The application of real options as an enhancement to the net present value technique: A case of the financial services sector

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DECLARATION

I, Kyle Clifton Fitzgerald, declare that this dissertation is a representation of my own work in concept and execution. This work has not been submitted in any form for another degree at any university or institution of higher learning. All information cited from published or unpublished works have been acknowledged.

20/7/2022

Mr. K.C. Fitzgerald Date

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DEDICATION

I would like to dedicate this study to myself, Kyle Clifton Fitzgerald, in honour of my virtue. I have always been my main supporter but without the self-love and confidence that God has bestowed upon me, I would not be where I am today. The journey may have been a tad longer, but it is definitely worth it and sincerely appreciated. To me, myself and I, with love.

ABSTRACT

There has been an incredible transformation in the capital budgeting literature over the past fifty years. Traditional methods, such as Net Present Value (NPV), are at best arbitrary decision-making tools, causing many uncertainties throughout the project lifespan. A major concern is that traditional investment models such as NPV do not adequately evaluate investments under uncertainty, so they cannot integrate managerial flexibility into decision-making. On the other hand, real option analysis draws on the traditional NPV technique and creates a broader range of investment alternatives, allowing management to effectively account for these uncertainties.

This study examined the perceptions of financial planners on the application of real options as an enhancement to the NPV technique in the Durban financial services sector. This study focused on a quantitative research design and used questionnaires to gather primary data. The target population of this study was 286 certified financial planners from Durban, KwaZulu-Natal. Data analysis comprised both descriptive and inferential statistics, allowing the researcher to draw conclusions about the target population and suggesting ideas for future research.

The results of this study concluded that NPV is insufficient as a standalone capital budgeting technique and that the usage of real options within the NPV framework enhances decision-making in investments when uncertainty is present. The results of the study also indicated that some of the financial planners who participated were unfamiliar with or had limited knowledge of real options, which prevented them from applying these judiciously. It is therefore recommended that these participants enrol in a professional development program on this subject to increase their knowledge and competence in dealing with real options appropriately in financial and investment decision-making. The study used certified financial planners from Durban's central business district, who are part of the country's financial services sector. To make the results generalisable in the context of South Africa, future studies should explore the same topic using certified financial planners from other cities.

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LIST OF ACRONYMS

AHP	Analytic Hierarchy Process
CRSP	Centre for Research in Security Prices
DCF	Discounted cash flow
FPI	Financial Planning Institute of Southern Africa
FPSB	Financial Planning Standards Board
IREC	Institutional Research and Ethics Committee
IT	Information Technology
KMO	Kaiser-Meyer-Olkin
MBA	Masters of Business Administration
NPV	Net Present Value
NSC	National Senior Certificate
R&D	Research and Development
RCB	Recognised Controlling Body
SAQA	South African Qualifications Authority
SARS	South African Revenue Service
SPSS	Statistical Package for Social Sciences
STATSSA	Statistics South Africa
SWOT	Strengths, Weaknesses, Opportunity's and Threats
UK	United Kingdom
US	United States

CHAPTER 1: INTRODUCTION

1.1 Background to the study

Investment decisions are made under the assumption of expected benefits and profit emanating from future growth and demand of a product or service. However, investment decisions are not made solely based on the potential profit and revenue to be gained but also incorporate the risks involved (Agyei-Mensah, 2021: 570). This suggests that corporate investment decisions are made with the intention of making a profit while simultaneously minimising firm expenses and capital exposed to risk. In view of this, investment decisions form part of the strategic decisions that organisations conduct as part of the business process and operations that may make or break the sustainability and future of these organisations. Therefore, investment decisions should not be taken lightly but should be allotted the weight they deserve through careful and meticulous evaluation to select the most profitable investments with lower risks.

Additionally, investment decisions are generally aided by financial planners, who typically act as financial advisors by sharing their perspective on corporate investment projects to bring some valuable information that the organisation might have overlooked (Clayton, Stanley, Lynch and Margret, 2007: 69). This information may include market research and analysis, assessing clients' needs and goals pragmatically, identifying new opportunities, and ensuring that regulations are met while keeping the investment/s profitable. In addition, financial planners can help organisations choose affordable project financing options and gain loan approval from institutions such as banks. One of the considerations that are made before an investment decision can be made is whether the project has a positive net present value (NPV) (Correia, Flynn, Uliana and Wormald, 2019: 8-6). Nevertheless, evidence and practical considerations have highlighted that NPV does not account for uncertainties and becomes less effective when market conditions are uncertain.

Over the last fifty years, capital budgeting literature has seen an incredible transformation in corporate investment practices (Batra and Verma, 2017: 29).

However, some financial practitioners have suggested that real options theory provides a framework to deal with the uncertainties relating to investment decision-making. Traditional techniques such as NPV provide arbitrary decision-making tools at best, accepting projects that yield a positive NPV and rejecting projects that yield a negative NPV (Agyei-Mensah, 2021: 569). These capital intensive investment projects deal with large sums of cash over a longer period, resulting in many uncertainties during the project's lifespan. A major concern is that models such as NPV do not efficiently deal with uncertainty in an investment and are thus unable to integrate managerial flexibility (Baker, Dutta and Saadi, 2011: 24).

Real options analysis expands on the traditional NPV technique and opens a wider range of options, provided that management is flexible regarding decision-making. These options can allow for the most efficient allocation of resources to occur and account for many uncertainties inherent in traditional capital budgeting techniques. According to de Andrés, de Fuente and San Martín (2015: 37), users of capital budgeting techniques are responsible for the differences that are experienced between theory and practice. This is because most managers cannot apply capital budgeting techniques to analyse and assess different investment opportunities. However, this does not suggest that finance practitioners are incapable of applying capital budgeting techniques but merely that they are unaware of the differences or implementation of these techniques (Lazaridis 2004: 427; Brijlal and Quesada, 2009: 37; Hall and Millard, 2010: 85).

Although real options have been known for over thirty years, their development only started to pick up approximately ten years ago. Additionally, there is limited research in the real options field partially due to the complexity of some of the models (Gharib, Berrado and Benabbou, 2018: 642). Nevertheless, researchers such as Graham and Harvey (2002: 8) and Hall and Mutshutshu (2013: 177) have explored the real options research field. The limited attention to this field may be due to real options being present in most capital budgeting techniques (Ryan and Ryan, 2002: 355; Baker, Dutta and Saadi, 2011: 18). Evidence has indicated that those in management who obtained a Master of Business Administration (MBA) qualification are unlikely to be aware of real options as opposed to managers without an MBA, and it is the complexity of real

options techniques that serves as the greatest challenge in implementing them amongst financial practitioners (Horn, Kjærland, Molnár and Steen, 2015; 74).

Moreover, Michelon, Lunkes and Bornia (2020) presented that real options determine the prospects for exploring the usage of current and advanced capital budgeting methods, which were seldom analysed in research. It is essential for the professional training of managers and analysts in advancing real options. This crucial step would be necessary to promote the replacement of simple capital budgeting techniques with more accurate techniques to enhance investment decisions. The authors further noted that one of the most important aspects to consider with capital budgeting techniques is that there is no single and extensive method to employ; conversely, several methods need to be integrated, preferably consisting of both simple and sophisticated techniques (Michelon, Lunkes and Bornia, 2020). This is where the power of real options can be maximised.

Industry and academic literature have advocated the usage of real options as a capital budgeting method to analyse corporate investments where uncertainty exists, as conventional techniques that include NPV inherently fail to account for the flexibility of management on a project's cost (Barton and Lawryshyn, 2011: 254; Zeng and Zhang, 2011: 43). It is important to note that there are limitations in terms of the available literature, which was due to the nature of the topic appearing to be complex.

1.2 Problem statement

While traditional techniques such as NPV provide arbitrary decision-making tools at best, accepting projects that yield a positive NPV and rejecting projects that yield a negative NPV. Capital-intensive investment projects deal with considerable sums of money for a longer duration, resulting in many uncertainties during the lifespan of the project. A major concern is that models such as NPV do not efficiently deal with uncertainty in an investment. Real options analysis expands on the traditional NPV technique and opens a wider range of options that are naturally occurring during a projects lifespan. Such options can allow for the most efficient allocation of resources to occur and account for many uncertainties inherent in traditional capital budgeting

techniques. The complexity of real options techniques serves as the greatest constraint to its implementation, and a lack of managerial flexibility is rooted at the hesitancy to apply real options, most of which is addressed with the current research.

Real options analysis accounts for managerial flexibility as an enhancement to the static NPV technique, as it unequivocally presents measures that account for these uncertainties, such as the future cash flows, which were not available during the initial NPV decision. There is a strong need for managers and analysts to be professionally trained in the advancement of real options. There is also a need for more empirical studies on real options involving a wider scope of industries, as fewer industries have been represented in existing studies.

