must be undertaken on a deal-by-deal basis, with the income basically measured in terms of the numerous achievements and the time-span taken to understand the return. This means that the only foundation for comparing the investment performance of companies is also on a deal-specific basis. However, appropriate data is hardly ever accessible to allow such an assessment to be made. Capital funds do not

usually make information accessible on the performance of individual investments in their portfolio. It is, therefore, difficult to make a comparison where such information is available because of the specialised focus of the majority of capital funds.

The calculation of the definitive internal rate of return of a fund requires a concluding and state-of-the-art valuation of the residual asset value. The residual asset value is investments that have not been realised and that have value. Although restricted partnerships have an established permanent life span of ten years, most funds show a residual asset value for some extensive time beyond ten years before being finally provoked. Therefore, most calculations of fund performance measure provisional returns. The internal rate of return, however, has a propensity to approach the absolute internal rate of return if the time period is longer (Hisrich, 2000:62; Landström, 2004:217-242). As mentioned, the life span of the project under investigation is 18 years. For discounting purposes, the project will be indicated as from Year 0 to Year 17.

The results of the study are based on the data extracted from AngloGold Ashanti's records. These data includes the forecast of cash flows per share, converted into total cashflow, in case the current operations continue (Scenario 1 (Base Case)), the project starts immediately (Scenario 2) and the project will be delayed by six months. The discount rate used for the net present value and internal rate of return techniques was ten percent, based on a low-inflation scenario with a four percent risk free rate plus a market premium of six percent. The payback period was calculated by using the annual forecasted cash flow to calculate the time it takes to get a break-even point of zero net cash flows.

(b) Taxation and tax-break

The mining taxation is calculated using the gold mining formula. This formula increases and decreases in the percentage to Mine X's profitability.

The gold mining companies pay tax as follows:

- If profit is equal to or less than five percent of revenue, then the taxation rate is zero.

- If profit exceeds five percent of revenue, then the taxation rate equals maximum 45 percent.
- Capital expenditure that is incurred when the profit divided by revenue is between zero and five percent is effectively shattered because no deduction in tax payable is tenable when this happens.

Taxation assumptions of Mine X:

- The assumption is that the taxation break will be achieved.
- However, should the revenue ratio for Mine X decrease to five percent for any number of years, there is a high risk that the internal rate of return will be extensively reduced.
- The relevant adjustments to the tax calculations using AngloGold Ashanti financials of the current business plans as discussed in (p. 55) and determined that Mine X's area has a revenue ratio above five percent for the applicable years.

(c) Methodological limitations

The supplementary projection and analyses are based on estimates and assumptions that we are using existing economic information, project specific information and former applicable information. It is the nature of forecasting, that some assumptions may not occur and unexpected events and circumstances may occur. Such changes are liable to require review or revision of this document. The following will illustrate the limitations according to the documentation and information used in this study (Curtis, 2008:52):

- The analyses contained in the documents are based, in part, on information from secondary sources such as financial managers, planning managers and third parties. While Mine X believes that these sources are reliable their accuracy is not guaranteed.
- The development cost information for the analysis of the capital-investment project obtained by the local sources of Mine X has been deemed reliable, but has not been separately verified. Note that the uncertainty includes the preservation and reprocessing

of historic structures. Note also that supplementary allowances are appropriate to reflect this uncertainty.

4.4 Capital investment evaluation techniques

The capital investment evaluation techniques, net present value, internal rate of return and payback period, will be applied in the subsequent sections. The available predicted data covers the life span of 18 years, from Year 0 to Year 17.

4.4.1 Net present value

As already explained in Chapter 3 (p. 33), the problem associated with this technique is that it will double count the risk. Firstly the double count will be in the discount rate and then by representing the net present value as a distribution. But if Mine X is aware of this shortfall, the result can be very useful in determining the probability of achieving the required discount rate (i.e. the probability of a positive net present value (Drury, 2011:159)).

All net present value figures are in millions and a 18 year plant life after start-up is assumed. The following assumptions were made:

- The discount rate of ten percent will be used for each investment option timeframe.
- Assume that the current operation recovered 15 304 000oz (476 ton) of gold.