Furthermore, research exploring the application of real options in capital budgeting decision-making is deficient within the financial services sector of South Africa. In view of this, the study explores the application of real options as an enhancement to the NPV technique in the South African financial services sector. According to the researcher, there have been no studies conducted on NPV and real options using financial planners as a target population within the financial services sector, especially within Durban.

1.3 Aim

The purpose of this research was to examine the perceptions of financial planners on the application of real options as an enhancement tool to the Net Present Value technique in the Durban financial services sector.

1.4 Research objectives

The research objectives of the study, intended to address the aim of the study, are as follows:

- To explore whether NPV is sufficient as a standalone capital budgeting technique,

- To examine whether the usage of real options in NPV enhances investment decision-making,
- To explore the reasons why real options are not widely adopted in practice.

By virtue of the research objectives being fulfilled, the aim of the research has been achieved. The research objectives are discussed in more detail in chapters 4 and 5. respectively.

1.5 Research design

The study adopted a positivism research philosophy as it assisted the researcher in remaining independent and objective from the research process (Saunders, Lewis and Thornhill, 2019: 91). The aim of this research was to examine the perceptions of financial planners on the application of real options as an enhancement tool for the NPV technique in the Durban financial services sector. A quantitative research design was adopted using a questionnaire as the research instrument; as it enabled the researcher to efficiently gather data on the target population. According to Creswell and Creswell (2017:123), quantitative research involves gathering numerical data and generalising the data to explain a phenomenon, allowing for a statistical model to be constructed describing the observations of a study. This quantitative approach allowed the questionnaires to be distributed, collected, and analysed in a shorter time frame.

The research instrument was piloted among the participants of the target population to assess its validity and was fine-tuned to the target population before being disseminated for the data collection process. The study's target population was certified financial planners residing in Durban, and purposive sampling was used to select the participants. Purposive sampling was necessary for the study, as it enabled the researcher to exclusively gather data from the target population.

The data that were collected were analysed using IBM Statistical Package for Social Sciences (SPSS) Windows version 26 and Statgraphics Centurion version 15.1, in which the data were populated, and various descriptive and inferential statistics were conducted in line with the objectives of the study. Descriptive statistics were used to

organise and summarise the quantitative data, allowing for research that is constructive and offering insights for future research (Allanson and Notar, 2020: 376). According to Dickson (2020: 35), inferential statistics allow for primary data to be collated and analysed, using a statement of significance to test the variables. The use of descriptive and inferential statistics enabled data that are more detailed and easier to analyse.

1.6 Significance of the study

The sensitivity to the cost of the real options is what makes it a better valuation tool than NPV; thus, it can greatly enhance the discounted cash flow (DCF) technique. It must be highlighted that real options are in fact optional, allowing for the option, whereas not the commitment, to explore such an option in a specified period (Smith, Driver and Matthews, 2018; 121). As a result, real options analysis accounts for managerial flexibility as an enhancement to the static NPV technique. It unequivocally presents measures that account for these uncertainties, such as the future cash flows, which were not available during the initial NPV decision (Benitez and Lima, 2019: 565).

In this regard, this research is expected to benefit managers, finance practitioners and other decision-makers by expanding their knowledge of real options and their applicability in investment decisions. This may give them the managerial flexibility they desire and enhance their capability of managing risk and uncertainty, particularly in large capital-intensive projects. Furthermore, the research is expected to be beneficial towards researchers and academics interested in the area of real options, as the field is niche specific, and research remains limited regarding real options.

1.7 Chapter organisation

The study is structured as follows:

- Chapter 1 presents the background of the research, in which the aim, objectives, and problem statement are outlined.

- Chapter 2 provides the literature review on NPV, real options, linkages between these variables, uncertainties in decision-making and empirical studies on real options.

- Chapter 3 addresses the research methodology by defining the research design, target population, sampling size and framework, collection of data, and analytical measures that will be used against the research instrument of study to provide statistical analysis. It also discusses the delimitations, limitations, validity and reliability, and ethical considerations.

- Chapter 4 details the data analysis and discusses how the results link to the existing literature.

- Chapter 5 presents the conclusion and recommendations.

1.8 Chapter summary

This chapter outlined the background, problem statement, research aim, and research objectives of the study. The next chapter addresses the literature review of the research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This section reviews the literature related to the study. It will provide a brief history of NPV and real options and present the linkages between these variables. It must be emphasised that seminal works of literature have been used for this study, as they contribute to the development of the theoretical framework of the research. The problem lies within the inherent features of capital budgeting techniques, of which real options seem to provide the overarching solution. This chapter will focus on the literature of the NPV technique and its limitations. It will then dive into the real options literature and attempt to link the two research variables before presenting the different types of real options. The chapter will then look at the uncertainty behind decision-making within capital budgeting and empirical studies on real options before presenting a brief overview of the financial services sector of South Africa and concluding with the conceptual and theoretical framework of the study.

2.2 Net Present Value

The net present value (NPV) has been around since before the 1900s, although it remains unclear who the scholar to disseminate NPV was. Most authors agree with Irving Fisher and his ground-breaking book The Rate of Interest first published in 1907 and the significantly extended and revised edition in 1930 titled The Theory of Interest (Poitras, 2006: 121). Fisher was fundamental to introducing the theoretical and practical acceptance and widespread of the NPV rule. The separation theorem he derived bears his surname and states that a company must maximise NPV regardless of shareholder preferences (Rubinstein, 2003: 45).

NPV may be defined as the sum of present values of the annual net cash flows earned for a project, discounted at a company’s cost of capital, minus the project's initial investment (Batra and Verma, 2017: 21). In simpler terms, NPV is all the income

earned on a project less all the costs to bring the project into existence and considers the time value of money principle. The general rule is that if the results are positive, the investment will be accepted, as this indicates an increase in shareholder wealth as the project earns more than the cost of capital for the company. However, if the results are negative, then such an investment will be rejected (Maiellare, 2020: 4).

NPV may be calculated by means of a formula or by use of the present value tables; such tables are based on rounded off figures derived from the formula. For the purpose of this study, the formula will be applied when performing NPV computations:

$$\text{NPV} = \sum_{i=1}^{n} \frac{Cash\ Flow_i}{(1+r)^i} - Initial\ Investment$$

Where:
n = number of years
i = period for which the investment is required
r = cost of capital

This formula can be seen as an adaptation to the present value formula from which it is derived (Correia et al., 2019: 8-6).

2.2.1 Decision-making under NPV

Gitman, Smith, Hall, Makina, Malan, Marx, Maestry, Ngwenya and Strydom (2014: 237) state that when deciding whether to accept or reject investment opportunities, NPV decision criteria are as follows:

- The project is accepted when the NPV is greater than zero,
- The project is rejected when the NPV is less than zero.

2.2.2 Limitations of NPV

NPV routinely violates the value of the project, not taking into account its future prospects, and although a project might not appear beneficial initially, this is not to say that it will appear this way all the time (Ragozzino, Reuer and Trigeorgis, 2016: 437). Circumstances, time and markets can and will change, so it is highly likely that these uncertainties will cause a project to also change. NPV appears risky at this point and is considered to be lacking in managerial flexibility regarding decision-making (Benitez and Lima, 2019: 564). Real options appeared as another technique in the world of capital budgeting techniques and finance in an attempt to cover up this shortcoming of NPV. Real options were found to be suitable for projects with high uncertainty due to their superior ability to provide flexibility in decision-making; this analysis is the perfect solution for quick decision-making in a complex marketplace full of uncertainties (Nur-Al-Ahad and Fujiwara, 2019: 627; Chang, Li and Gao, 2016: 186).

According to Weil and Oyelere (2006: 25), the main advantage of DCF techniques, such as NPV and internal rate of return, over traditional capital budgeting techniques, such as payback period and accounting rate of return, is that they take the time value of money principle into account. The very nature of the time value of money principle consequently enables DCF techniques to account for the uncertainties related to future cash flows; however, as cash flows need to be predicted, there are greater difficulties in generating accuracy in these predictions (Kengatharan and Diluxshan (2017: 290). It is particularly important to use precise data when applying the NPV technique (Hanafizadeh, Kazazi and Jalili Bolhasani, 2011: 514).

This further complicates the application of DCF techniques regarding cash flows. These cash flows are the inputs of DCF calculations; thus, the problem is essentially these inaccurate inputs, rather than the DCF technique itself. Mensah and Miranti (1989: 186) reviewed the issues with applying DCF techniques and noted the project's future cash flows as the most serious. The issues above regarding DCF techniques, namely, NPV, were highlighted by Ragozzino, Reuer and Trigeorgis (2016: 436). Michelon, Lunkes and Bornia (2020) presented a systematic review of capital budgeting literature and noted the difficulty in generating accurate inputs for DCF techniques, such as cash flows and the cost of capital. In an attempt to mitigate the

uncertainties that projects inherently experience, investments are represented in stages instead of the entire project, which results in many options becoming available when the latest information is presented. Each of the project stages can be viewed as a compounding option based on the value of subsequent stages (Baldwin and Trigeorgis, 1993: 226). These options are known as real options.

DCF techniques function under four major principal assumptions, which are rarely satisfied, identified by Li (2008: 36; Correia, Flynn, Uliana and Wormald, 2019: 8-4) as:

- All cash flows occur at year-end.
- Cash flows are treated with certainty; however, uncertainties regarding cash flows can be factored into NPV analysis.
- All returns are reinvested back into the business.
- A perfect capital market where no profit or loss is made.

Additionally, Alikram (2020: 266) highlighted the disadvantages of NPV by indicating the following:

- The complexity required to perform these calculations.
- The lack of accounting for capital efficiency within a business.
- The impossibility of obtaining the same net discounted income or projects with different capital structures.
- The inability to allocate resources fairly due to project limitations.

The following major limitations have been identified from the literature:

- Future cash flows are merely estimates that are likely to change over time, increasing their uncertainty.
- Discount rates are arbitrarily decided upon by management, and these may need to be revised when the riskiness of similar projects increases/changes. These rates may be too low when initially making a project's decision.
- The technique is not suitable when evaluating projects with unequal initial investments.
- The technique is not acceptable when evaluating projects with different lifespans.

A look into real options will now be presented.

2.3 Real options approach

The concept of real options originated from financial options (Rams, 2019: 94), and the term “real options” was conceived 30 years ago to refer to real investment scenarios where options valuation techniques were used (Myers, 1977: 147). Real options theory rose to prominence in the 1970s due to criticism of fixed and passive techniques used in investment decision-making (Machiels, Compernolle and Coppens, 2021: 448). Myers (1977: 149) introduced real options to value firms and predict corporate borrowing patterns using financial options theory as a technique. However, unlike financial options, which are arbitrary, real options are applied to real assets, projects and physical objects (Trigeorgis, 1996). This was to model growth opportunities as options of an organisation, especially for difficult or impossible to reverse investment decisions in a business environment where uncertainty is expected in the future (Rams, 2019: 97).

In this regard, a real option factors the uncertainty of a project into account by incorporating techniques used to value financial options and applying them to a project where uncertainty exists. These uncertainties cannot be adequately accounted for using traditional capital budgeting techniques, and when facing risk and uncertainty in investment decisions, organisations seek to use strategies that reduce risk without losing opportunities (Michelon, Lunkes and Bornia, 2020). Real options offer strategic opportunities that allow the organisation to shorten the reaction time to environmental changes by opening the possibility to exploit opportunities, almost leaving the organisation room to manoeuvre and protect itself against potential losses (Rams, 2019: 98).

According to Dixit and Pindyck (1994), real options theory is typically applied to investment decisions that i) are irreversible, ii) exhibit uncertainty about future benefits or costs and iii) have flexibility in the timing of the investment. In this regard, real options may be used strategically to account for project-based decisions. Project-based decisions are usually based on real options that were derived from a financial

approach (Ragozzino, Reuer and Trigeorgis, 2016: 428). Real options techniques expand on the traditional NPV technique by providing options that help to counteract the uncertainties of a project. On the condition that management is flexible regarding decision-making, these options can allow for the most efficient allocation of resources to occur. In view of this, an investment with flexibility is more valuable and/or preferable than an inflexible investment (Rams, 2019: 94-101).

From 1977 to 1990, the discussion on the approach to real options mainly focused on similarities and differences between real options and financial options, which is seen in the works of Margrabe (1978: 177-186), Ross (1978), Cox, Ross and Rubinstein (1979: 229-236), Geske (1979: 63-81), Kester (1984: 153-160), Myers (1984: 126-137), McDonald and Siegel (1984: 261- 265), McDonald and Siegel (1985: 331-349), Brennan and Schwartz (1985: 135-157), Trigeorgis and Mason (1987: 14-21), Carr (1988: 1235-1256) and Paddock, Siegel and Smith (1988: 479-508). Additionally, from 1990 to 2005, the real options approach in literature expanded and was also adopted into practice by many organisations (Rams, 2019: 94-101). Pindyck (1991: 1110-1148) examined the behaviour of organisations when making investment decisions uncertain, which resulted in the further development of a real options approach. Moreover, the work of Trigeorgis (1995) bridged the gap between theory and practice to highlight the strategic and practical implementation of the real options approach.

Nevertheless, the works of Copeland and Antikarov (2001) and Damodaran (2005) suggested the practical possibilities of incorporating real options in the strategy of organisations. In addition, from 2005 onwards, the real options literature has largely focused on empirical tests to assess the applicability of real options in different sectors (Rams, 2019: 96). Nonetheless, it should be noted that investing is an opportunity cost that gives up the value of waiting (Machiels, Compernolle and Coppens, 2021: 457). In light of this, choosing to apply a real option is a choice and not an obligation (Dixit and Pindyck, 1994), and because of this, determining the optimum time to execute the real options or to abandon them is crucial. The different types of real options will now be discussed.

2.3.1 Types of real options

Trigeorgis (1996), Fichman, Keil and Tiwana (2005: 78), Baker, Dutta and Saadi (2011: 23) and Ragozzino, Reuer and Trigeorgis (2016: 432) identified seven distinct types of real options: delay, scale, abandon, growth, stage, switch use, and risk mitigation. These have been discussed in the following subsections.

2.3.1.1 Delay real option

The delay real option defers investment to a later date to increase the probability of making the right decision when the environment is more conducive (Fichman, Keil and Tiwana, 2005: 74). This option is also known as an option to delay or defer when a future investment is based on certain prevailing conditions. This allows the initiation of a project to be delayed, and such an option will only occur if economical situations that prevent a business from initially accepting the project improve at a future date (Muharam and Tarrazon, 2017: 4).

2.3.1.2 Scale real option

The scale real options assess whether to expand or contract the number of resources allocated to a project through the determination of the future potential of the project using current business circumstances (Fichman, Keil and Tiwana, 2005: 74). The option to expand looks at making a further investment in the project by increasing the production output if future conditions are favourable. Consequently, the option to contract would decrease any future investment in a project, with the purpose of completing a project earlier than its expected date, as conditions have not been so favourable date (Benitez and Lima (2019: 569).

2.3.1.3 Risk mitigation real option

The risk mitigation real option investigates temporarily stopping business operations when costs exceed benefits until it was more profitable to resume operations (Trigeorgis, 1996). Furthermore, radical innovation projects are too risky, and their

initial costs are often too high. Prototyping may be an effective risk mitigation option because it gives investors the option of hedging their risk until the product is proven to be functional and having economic value before making a full-scale investment into the project (Lai and Locatelli, 2021: 119-290).

2.3.1.4 Growth real option

The growth real option explores investment opportunities by making initial small investments that may create lucrative business opportunities to be pursued once the potential becomes apparent in the future (Fichman, Keil and Tiwana, 2005: 75). This is typical in research and development (R&D) projects where acquiring certain strategic assets or developing capabilities may open other future opportunities (Trigeorgis, 1996). For example, an investment might have a negative NPV but may open growth opportunities that managers have the right, but not the obligation to pursue by virtue of the first-stage investment (Ragozzino, Reuer and Trigeorgis 2016: 436). Such growth opportunites must be factored into decision-making.

2.3.1.5 Stage real option

The stage real option divides a project into separate phases in which continuation to the next phases is dependent on the valuation of the project's subsequent stages by assessing the costs and benefits at the preceding stages of completion (Fichman, Keil and Tiwana, 2005: 75). This reduces the risk in large projects where investors may not want to risk all their resources before confirming the visibility and profitability of the projects. Projects that can be broken down into several distinct stages and possibly outsourced when resources are limited are crucial to strategic decision-making (Muharam and Tarrazon, 2017: 9).

2.3.1.6 Switch real option

The switch real option investigates the potential benefits of changing from one functional use to the other (Trigeorgis, (1993: 204); Trigeorgis (1996). For instance, in information technology (IT) projects, it may be discovered that recent technology is

more robust and beneficial than the one that is being currently used by an organisation, and in view of this, the organisation may switch to modern technology because it brings more value to the project (Fichman, Keil and Tiwana, 2005: 76). The option to switch allows the decision-maker to evaluate the possibility of switching the inputs or the outputs of the project; this possibility will ensure adaptive flexibility to changes in market conditions (Fernandes, Cunha and Ferreira, 2011: 4492). For example, if there are changes in prices or demand, management can change the type of projects (outputs), enabling project flexibility. On the other hand, the same types of projects can be executed from different types of raw material (inputs), giving process flexibility and strengthening the overall flexibility of management in decision-making.