Table 4.1: Summary of net present value

	Current operation without new investment	Original feasibility beginning immediately	Six-months delay
Gold recovered	476t	104t (Additional)	55t (Additional)
Net present value @ 10% (Excluding sunk)	R191.13m	R195.33m	R184.53m

Table 4.1 indicates that without any new investment, the current gold recovered will be 15 304 000oz (476ton) for Mine X. If the project begins immediately, it will be assumed that the gold recovered will increase the current operations of Mine X by 5 724 000oz (104ton), and if there is a six-month delay in the project, the gold recovered will only be 1 777 000oz (55ton) more. This assumption shows that beginning the project immediately will recover 49ton more than to delay the project by six months.

Note that the delay in the project means that the normal current operations at the mine will still take place, but the current operations at the mine will cause high stress conditions. This high stress levels cause seismic events to take place that may result into lower gold production. For a more in-depth discussion, see Chapter 1: p. 8-9.

The net present value at ten percent will be R191.13m for the current operations at Mine X without the new investment, and R195.33m if the project begins immediately. If there is a six-month delay in the project, the net present value shall be R184.53m. This means that the net present value will be R10.80m (R195.33m – R184.53m) more if the project starts immediately, as opposed to having a six-month delay in the project. All these calculations can be found in Appendix A in Schedules 1-3.

To start the project immediately at Mine X, presents an opportunity to invest further in a feasible project return. The investment will increase the net present value, at a discount rate of ten percent, by R4.2m (R191.12m – R195.33m) relative to the base case (current operations).

There are other opportunities that could add further value to Mine X, e.g. it also reduces the different risks identified in Chapter 3 by reducing the capital requirements at a time of a capital constraint. There is a high level of assurance in the ore body to be oppressed and as a consequence, uncertainties in this area will be minimised. The investment project will comprise the development of the VCR reef from 109 level to 120 level. Mine X will make provisions for pumps, sumps and settlers on 120 level, and maintaining the mill capacity. Mine X will use a

single discount rate as an estimator for all the periodic changes in the market rates that take place during the life of the investment project, which may either overestimate or underestimate the net rate of return on the investment project. Identical results for the present value of the future net cashflows will be achieved if the rates remain constant or if they change in a neutralising fashion.

4.4.2 Internal rate of return

The internal rate of return of the investment project is the discount rate applied to its future cashflows to produce a zero net present value. This means that the discount rate balances the value of all revenues and costs of the investment project. If the cashflows are uncertain, the internal rate of return will also be uncertain and therefore have a distribution associated with it (Drury, 2011:254).

A distribution of the possible internal rate of return is used to determine the probability of achieving any specific discount rate and this can be compared with the probability to other investment projects in aiming to achieve the target discount rate. This is not recommended for comparing projects, because of the properties of the internal rate of return discussed below.

Table 4.2: Summary of the internal rate of return

	Current operation without new investment	Original feasibility beginning immediately	Six-month delay
Internal rate of return	37.3%	38.2%	41.0%

The sunk costs are retrospective (past) costs that have already been incurred and cannot be recovered. In traditional microeconomic theory, only prospective (future) costs are relevant to an investment decision. Therefore, in this study, the focus will only be on the results excluding sunk cost. Table 4.2 demonstrates that the internal rate of return will remain at 37.3 percent for Mine X's current operations without the new investment, and if the project begins immediately,

the internal rate of return will be 38.2 percent (excluding sunk cost). The internal rate of return will be 41.0 percent if there is a delay of six months in the project. These assumptions show that the internal rate of return will be the highest if there is a six-month delay in the project.

4.4.3 Payback period

The payback period is defined for the study as the time it would take annual cashflows to get to a break-even point of zero net cashflows. It is vital to estimate the time started, i.e. project commencement or starting of production. In this study, time will start at the project commencement (Yeung, 2002:315-317).

Table 4.3: Summary of the payback period

	Current operation without new investment	Original feasibility beginning immediately	Six-month delay
Payback period	6 years 15.7 days	6 years 28.8 days	5 years 11.2 months

Table 4.3 demonstrates that for Mine X to stay with its current operations, the payback period would be six years and 15.7 days. The payback period for Scenario 2, the investment project begins immediately, and Scenario 3, a six-month delay of the project results in a payback period of six years and 28.8 days and five years and 11.2 months, respectively. This payback period of five years has been calculated in the schedule according to the cashflows of Appendix A in Schedules 1-3.

4.5 Sensitivity analysis

4.5.1 Sensitivities

The investment project was operated at different revenues, working costs and capital expenditure levels, in order to test the sensitivity of the investment project to bring about change in these inputs. The inputs were adjusted in five percent increments to a maximum of 15 percent up and down against the base inputs.