2.3.1.7 Abandonment real option

The abandonment real option looks implicitly at making a subsequent decision to terminate a project and reallocates the remaining resources to other projects (Fichman, Keil and Tiwana, 2005: 76). This type of option is exercised when abandoning the project and realising a salvage value from the project is considered better than pursuing a project that is more likely to result in a loss (Trigeorgis, 1993; 204; Trigeorgis, 1996). Vintila (2007: 51) discusses the possibility of renouncing a project once conditions become unfavourable, representing the abandonment real option. The author concluded that the option to delay or abandon creates an additional value of 26 per cent of the cost of the investment, which represents approximately 75 per cent enhancement to the NPV technique, as opposed to situations where real options are disregarded in investment decision-making. This real option is abandonment and will only be applied if the subsequent annual net cash flows are negative or not profitable enough to continue with the project (Benitez and Lima, 2019: 563).

It becomes necessary to abandon a project in some situations, markets changes reveal to be adverse and possibly sell off the capital equipment and other assets utilised during the project. This can be extremely important to avoid losing an entire investment, and the real options analysis offers a way to recoup the expenses of a project. These types of abandonment options are important in capital-intensive

industries such as airlines and railroads, financial services and the introduction of new products in uncertain markets (Fernandes, Cunha and Ferreira, 2011: 4493). According to Ampofo (2017: 42), real options are particularly suitable for the evaluation of projects requiring a construction and/or start-up time that does not allow any profit until completion or involving some sequential decision-making. This option gives management the possibility of abandoning the project if certain unfavourable or critical information is received. The authors noted that R&D intensive industries, such as pharmaceuticals, long-development capital-intensive projects and start-ups, are examples of investments for which these types of options may be applied. This study will focus on the real option of abandonment of a project by looking at a project subsequent to the initial investment decision. The different types of real option valuation methods will now be discussed.

2.3.2 Real option valuation methods

There are four main real option valuation methods: the binomial option pricing model, decision tree analysis method, Monte Carlo simulation method and dynamic programming method (Machiels, Compernolle and Coppens, 2021: 450). However, the decision tree analysis method has been discussed in more detail compared to the other real option valuation methods because it is the focus of this study.

2.3.2.1 Binomial option pricing model

The binomial option pricing model is based on a risk-neutral argument that enables the creation of a simple representation of the development of an asset, which assumes two possible future outcomes that increase or decrease in value (Martins, Marques and Cruz, 2015: 10). Given that the initial value of an asset is "X" and probability "p" of the value of the asset going up is "u" and probability of the asset value going down is "d", assuming that the asset is maintained for two periods, the following asset values may be realised Xu^2, Xud or Xd^2. This is illustrated in Figure 1.

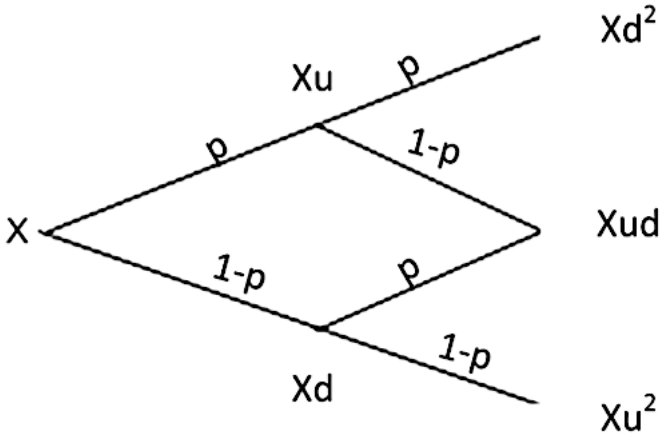


Figure 1: Binomial tree

Source: Martins, Marques and Cruz (2015: 04014026-7)

The binomial option pricing model is effective when there is one uncertainty involved, and it also allows estimation of the several option futures; however, the model requires advanced financial knowledge and is not suitable for scenarios where there is more than one uncertainty (Martins, Marques and Cruz, 2015: 11). The binomial option pricing technique may not be sufficient when there are multiple, interacting uncertainties experienced in market conditions, as such a basic tool may fail to incorporate the flexibilities of management and thus not present all the real options available (Ragozzino, Reuer and Trigeorgis 2016: 439). It is due to this very nature that the binomial option pricing model will not be considered for the valuation of real options

2.3.2.2 Monte Carlo simulation method

Monte Carlo simulation is used to determine the results of an investment appraisal developed to carry out the financial analysis that includes the identified risk variables (Ampofo, 2017: 42). This type of simulation is used to examine tough investment decisions in depth, as it provides a complete statistical representation of the output variables while utilising multiple criteria simultaneously (Dranka, Cunha, de Lima and Ferreira, 2020: 444). Martins, Marques and Cruz (2015: 12) assert that the Monte Carlo simulation method is capable of dealing with several uncertainties and uses

probability distribution to generate different possible outcomes. These outcomes represent the various real options that are available for a project, and although they produce more realistic outcomes than the binomial option pricing model and the decision tree analysis method, they are overly complicated (Martins, Marques and Cruz, 2015: 13). This complication is why this method was not selected in the study.

2.3.2.3 Dynamic programming method

The dynamic programming method focuses on determining the optimum time to apply the real option (Martins, Marques and Cruz, 2015: 5). According to Kozlova (2017: 181), the method works backwards to calculate the optimal time to exercise a real option. The dynamic programming method is suitable for considering the uncertainties of renewable energy technology; however, this method requires a strong understanding of mathematical techniques (Li, Wu and Li, 2018: 3). This understanding has led to the method being too complex to apply to practice and serves as one of the limitations regarding the implementation of real options (Ampofo, 2017: 52). The complexity experienced when performing dynamic programming has served as the reasoning behind excluding this method from the study.

2.3.2.4 Decision tree analysis method

The decision tree analysis method is a statistical method presented in a graphical fashion to illustrate the decision-making process occurring under several distinct conditions (Mittal, Khanduja and Tewari, 2017: 111). Decision trees have been around for many years and are trained at an intermediate level of financial management as they allow for the various options of a project to be represented. This statement is important when illustrating decision trees to financial practitioners, as it assumes there is a general understanding of decision trees to the target population. According to Kengatharan and Diluxshan (2017: 288), decision trees are a simple decision-making tool that implicitly looks at the subsequent outcomes associated with their probabilities. It is comparable to the binomial option pricing model, but it allows for more practical options and can accommodate multiple uncertainties (Martins, Marques and Cruz, 2015: 12), and it is also “a technique very similar to dynamic programming” (Hespos

and Strassmann, 1965: B-248). This suggests that decision tree analysis methods share some roots with both the binomial and dynamic programming methods.

Additionally, it is typically used “in sequential decisions, where various decision points are studied in relation to the subsequent chance events” (Lee and Tai, 2013: 818). Moreover, it is used for selecting the optimal decisions as well as scaling in when the decision has already been made to take lessons from past experiences that may be useful in similar conditions in the future (Mittal, Khanduja and Tewari, 2017: 111-115). Furthermore, decision trees are also used in capital budgeting and investment decisions for virtually any industry (Bailes and Nielsen, 2001: 15; Lee and Tai, 2013: 818). Similarly, de Ville (2013: 448) states that decision trees are used for predicting and classifying mechanisms that were among the first statistical algorithms to be adopted and used in the implementation of electronic computers in the 20th century.

In addition, this has led to the development of a range of new methods due to cross-disciplinary and cross-fertilisation, such as resampling methods to the more recent generalised multiple tree methods (de Ville, 2013: 448-455). The way decision trees are structured typically displays an algorithm under given conditions that gives a flowchart of sequential problems and their effect to help make informed decision-making (Mittal, Khanduja and Tewari, 2017: 111). Decision trees have progressed into several disciplines, including but not limited to artificial intelligence, machine learning, knowledge discovery and data mining (de Ville, 2013: 449). Decision tree analysis has ultimately been the most effective way of incorporating real options in investment decision-making (Ampofo, 2017: 52). Now that the real options valuation methods have been presented, it is easy to understand why the researcher selected decision trees as the most appropriate method of valuing real options in the study.

There is growing evidence of the application of decision tree analysis in site, vendor, process, material selection, and system reliability analysis. Some of its applications have been demonstrated by different authors and researchers over the years, as shown in Table 1.

Table 1: Decision tree analysis research and applications

Author and year	**Brief description**
Longbottom (1973)	Calculated the firm's future resource requirement for two noncompeting refrigerated container product line
Crawford, Huntzinger and Kirkwood (1978)	Conducted a decision analysis for several conductors' alternatives for an electric transmission line
Keeney (1979)	Presented a multi-attribute decision analysis approach for selecting a site for pumped storage facility considering various measures
Hobbs (1980)	Explained the use of decision analysis in nuclear power plant site selection by paired comparison methods
Golabi, Kirkwood and Sicherman (1981)	Explained a combination of decision analysis and optimisation methods to evaluate solar energy project proposals
Ronen and Pliskin (1981)	Used the decision tree analysis for the system reliability decision in a microelectronics company
Dyer and Lorber (1982)	Evaluated the potential subcontractors for project planning purposes
Higgins (1982)	Described the use of decision tree analysis in the pricing of a newspaper industry and property litigation problem of a food retailing company
Kirkwood (1982)	Conducted and explained a study on nuclear power plant site selection
Bell (1984)	Constructed a decision tree for selecting the company's coal halting method

Author and year	Brief description
Kirkwood and Sarin (1985)	Used the approach for the selection of borehole plugging material for radioactive water storage
Belton (1985)	Used a multi-attribute decision analysis approach in the selection of a contract for the development of a computerized financial management system
Allett (1986)	Analysed a labour contract bargaining strategy of heavy industry under the state of uncertainty
Quinlan (1987)	Described the multivariate analysis for selecting a site for the coal mine
Merkhofer and Keeney (1987)	Described four processes for simplifying decision trees and compared their results from a variety of domains
Peerenboom, Buehring and Joseph (1989)	Presented a multi-attribute decision analysis approach for selecting a site for nuclear waste disposal
Dote and Ovaska (2001)	Developed a portfolio of environmental and health research programs for a synthetic fuel facility through decision tree analysis
Berger, Gerstenfeld and Zeng (2004)	Explained the various soft computing techniques like fuzzy sets, decision trees and intended to remove the gap between their theory and practical implementation in industries
Janssens, Wets, Brijs, Vanhoof, Arentze and Timmermans (2006)	Explained the use of decision trees in calculating the number of suppliers in case of emergency situations
Sugumaran, Muralidharan and Ramachandran (2007)	Used a combination of both decision trees and the Bayesian approach in developing a transformational model

Author and year	Brief description
Sakthivel, Sugumaran and Babudevasenapati (2010)	Used decision tree analysis in feature selection in roller bearing
Dey (2012)	Used decision tree algorithm in vibration-based fault diagnosis in monoblock centrifugal pump
Saimurugan, Praveenkumar, Krishnakumar and Ramachandran (2015)	Studied the classification ability of decision tree in a gearbox fault detection
Chenaru, Popescu and Enache (2016)	Used decision tree analysis in real-time practical fault management
Tewari, Mittal and Khanduja (2017)	Compare three techniques of decision-making, fuzzy Analytic Hierarchy Process (AHP) and decision tree analysis giving the optimum results

Source: Mittal, Khanduja and Tewari (2017:112)

The decision tree is analogous to Bayes' Theorem of conditional probability, in which different value sets are computed at different nodes that are incorporated in the considerations for optimal decision selection (Mittal, Khanduja and Tewari, 2017: 113).

In this regard, there are three different types of nodes associated with decision tree analysis: decision nodes, chance/probability nodes and terminal nodes. These have been discussed below:

- The decision node is represented by a square shape [□] that indicates where the selection of one of the various options available,
- The chance/probability node is represented by a circular shape [O], which denotes events that are beyond the control of the decision makers,
- The terminal node is represented by a triangular shape [Δ], which indicates the final outcomes,
- Branch represents the course of action, which can either be a decision branch or a chance/probability branch depending on where the branch comes from (Mittal, Khanduja and Tewari, 2017: 112).

According to de Ville (2013: 449):

> *The decision tree unfolds in a stepwise fashion: the tree is formed by first partitioning the root node to form branches that define the descendent leaves (or nodes) that form clusters of observations that are alike within a node yet dissimilar when compared to other nodes at any given level of the tree. The branch partitions are based on a selection that is taken from a search through the data set to discover fields of data that can be input as partitioning fields to best describe the variability among the target values that are displayed in the root node. Potential partitioning fields are thereby termed 'inputs'. Once an input is selected, the descendent leaves, or nodes, are produced (terminal nodes are usually called "leaves").*

An example of a typical decision tree taken from Lee and Tai (2013: 818) about an organisation considering launching and distributing a new product either on a national, regional or international level with demand being uncertain is shown in Figure 2. This decision tree demonstrates the different combinations of parameters and probabilities, including NPV calculations, for each sequential string of decisions shown in Figure 2.

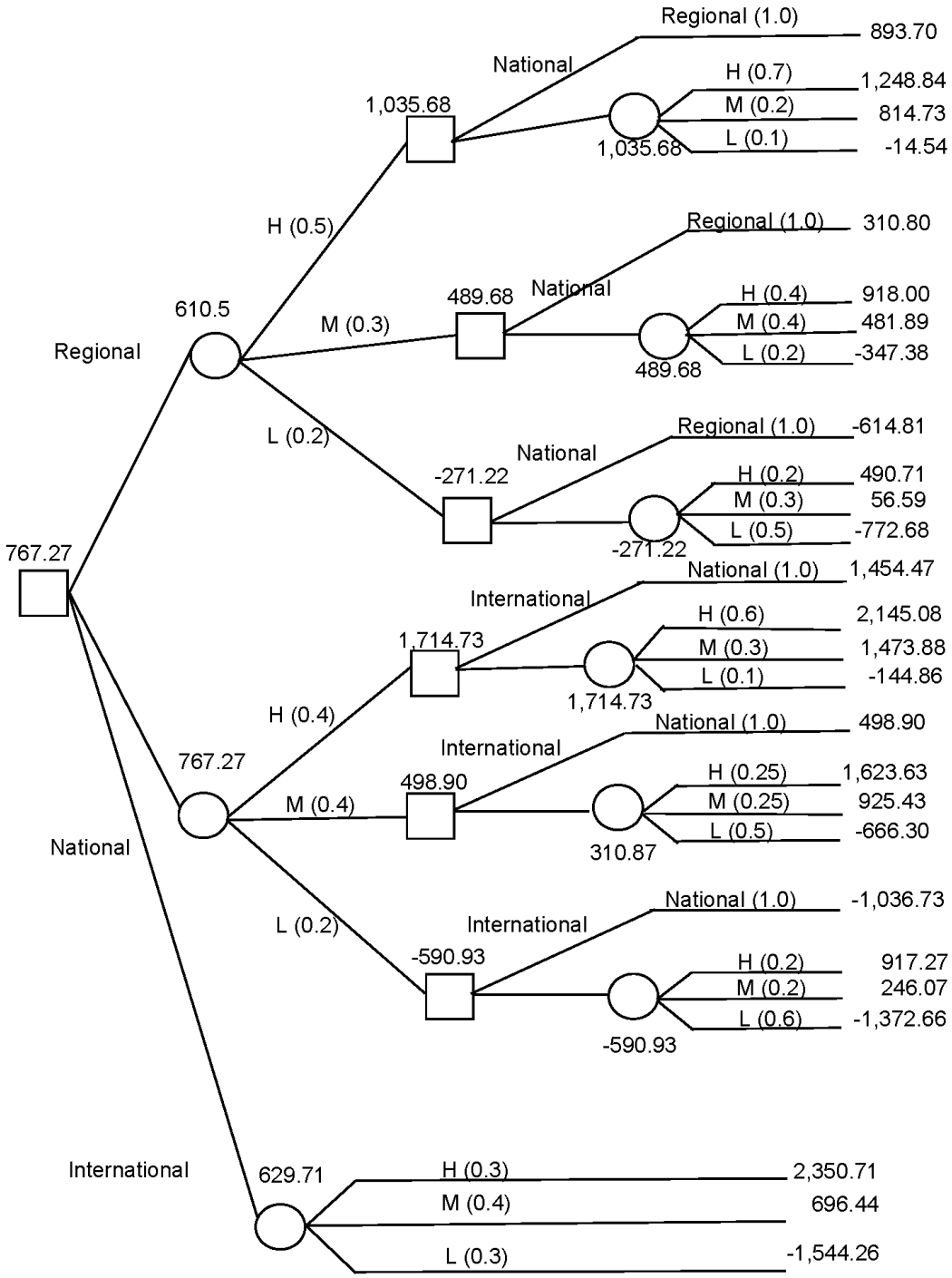


Figure 2: Decision tree for a new product distribution with demand being uncertain

Source: Lee and Tai (2013:819)

According to Sharma, decision tree analysis has many applications in different industries, social problems and the service industry, including the financial and banking industries (Sharma, 2012: 521; Sharma, 2013a: 618; Sharma, 2013b: 1).

Decision tree analysis can be used in a situation where i) several simultaneous objectives need to be achieved from a single decision that the outcomes may have adverse effects, ii) indirect benefits can be realised by choosing the right alternative that maximises both direct and indirect benefits, and iii) the decision made should cater not only to short-term goals but also to the long-term goals of the organisation (Mittal, Khanduja and Tewari, 2017: 112).