As mentioned in Chapter 3 (p. 42-43), the outcomes of these techniques can be influenced by changes in variables such as the initial investment amount, cashflows from revenues and costs, the timing of these cashflows, the discount factor and the life-time of the project. Due to these factors identified, the following tables will demonstrate the following assumptions and results of the internal rate of return for the different project scenarios:

4.5.2 Sensitivity analysis of net present value

Sensitivity tests were performed for the net present value to show the effect of an increase or decrease of five percent or 15 percent in the annual cashflows.

Table 4.4: Net present value sensitivity of the current operations

Current operations: normal NPV = R191.13	
	Cashflow per share
Decrease by 15%	R162.5m
Decrease by 5%	R181.6m
Increase by 15%	R219.8m
Increase by 5%	R200.7m

Table 4.5: Net present value sensitivity of the project that begins immediately

Immediate operations with new investment: normal NPV = R195.33	
	Cashflow per share
Decrease by 15%	R166m
Decrease by 5%	R185.6m

Increase by 15%	R219.8m
Increase by 5%	R205.1m

Table 4.6: Net present value sensitivity of a six-month delay in the project

Six-month delay: normal NPV = R184.53	
	Cashflow per share
Decrease by 15%	R156.9m
Decrease by 5%	R175.3m
Increase by 15%	R212.2m
Increase by 5%	R193.8

All three tables have been calculated using the three schedules in Appendix A. Tables 4.4, 4.5 and 4.6 demonstrate that if the cash inflow decreases and increases by five percent and 15 percent, the net present value will be the highest when the project begins immediately.

4.5.3 Sensitivity analysis of internal rate of return

Table 4.7: Internal rate of return sensitivity of the current operations

Current operations: normal IRR = 37.3%	
	Cashflow per share
Decrease by 15%	36.69%
Decrease by 5%	36.15%
Increase by 15%	41.10%
Increase by 5%	40.71%

Table 4.8: Internal rate of return sensitivity of the project that begins immediately

Immediate operations with new investment: normal IRR = 38.2%

	Cashflow per share
Decrease by 15%	35.93%
Decrease by 5%	35.40%
Increase by 15%	40.24%
Increase by 5%	44.12%

Table 4.9: Internal rate of return sensitivity of a six-month delay in the project

Six-month delay: normal IRR = 41.0%	
	Cashflow per share
Decrease by 15%	39.38%
Decrease by 5%	38.80%
Increase by 15%	44.12%
Increase by 5%	43.69%

Tables 4.7, 4.8 and 4.9 have been calculated from the first three schedules of Appendix A. Chapter 3 (p. 36) demonstrates that a higher internal rate of return shows to be more feasible. Therefore, a decrease of 15 percent, a decrease of five percent and an increase of 15 percent in the cashflow demonstrate that the internal rate of return will be the highest for Scenario 3, a six-month delay of the project. If the cashflow increases, however, by five percent, the highest internal rate of return will be for Scenario 2, i.e. to begin the project immediately.

If there are any changes in the variables, these changes can cause a positive or negative effect on the internal rate of return percentage. Due to the disadvantages explained in Chapter 3 (p. 40), it is necessary to also take the other techniques into consideration when an investment decision needs to be made.

4.5.4 Sensitivity analysis of payback period

Assume that the payback period will increase or decrease according to the percentage increase or decrease in cashflow. This is based on the assumption that the repayments per month will stay fixed and that there is no interest component.

Table 4.10: Payback period sensitivity of the current operations

Current operations: normal payback period		R142.14
	Cashflow per share	Period
Decrease by 15%	R120.82	5 years 14 days
Decrease by 5%	R135.03	5 years 74 days
Increase by 15%	R163.46	6 years 94 days
Increase by 5%	R149.25	6 years 34 days

Table 4.11: Payback period sensitivity of the project that begins immediately

Immediate operations with new investment: normal payback period		R144.96
	Cashflow per share	Period
Decrease by 15%	R123.22	5 years 17 days
Decrease by 5%	R137.71	6 years 9 days
Increase by 15%	R166.70	6 years 97 days
Increase by 5%	R152.21	6 years 38 days