The decision tree analysis method assigns numerical values to decision choices computed by considering various parameters (Mittal, Khanduja and Tewari, 2017: 111; Maiellare, 2020: 42). This helps to select the optimal decision, which may enhance organisational productivity and profitability. According to de Ville (2013: 450), decision trees are robust, flexible and easy to use methods even in the presence of missing data; by incorporating a few assumptions, high-quality outcomes can still be achieved.

However, this method may be affected by unforeseeable events, including but not limited to a recession, inflation and acts of God, which adversely affect the optimum decision-making process (Mittal, Khanduja and Tewari, 2017: 112). In addition, the decision-making analysis method heavily relies on the decision maker's experience. In this regard, an inexperienced decision maker may be unable to utilise the method appropriately to make the optimal decision, as it uses approximations and therefore lacks the provision of the project's true value (Ampofo, 2017: 42).

Furthermore, the method can easily become more complex as several branches are developed, which may also present difficulties in interpreting the results (Martins, Marques and Cruz, 2015: 14). In agreement, Bailes and Nielsen (2001: 15) stated that although decision tree analysis is purported to be a simple method, it can easily become too complicated when the number of uncertainties increases. Additionally, if no effort is made to regulate the amount of possible future outcomes, then it may become exceedingly too sophisticated and overwhelming to analyse (Bailes and Nielsen, 2001: 16).

Decision trees were selected for use in the study, as they were known to the target population, whereas the other methodologies regarding real options can be seen as too complex. These complex mathematical techniques were therefore included to

highlight one of the issues regarding the implementation of real options. Decision trees were focused solely on in the study, as they are an already sound financial management concept that all financial practitioners were aware of and thus provided an attractive measure to expand on the current knowledge of the target population. The reasons why real options are not widely adopted in practice are now discussed.

2.3.3. Reasons why real options are not widely adopted in practice

As early as 2011, several scholars, such as Baker, Dutta and Saadi (2011: 18-29), began discussing the management views on real options in capital budgeting. They put forward the distinct reasons real options are not successfully adopted in practice and recommend a total paradigm shift amongst practitioners to equally implement all aspects of capital budgeting. The landscape of budgeting since then has not changed as much as the above topic continues to be a topic of research interest. Michelon, Lunkes and Bornia (2020) suggest that the difference between theory and practice in capital budgeting techniques such as real options is caused by practitioners who are unable to compute these techniques. The authors also noted that factors such as cognitive ability, preferences, profile, experience function, and managerial training can also be viewed as limitations regarding the implementation of real options. Ampofo (2017: 161) identified the expertise of financial practitioners, applicability in business, complexity to apply in practice, estimating inputs and realistic assumptions as some of the major reasons why real options are not widely adopted in practice. These reasons have been further investigated in this study. This section has drawn from current and past research to find both reasons and recommendations as to why the implementation of real options in capital budgeting techniques is yet to be standardised and effectively monitored. A brief investigation into the linkages between real options and NPV will now be presented.

2.4 Real Options and NPV

Real options analysis is contrasted by NPV analysis, as it caters to the subsequent nature of the decision-making process. This has been observed numerous times and is recognised by the behavioural theory of firm researchers (Cyert and March 1963)

and evolutionary economics (Dosi 1982: 162-174, Nelson and Winter 1982, Penrose 1959), which has always expressed sensitivity to the stage of a project. The characteristics of the application of real options as a tool of analysis (Dixit and Pindyck 1994, Trigeorgis 1996) and a strategic problem-solving method (Luehrman 1998, McGrath 1997: 89-99) are that the real options approach presents the possibility of obtaining real values to the various stages of an investment. However, while the approach may be used to generate real values, the validity of these real values will depend on some major assumptions. Ragozzino, Reuer and Trigeorgis (2016: 438) noted that these major assumptions are the limitations in implementing real options into strategic business decisions.

Contrastingly, with these major assumptions, Leslie and Michaels (1997: 4-22) compared the application of NPV analysis with real options and deemed real options as a better valuation tool, further serving to draw the parallels among real options and financial options. A real option assumes certain reactive flexibility on its investment holder; usually, the flexibility that management has regarding decision-making is an important factor that real options take into account (Nur-Al-Ahad and Fujiwara, 2019: 626). These flexibilities are simply ignored when using traditional methods such as NPV that are only calculated at investment inception. It is not to say that NPV does not provide a good measure, as it does for certain types of investments, as noted by Benitez and Lima (2019: 564). NPV appears to be weak, as it fails to account for the uncertainties experienced with a project in subsequent years, whereas real options do. The NPV method was found to be useful in certain market conditions, while real options were found to be more useful in uncertain market conditions.

Table 2: Comparison of NPV and real option value

NPV	**Real option value**
takes into account	
Present value of fixed costs ✓	Present value of fixed costs
Present value of expected cash flows ✓	Present value of expected cash flows
X	Time to expiry
X	Uncertainty of expected cash flows
takes into account	

NPV	Real option value
X	Risk-free interest rate
X	Value lost over duration of the project

Source: Leslie and Michaels (1997: 11)

Table 2 compares the distinct factors that NPV and real option value take into account. It appears from Table 2 that the traditional NPV only recognises two of the six variables presented by real options by neglecting the flexibility of management. This causes the use of NPV analysis to mislead in cases where flexibility plays a great factor. Trigeorgis (1993: 202) highlighted that those uncertainties create difficulties in determining appropriate cash flows, rates and future costs. The resulting disproportion is caused by management flexibility that demands an "expanded NPV" computation rule that reflects both of its values: the static NPV and the real option value, which accounts for the flexibility in decision-making (Nur-Al-Ahad and Fujiwara, 2019: 626). Michelon, Lunkes and Bornia (2020) suggested that the static NPV should not be discarded but essentially be factored into an expanded NPV analysis to account for the uncertainties experienced by a project, i.e.:

Expanded (strategic) NPV = static (passive) NPV of expected cash flows + value of flexibility from active management

(Adaptation of Baldwin and Trigeorgis (1993: 206)

A real options approach to traditional capital budgeting can develop and assign values to options from flexible management (Li, Wu and Li (2018: 2). These values are embodied as an assortment of real options rooted in capital investment decisions. Most real options occur naturally, such as to contract, defer, abandon, or shut down, although other real options can be forecasted and integrated at an added cost, such as to expand, grow, default or switch between alternative projects (Ragozzino, Reuer and Trigeorgis, 2016: 431). Table 3 was developed by Baldwin and Trigeorgis (1993) and has been slightly adapted; it briefly describes the most common types of real options encountered in the different industries and the representative authors who have analysed them (the option highlighted in bold is what this study has focused on).

Table 3: Common real options

Category	Description	Important in	Analysed by
Option to defer	Management holds a lease on (or an option to buy) valuable land or resources. It can wait (x years) to see if output prices justify constructing a building or plant or developing a field	All natural resource extraction industries; real estate development; farming; paper products	Tourinho [1979]; Titman [1985]; McDonald & Siegel [1986]; Paddock, Siegel &Smith [1988]; Ingersoll & Ross [1992].
Time to build (staged, investment)	Staging investment as a series of outlays creates the option to abandon the enterprise in midstream if new information is unfavourable. Each stage can be viewed as an option on the value of subsequent stages and valued as a compound option.	All research and development (R&D) intensive industries, especially pharmaceuticals; long development capital-intensive projects, e.g., large-scale construction or energy-generating plants; start-up ventures.	Majd & Pindyck [1987]; Carr [1988]; Trigeorgis [1998].
Option to alter operating scale (e.g., to expand; to contract; to shut down and restart)	If market conditions are more favourable than expected, the firm can expand the scale of production or accelerate resource utilisation. Conversely,	Natural resource industries such as mining operations; facilities planning and construction in cyclical industries; fashion apparel;	Brennan & Schwartz [1985]; McDonald & Siegel [1985]; Trigeorgis & Mason [1987]; Pindyck [1988].

Category	Description	Important in	Analysed by
	if conditions are less favourable than expected, it can reduce the scale of operation. In extreme cases, production may temporarily halt and start up again.	consumer goods; commercial real estate.	
Option to abandon	**If market conditions decline severely, management can abandon current operations permanently and realise the resale value of other capital equipment and other assets in second-hand markets.**	**Capital intensive industries, such as airlines and railroads; financial services; new product introductions in uncertain markets.**	**Myers & Majd [1990] Muharam & Tarrazon [2017] Liu, Zhang & Zhao [2018] Danylyshyn et al. [2019]**
Options to switch	If prices or demand changes, management can change the output mix of the facility ('product' flexibility). Alternatively, the same outputs can be produced using different types of inputs ('process' flexibility).	Output shifts: Any good sought in small batches or subject to volatile demand, e.g., consumer electronics, toys, specialty paper, machine parts, autos. Input shifts: All feedstock-dependent	Margrabe [1978] Kensinger [1987] Kulatilaka [1988] Kulatilaka & Trigeorgis [1993]

Category	Description	Important in	Analysed by
		facilities, e.g., oil, electric power, chemicals, crop switching, sourcing.	
Growth options	An early investment (research and design, lease on underdeveloped land or oil reserves, strategic acquisition, information network/infrastructure) is a prerequisite or link in a chain of interrelated projects, opening up future growth opportunities (e.g., new generation product or process, oil reserves, access to new market, strengthening of core capabilities).	All infrastructure-based or strategic industries, especially high-tech, R&D, or industries with multiple product generations or applications (e.g., computers, pharmaceuticals); multinational operations; strategic acquisitions.	Myers [1977] Brealey & Myers [1991] Kester [1984], [1993] Trigeorgis [1988] Pindyck [1988] Chung & Charoenwong [1991]
Multiple interacting options	Real-life projects often involve a “collection” of various options, both upwards-potential enhancing calls and downwards-protection put options present in	Real-life projects in most industries discussed above.	Brennan & Swartz [1985] Trigeorgis [1993] Kulatilaka [1993]

Category	Description	Important in	Analysed by
	combination. Their combined option value may differ from the sum of separate option values, i.e., they interact. They may also interact with financial flexibility options.		

Source: Baldwin and Trigeorgis (1993: 213-217)

2.5 Accounting for uncertainty in decision-making with real options

Baker, Dutta and Saadi (2011: 20) asserts that in an uncertain world of competitive interactions, changes in technologies and markets, the realisation of cash flows is bound to be different from what was initially anticipated by management. The accuracy of information increases when certainty regarding future cash flows is available, thereby presenting management with a variety of options that were not previously available. For instance, management may be able to utilise the various options presented, such as to contract, defer, expand, abandon, or adjust a project in stages. These options are labelled real options.

The costs of real options are sensitive to changes, making it a better valuation tool than NPV; thus, it can be used to greatly enhance the DCF technique. It must be highlighted that real options are in fact optional, enabling management with the option, but not the duty to fulfil the option, in a specified time. (Smith, Driver and Matthews 2018: 126). The greatest issue in deciding whether to continue investment or abandon a project is the time taken in the decision-making process (de Souza Scotelano, da Conceição, da Costa Leonídio and de Jesus, 2017: 502). Typically, the duration taken to make a decision may present a problem by delaying the start of the project and thus impeding the power of the decision-making process. Real options theory thereby brings the flexibility of management regarding decision-making into account as an

improvement to the NPV technique as it produces precise information for a project that was not previously available during the NPV decision (Benitez and Lima, 2019; 562-571). The next section presents the empirical review on real options.

2.5.1 Empirical review on real options

Mkhize and Moja (2009: 1-20) examined the application of real option techniques in the mobile communications industry of South Africa when making capital investment decisions in next-generation service structures that basically amounted to the entire infrastructure of the industry. International recommendations regarding the use of apply real options in the telecommunications industry were applied, and the results show that real option techniques are effective investment analysis tools in the mobile communications operators of South Africa. The authors asserted that these strategic real options serve to strengthen the traditional NPV model.

Nur-Al-Ahad and Fujiwara (2019: 626-629) observed that real options analysis accounts for flexibility in decision-making, which is an inherent shortcoming of NPV for large-scale investments. The study was conducted in the aviation industry of Japan, which is a highly capital-intensive and risky industry that also bears high research and development costs. The authors presented that real option analysis can transform a traditional negative NPV into a more sophisticated positive NPV and ultimately turn an investment decision around. They also detailed the main challenges of integrating these options into the established capital budgeting practices.

Li, Wu and Li (2018: 9) noted that traditional investment decision-making techniques are now unable to meet the requirements of renewable energy projects. A case study was performed in North China on a wind farm, which proved the effectiveness of real options. This model was applied to determine the volatility and risk of renewable energy investments more precisely and help investors with proper planning of the execution for a project, thereby enabling an efficient allocation of resources in the renewable energy industry.

Liu, Zhang and Zhao (2019: 3494-3499) reviewed the evolution of real options theory and practices in the renewable energy investments sector. The study considered the

application of real options in the renewable energy industry. It pertinently emphasised the limitations of traditional techniques such as NPV, which make it unsuitable to appraise renewable energy investment decisions. The authors further demonstrated that these real options are effective in accounting for the uncertainty and flexibility of management regarding projects.

Traditional capital budgeting techniques ignore the fact that many options occur naturally for many projects, such as the option to contract, expand, delay or abandon the project once it has already been started (de Souza Scotelano et al., 2017: 503). Without knowing how to estimate these options and integrate them into NPV, the probability is higher than the project's NPV will be underestimated by the analyst. Coupled with the uncertainties inherent in NPV, the assessment of real options can be adopted as an alternative approach (Borges, Dias, Dória Neto and Meier, 2018: 111-123; Lambrecht, 2017: 168; Andalib, Tavakolan and Gatmiri, 2018: 600-611). Basically, real options theory applied to investment projects attempts to overcome the limitations of traditional criteria and the lack of sophisticated analytical methods (Lambrecht, 2017: 166-171; Almeida, Dias, Brandão and Samanez, 2019: 118-135; Fernandes, Cunha and Ferreira, 2011: 4491-4497).

Table 4 indicates the six main types of real options that are in practice. Tiwana, Wang, Keil and Ahluwalia (2007: 157-181) presented a study that investigated whether managers suffer from systematic biases in associating real options with project value using the following real options: growth, stage, scale, switch, defer and abandon, as illustrated in Table 4. They discovered that managers in IT projects from the 88 firms examined did not behave rationally and therefore were unable to appropriately apply real options in the investment decision-making process. Furthermore, the results suggested that managers were only able to associate real options and project value when the benefits are low and can be easily quantifiable benefits and were unable to when the benefits were high. The option highlighted in bold is what this study has focused on.

Table 4: Six types of real options

Option	Options exists in project if…
Growth	A project unlocks opportunities for future follow-on IT investments, many of which cannot be foreseen at the time of initiating the project.
Stage	A project is structured as a series of incremental investments in a project that allow the project to be terminated if unfavourable business conditions later warrant.
Scale	The allocated resources, budgets, personnel, hardware and software in IT projects can be contracted or expanded.
Switch	It can be put to a different application from the one for which it was originally intended.
Defer	The initiation of a project can be delayed without risking foregoing a valuable opportunity.
Abandon	**Managers have the discretion to discontinue a project prior to completion and redeploy remaining resources.**

Source: Tiwana et al. (2007: 159)

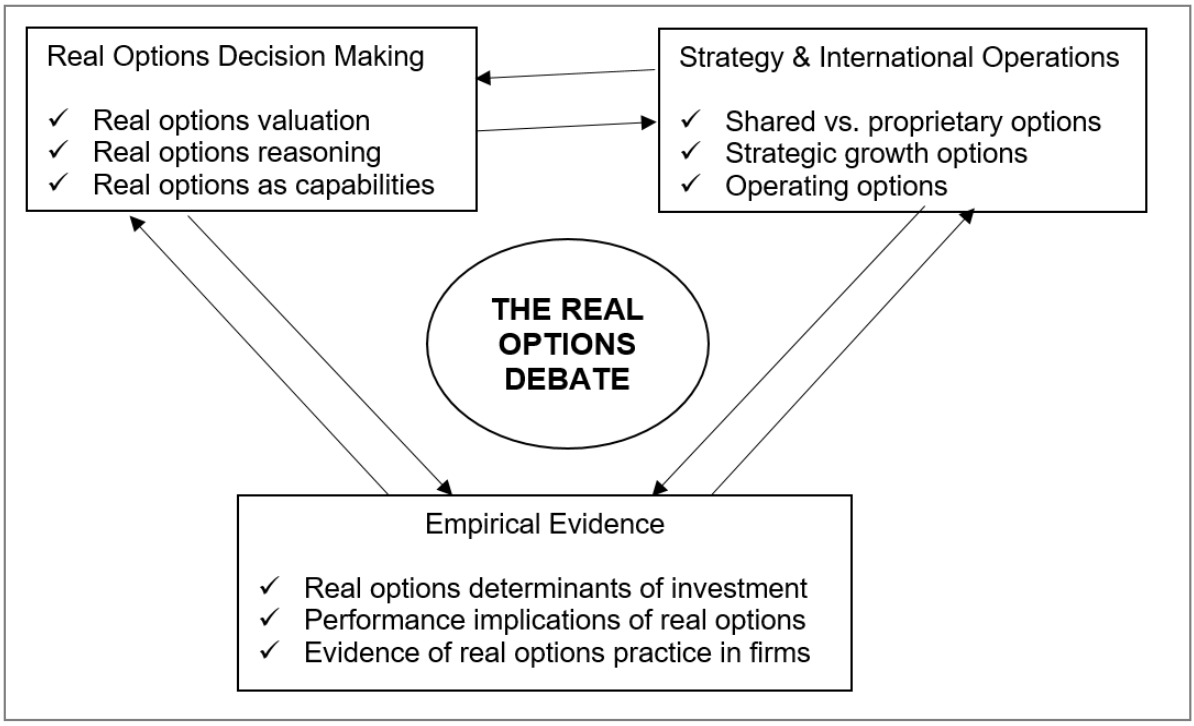
Moreover, a study by Lee, Makhija and Paik (2008: 16-34) examined Korean firms during the Korean economic crisis of 1998, which created a natural experiment with conditions of tremendous uncertainties in which real options could be tested. The study revealed that real option value is dependent on the level of uncertainty experienced by the organisation, suggesting that real options have more value in times of uncertainty than when there is great stability. This implies that some organisations may resort to using real options only when the economic conditions exhibit elevated levels of uncertainty. In view of this, Grullon, Lyandres and Zhdanov (2012: 1499-1537) examined the interruption between corporate returns and volatility for organisations that used real-time options.