Table 4.12: Payback period sensitivity of a six-month delay in the project

Six-month delay: normal payback period		R137.88
	Cashflow per share	Period
Decrease by 15%	R116.35	5 years 8 days
Decrease by 5%	R130.99	5 years 67 days
Increase by 15%	R158.56	6 years 87 days
Increase by 5%	R144.77	6 years 27 days

All three tables were calculated using Appendix A's data as well as Schedules 1-3. Chapter 3 (p. 48) demonstrated that the shorter the payback period, the more feasible the project will be. Therefore, Tables 4.10, 4.11 and 4.12 demonstrate that all four changes will cause the payback period to be at the lowest period for Scenario 3, and that a six-months delay in the project would be the most feasible project. The second lowest payback period will be Scenario 1, i.e. to stay with the current operations. However, keep in mind that due to the disadvantages explained in Chapter 3 (p. 40-42) this technique cannot be used alone to make an investment decision and needs to be combined with the net present value.

4.6 Summary

This chapter covered the analysis of data obtained from the mining sector of AngloGold Ashanti's financial statements. The aim of this chapter was to determine if Mine X can be feasible in making a new investment, referring to the three scenarios. The three investment appraisal techniques were used to evaluate the feasibility for Mine X. Sensitivity analysis was applied for each of the investment appraisal techniques. The following is a summary of the findings.

The net present value was positive, the internal rate of return was more than the discount rate and the payback period was shorter than the project's life-time regarding to all three scenarios, namely the current operations, to start immediately with the project and as a six month delay in the project. The highest net present value is calculated in case the project starts immediately. Both the internal rate of return and the payback period indicated that a six month delay in the project is the most viable.

Regarding to the sensitivity analysis, a five percent and 15 percent increase and decrease in the net present value indicated that it is the most viable scenario to start the project immediately. A

five percent increase in the internal rate of return also found the best scenario is to start the project immediately. A 15 percent and five percent decrease, as well as a five percent increase in the internal rate of return found the most viable scenario to delay the project with six months. According to the payback period, all four these sensitivity measures also indicated that the most viable scenario is to delay the project with six months.

The calculations and results of Chapter 4 will form the basis of the final chapter in determining the overall conclusions and recommendations of this feasibility study of Mine X.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter 5 contributes to the main and secondary objectives of this study, which are to determine whether Mine X could be feasible in undertaking this investment project in order to be a major global gold producer and to contribute towards economic growth (see p.6 Chapter 1 for the objectives).

To reach the first secondary objective, i.e. to describe the nature and significance of the feasibility study (p. 6), Chapter 2 was presented to explain the operational background and investment risks and -opportunities with regard to Mine X, where Chapter 3 explained the capital evaluation techniques. Chapter 3 contributed to reaching the second secondary objective of this study, to recognise appropriate capital investment evaluation techniques in conjunction with sensitivity analysis. The third secondary objective, the application of the techniques and sensitivity analysis, was presented in Chapter 4. All the preceding chapters provide a basis to reach the fourth secondary objective, i.e. to develop a framework to assist similar feasibility studies in the future, and the main objective, i.e. to investigate the feasibility from Mine X's point of view with a deepening project including Mine Z.

This chapter will summarise the results of the preceding chapters, conclusions will be deduced from the findings, a recommendation will be made with regard to the main objective, a framework will be developed to assist similar feasibility studies in future, the value of the study will be indicated, the limitations of the study will be identified, and finally, a final conclusion will be made and areas of future research will be identified.

5.2 Capital investment evaluation techniques

The financial returns for the project were determined as follows:

The project area was planned and scheduled using the Mine X planning and scheduling parameters. This schedule was transferred into pivot tables and a business mining equation was compiled. The business financial equation was then populated using the information from the cost model and the capital estimate. Taxation was also taken into consideration.

5.2.1 Net present values

Regarding Scenario 1 – the current operations – the net present value at a ten percent discount rate equals R191.13m (Chapter 4: p. 57). The net present values for Scenario 2 – the investment project begin immediately – and Scenario 3 – a six-month delay of the project – provide a net present value of R195.33m and R184.53m, respectively.

The net present value is therefore positive for all three scenarios (p. 57 and Appendix A, Schedules 1-3). However, the net present value is the highest for the project to start immediately. A positive net present value is an indication that a project is viable (Chapter 3: p. 29). Therefore, the conclusion is made that Mine X should immediately start the deepening development project.

5.2.2 Internal rate of return

Regarding Scenario 1 – the current operations – the internal rate of return equals 37.3 percent (Chapter 4: p. 59). The internal rates of return for Scenario 2 – the investment project begins immediately – and Scenario 3 – a six-month delay of the project – provide an internal rate of 38.2 percent and 41 percent, respectively. The internal rate of return is therefore higher for Scenario 3 – a six month delay of the project (p. 63 and Appendix A, Schedules 1-3). However, the internal rate of return is the highest for a six-month delay of the project. The highest internal rate of return is an indication that a project is most viable (Chapter 3: p. 40). Therefore, the conclusion is made that Mine X should accept the project, but delay the beginning for six months.

5.2.3 Payback period

Regarding Scenario 1 – the current operations – the payback period equals six years and 15.7 days (Chapter 4: p. 60). The payback periods for Scenario 2 – the investment project begins immediately – and Scenario 3 – a six-month delay of the project – provide a payback period of six years and 28.8 days and five years and 11.2 months, respectively. The payback period is therefore the highest for Scenario 2, i.e. the investment project begins immediately (p. 60 and Appendix A, Schedule 1-3). However, the lowest payback period is the lowest for a six-month delay of the project. The lowest payback period is an indication that a project is most viable (Chapter 3: p. 41). Therefore, the conclusion is made that Mine X should accept, but delay the beginning of the project for six months.

5.3 Sensitivity analysis

The project was run at different cashflow levels in order to test the sensitivities of the project to changes in these inputs. The inputs were adjusted at five percent increments to a maximum of 15 percent up and down against base inputs.

5.3.1 Sensitivity analysis of net present value

The net present value was positive regarding to all three scenarios, namely the current operations, to start immediately with the project and as a six month delay in the project. The highest net present value is calculated in case the project starts immediately (Chapter 4: p. 61-62). Regarding to the sensitivity analysis, a five percent and 15 percent increase and decrease in the net present value indicated that it is the most viable scenario to start the project immediately (Chapter 4: p. 61-62).

Therefore, the highest net present value will be the most feasible, as explained in Chapter 3 (p. 29). The above results show that the current operations and to start the project immediately will be the most feasible when the different sensitivity scenarios have been applied. However, the original net present value must still be excluded to make the final feasibility decision regarding sensitivity. Therefore, the sensitivity analysis will not be the only factor to bring into consideration when an investment decision needs to be made.

5.3.2 Sensitivity analysis of internal rate of return

The internal rate of return was more than the discount rate regarding to all three mentioned scenarios. The sensitivity analysis has shown that in case of a five percent increase in the internal rate of return, the best scenario is to start the project immediately. A 15 percent and five percent decrease, as well as a five percent increase in the internal rate of return found the most viable scenario to delay the project with six months (Chapter 4: p. 62-63).

Referring to Chapter 4 (p. 62-63), it is clear that for all the sensitivities demonstrated, the six-month delay in the project would deliver the highest internal rate and by looking only at the internal rate of return, it would be the best option for feasibility to delay the project for six months. Based on the discussion in Chapter 3 (p. 40) of the internal rate of return disadvantages, the internal rate of return alone cannot be the only technique to consider when the feasibility decision needs to be made.

5.3.3 Sensitivity analysis of payback period

The payback period was shorter than the project's life-time regarding to all three scenarios. According to the payback period, all four these sensitivity measures, a five percent and 15 percent increase and decrease, indicated that the most viable scenario is to delay the project with six months (Chapter 4: p. 64). In Chapter 3 (p. 41), it was demonstrated that the shorter the payback period is, the more feasible the project would be. Therefore, Table 4.12 in Chapter 4 (p. 64) demonstrates that a decrease of 15 percent will cause the payback period to be at a minimum

and would be the best option to use for all three scenarios. This, however, cannot be the only factor in making a feasible decision, due to the disadvantages discussed in Chapter 3 (p. 41-42). Therefore, an overall view needs to be created to make the most feasible decision.

5.4 Summarise conclusions and recommendations

The sensitivity analysis reduces the different risks identified in Chapter 3 by reducing the capital requirements at a time of a capital constraint. There is a high level of assurance in the ore body to be oppressed and, as a consequence, uncertainties in this area will be minimised. The investment project will comprise the development of the VCR reef from 109 level to 120 level.

The evaluations show that the highest net present value for the three scenarios is where the project starts immediately. This is supported when the sensitivity analysis for net present value has been combined into the evaluation calculations, the final conclusion states that for both calculations the highest net present value will be for Scenario 2 – to begin the project immediately (Chapter 5: p. 68 & p. 69). This conclusion is due to the high value of the original net present value calculations and the closeness of each sensitivity calculation. The study concluded that the highest combined internal rate of return with the sensitivity analysis shows that the six-month delay in the project will deliver the highest internal rate of return and therefore the best feasible decision (Chapter 5: p. 68 & p. 70). The highest combined payback period evaluation with sensitivity analysis demonstrates that the most viable decision would be for Scenario 3 – a six-month delay in the project (Chapter 5: p. 69 & p. 70).

The main focus will be the net present value in conjunction with the internal rate of return and payback period. This combination will be to make a final investment decision according to the most viable project. This was explained in Chapter 3 (p. 40-45). According to the conclusion (p. 73-77), the two most viable scenarios would be Scenarios 2 and 3.

Therefore, it can be concluded that due to the highest net present value and both Scenarios' internal rates of return, expectations are positive. In order to reach the main objective of the study and to answer the research question (Chapter1: p. 6), the best feasible recommendation for this study would be to start the project immediately, due its higher net present value as the

payback periods are viable for both scenarios. However, the disadvantages of all these techniques still need to be considered, as demonstrated in Chapter 3 (p. 33-42).

This study has revealed that any inefficiencies or delays in capital projects will increase the time of preliminary productivity hold-back output to revenue. Therefore, uncomplicated predictions are complicated to illustrate. Due to all the uncertainties and disadvantages in the techniques identified in Chapter 3, the model of this research study could be completed in a number of ways (Nalebuff, 1985:34). Including the above financial and non-financial measures, the study has shown that it would be best to start the mining project immediately. There are also many risks involved in such a decision, as shown in Chapter 2, which can cause the sensitivity analysis results and conclusions to change rapidly. The risks can therefore be decreased through a well-established risk management system, as explained in Chapter 2. In certain **circumstances** where both option **principles** and strategic **relations occur**, it is **essential** to **revise** the circumstances before forming a view on whether the **reason** to pre-empt or the option **cost** of **postponement** will **dictate**. When Mine X has the opportunity to invest under **circumstances** of irreversibility and improbability, there is an option **cost** of **postponement**. By **similarity**, with a **economic** call option, it is **most favourable** to **postpone** exercising the option, or proceeding with the investment, even when it would be **lucrative** to do so in the **expectation** of gaining a **superior reimbursement** in the future.

5.5 Framework including practical implications

The theoretical framework of the study is a structure that can hold or support a theory of a research work. It presents the theory that explains why the problem under study exists.

Therefore, the theoretical framework is but a theory that serves as a basis for conducting research.

One: Problem

Identifying the research problem – this identification was explained and determined in Chapter 1 (p. 5).

Two: Question

The next stage of the research framework was to formulate the research question. This creates focus and requires a significant thinning down of the original problem. The formulation of the research question was determined and explained in Chapter 1 (p. 6).

Three: Design and method

The purpose of the design of this study was to determine capital investment evaluation techniques in conjunction with a sensitivity study to create accurate and unbiased data from which valid conclusions may be drawn. This includes determining how experimental closure will be achieved. These techniques were identified in Chapter 1 and explained in Chapters 2 and 3.

An important part of experimental design is to ensure that all variables other than those of interest are held stable and do not distort the results. This was done by repeating the three scenarios under the same conditions and techniques, but without manipulating the independent variable. The results of the three scenarios may then be compared.

Four: Data

Data design not only includes the identification of what data is needed, but also includes the design of how the data will be collected. The measurement of data typically involves manipulating independent variables and measuring dependent variables. This has been done through a literature study (Chapters 2 and 3) and the evaluation of research in Chapters 4 and 5.

Five: Analysis

After gathering the data, the next stage of the framework was to analyse the data to effectively turn the data into useful information. This analysis was done in Chapter 4.

Six: Conclusion

Finally, the analysis is reviewed and specific conclusions drawn that relate to the original question. These conclusions were explained in Chapter 5.

The opportunities and benefits identification, to improve an organisation's competitiveness and the accuracy of the feasibility study, were discussed in Chapter 2 and Chapter 3. Chapter 2 demonstrates that, due to the sensitivity analysis, it is very important to establish a risk management structure, and that using the best practice principles, applied to the mining area, will minimise the risks causing changes in the variables. This structure will provide the best suitable principles, practices, policy and procedures applicable to Mine X's current operation and will therefore be equally applicable to the deepening project and will therefore be adopted as working documents to manage the risk in the VCR Below level 120 project area.

The study's practical implication has shown that the VCR Below level 120 project can increase Mine X's reserves if Mine X starts with its operations immediately. The project can also increase the life of the mine and can create an opportunity to access further project areas within Mine X's operations. This could lead to an increased feasibility and, furthermore, could create a contribution towards economic growth. Therefore, the extended life of the mine has also provided a platform for further projects to be implemented at Mine X.

This study also showed the importance that the impact of an option to delay can have on an organisation's competitive advantage. The study further shows how a firm can manage its opportunity to invest under conditions of uncertainty and irreversibility. The study also shows how management can use cost behaviour to gain competitiveness through cost savings in using the decision to delay or to start immediately with the project.

The management of mining companies, where a negative relationship in competitiveness was noted between the timing of the project investment and risk management structure, should realise that they can be more competitive by considering the difference in timing of the project and modifying their risk management structure to benefit their decision.

The management of mining companies, where a positive relationship in competitiveness was noted between the timing of the project and risk management structure, should be used as a benchmark by other companies to improve their competitiveness. Further research must be done to determine the reason behind their success and these controls should be adopted by other companies to also improve their competitiveness.

The study will also **support** the management of mining investors and companies to minimize a project's **coverage to time** and cost risks. The management will need to focus **more** on risks at **the assignment stage**. When project managers **approximately calculate** the cost and time for **an assignment**, some **suppose** a best-case **condition**, while others **suppose** a worst-case **condition**. **Equally** approaches can be problematic. The first approach **frequently** results in **a reduced amount** of cost or time being estimated for **an assignment** than actually **occurs**, while the **second approach** may result in **extra** cost or times being estimated since assets are assigned to the project for longer periods than **in reality are** necessary. No calculations were in depth explained in this study. The accuracy of this study can also be verified using the attached CD on the Microsoft Excel file. The calculations will be in depth explained on the attached CD.

5.6 Value of the study

The study adds value to mining companies by identifying opportunities to improve their competitiveness in providing a capital investment management framework to identify project components and related issues for each phase of the project's lifecycle. Companies in the mining industry, as well as investors, can use the findings presented in this study to realise the importance of a well-established risk management structure. This study is unique as it is the first study to investigate the relationship between the viability to delay or to start the investment project immediately in the South African mining industry. This study is also unique since it takes into account how mining industries world-wide can achieve long-term success through development projects without losing key players, due to impulsive short-term downsizing decisions.

5.7 Limitations of the feasibility study

The supplementary projection and analyses are based on estimates and assumptions that used existing economic information, project specific information and formerly applicable information. It is the nature of forecasting that some assumptions may not occur and unexpected events and circumstances may occur. Such changes are liable to require review or revision of this document. The following will illustrate the limitations according to the documentation and information used in this study, namely while Mine X believes that these sources are reliable, their accuracy is not guaranteed; and the development cost information for the analysis of the capital-investment project obtained by the local sources of Mine X has been deemed reliable, but has not been separately verified (Chapter 1: p. 9-10).

5.8 Final conclusion

This study was done against the backdrop that executives should carefully consider all the options to manage difficult periods before letting employees go, especially if they are going to rehire employees shortly after the economic recovery. Therefore, the study investigated whether investing in operational development of a plant can be used to increase feasibility, rather than to make across-the-board labour cuts. In this context, the main objective of the study was to answer the following research question was stated: Will Mine X's investment project in extracting gold from Mine Z, be feasible?

The main objective, supported by the first three secondary objectives, of this mini-dissertation was reached when it was concluded that the mine will achieve a competitive advantage if the project begins with development immediately. The fourth secondary objectives was also reached, as it was indicated when it was concluded that a framework for identifying the investment project components and related issues of Mine X was established and successful project outturn was achieved.

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PROOFREADING OF

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To whom it may concern

This document has been through a process of proofreading and editing. The document was sent for proofreading followed by editing based on the proofreading. This process was repeated until the author was satisfied with the document.

I did the proofreading of this document to the best of my ability. The final responsibility for accuracy and integrity of the document lies with the author.

Gene Mathey