The Centre for Research in Security Prices (CRSP) analysed daily and monthly data. They found that a positive interrelationship between the volatility of equity and corporate returns was experienced in companies with real options. The positive volatility-return ratio was significant in organisations that had the availability of more

real options. In contrast, Thompson, Davison and Rasmussen (2009: 226-238) revealed that the analysis of real options can be applied to natural gas management comparable to financial put or call options, which was demonstrated using realistic price dynamics and operational characteristics. They used an algorithm for real options to retrieve nonlinear partial integro-differential equations for valuation purposes and the optimum operation of natural gas storage warehousing by incorporating capacities, deliverability, injection rates, and limitations of cycles of natural gas management.

Additionally, Savolainen, Collan and Luukka (2017: 54-72) used a system dynamic model to determine the effectiveness of real options for the metal mining industry to assess the positive impact of profitability on three real options: i) temporarily stop production, ii) stop production and iii) increase production. These two examples showing real options in the gas and mining industry revealed that real options analysis can be used in almost any field or industry that needs to weigh the options at their disposal for strategic decisions. This notion is also supported by Rigopoulos (2017: 9-26), who used signalling game theory to discuss the strategic interaction of different players with incomplete information in a discrete time framework, where it was discovered that the methodology using real options is applicable for investment appraisals.

Figure 3: Real options in management and organisational strategy



Source: Driouchi and Bennett (2012:56)

Furthermore, Driouchi and Bennett (2012: 39-62) examined the impact of decision-making on organisational performance to demonstrate the applicability of real-time options on management and strategy, as shown in Figure 3. They found that real options attention, knowledge, and management have better value versus real options opportunities, which suggests that the capability of managers or decision-makers in an organisation to identify and assess real options opportunities can be viewed as a competitive advantage. This suggests that real options opportunities that are not exploited by organisations are of no value to it.

Savolainen, Collan and Luukka (2017: 54-72) used a system dynamic model to demonstrate the application of real options to the metal mining industry in their study to assess the positive impact of profitability on three real options: i) temporarily stop production, ii) stopping production and iii) increasing production. On the other hand, Rigopoulos (2017: 9-26) used signalling game theory to discuss the strategic interaction of different players with incomplete information in a discrete time framework, and he found that the methodology is applicable for investment appraisals.

The information discussed in this section shows that real options can be applied in a variety of industries. In addition, by leveraging real options for investment and financial decision-making, organisations can gain competitive advantage that would not have otherwise realised using real options alone. It was also further noted that real options are of no value to an organisation if they are not exploited. This implies that even if real opportunities are there and the organisation has not identified them or does not have knowledge of them, then they have no value to the organisation. In view of this, organisations should always look out for these real option opportunities to enhance their decision-making process.

Table 5 shows the summary of empirical studies relevant to this study:

Table 5: Summary of empirical studies in chronological order

Author	**Summary of study**	**Findings**
Tiwana et al. (2007)	Real options in management and organisational strategy: a review of decision-making and performance implications	Managers suffer from systematic biases in associating real options to project value.
Lee et al. (2008)	The value of real options investments under abnormal uncertainty: The case of the Korean economic crisis	Real options have more value in times of uncertainty than when there is great stability.
Mkhize and Moja (2009)	The application of real option valuation techniques in the cellular telecommunication operators of South Africa	Real options strengthens the traditional NPV model and are effective investment analysis tools in the cellular communication industry.
Thompson et al. (2009)	Valuation and optimal operation of electric power plants in competitive markets	Real options approach can be applied to natural gas management where uncertainty is factor and can

Author	Summary of study	Findings
		adequately account for uncertainty.
Fernandes et al. (2011)	The use of real options approach in energy sector investments	Real options theory allows investors to overcome the limitations inherent in traditional capital budgeting techniques by allowing for more flexibility regarding decision-making.
Grullon et al. (2012)	Real options, volatility, and stock returns	A positive correlation between equity returns, and volatility of corporate returns was experienced in companies that had real options and that the positive volatility-return ratio was significant in organisations which had more real options.
Driouchi and Bennett (2012)	Real options in management and organisational strategy: A review of decision-making and performance implications	Real options attention, knowledge and management has better value versus real options opportunities, these real options are competitive advantages. The real options opportunities are of no value to an organisation if they are not exploited. that are not exploited by organisations are of no value to it.
Lambrecht (2017)	Real options in finance	Identified four broad areas for future research in real options and capital budgeting. These included real option

Author	Summary of study	Findings
		applications, development, empirical studies, and surveys on practitioners regarding real options value.
Savolainen et al. (2017)	Analysing operational real options in metal mining investments with a system dynamic model	The application of real options to metal mining investments has a positive impact of profitability of projects by incorporating real options.
Rigopoulos (2017)	Application of a two period real options signalling game	A model for a real options signaling game is applicable for investment appraisals.
de Souza Scotelano et al. (2017)	Project management maturity model: the case in an automotive industry in Brazil	Traditional investment analysis tools simply ignore the options that naturally occur once the project has already been accepted. These options can be used to maximise the profitability of projects in the automotive industry.
Andalib et al. (2018)	Modelling managerial behavior in real options valuation for project-based environments	This study argues that the current approach for treating risk and uncertainty inproject valuations is one of the main reasons for the existing gap between the theory and practice of real options valuation in poject based environment.
Li et al. (2018)	A real options analysis for renewable energy	Real options accounts for efficient allocation of resources

Author	Summary of study	Findings
	investment decisions under China carbon trading market	in the renewable energy industry.
Borges et al. (2018)	Fuzzy pay-off method for real options: The center of gravity approach with application in oilfield abandonment	Where uncertainties play a factor inherent in NPV, an alternative approach of real options can be adopted.
Nur-Al-Ahad and Fujiwara (2019)	Application of real options analysis in commercial aircraft manufacturing: evidence from Japan	Real options analysis accounts for flexibility in decision-making and transforms traditional the NPV into a more sophisticated one.
Liu et al. (2019)	A review of the application of real option to renewable energy investment	Real options provide an effective tool for resolving uncertainty and managerial flexibility regarding projects.
Almeida et al. (2019)	Real options model with games applied to the Rio de Janeiro residential real estate market	Provided an analysis how the combination of game theory and real options can contribute to the economic analysis of investments in new projects in the real estate market, supporting the process of decision-making by managers.

A brief discussion of the financial services sector is now presented.

2.6 The financial services sector of South Africa

Financial services are essential to the economy of South Africa, as they allow people to conduct daily economic transactions, save and preserve their savings for future aspirations and retirement needs, and insure against personal financial losses. Macroeconomically, the financial sector plays an important role in economic development, job creation, the building of infrastructure, and sustainable development in South Africa. The global financial crisis of 2008, however, brought into sharp focus the consequences of poorly regulated financial services (National Treasury Policy Document, 2011: 1-2).

The financial planning profession and its role in the financial services sector are increasingly being scrutinized and regulated by both government and industry watchdogs, and concern is growing about potential conflicts of interest for financial planners when they advise clients on investment product choices, which may not be in the interests of the client. (Clayton et al., 2007: 64). Financial planners provide guidance and assistance to clients by enabling them to manage their financial situations better, which is one of the vital services that financial planners offer (Botha, Rossini, Geach, Goodall, Du Preez and Rabenowitz, 2016: 5).

The South African Qualifications Authority (SAQA) recognises the Financial Planning Institute of Southern Africa (FPI) as an appropriate professional body for financial planners in South Africa. The FPI is the exclusive institution in the country that offers certification of financial planners and is approved by the South African Revenue Service (SARS) as a Recognised Controlling Body (RCB). A non-profit professional body, the institute, is a founding and affiliate member of the Financial Planning Standards Board (FPSB), whose purpose is to improve professionalism and positively influence the quality of advice provided by its members (The Financial Planning Institute of Southern Africa, 2022).

Financial planners have been overlooked in the literature despite all that has been written (across disciplines) on capital budgeting techniques (Clayton et al., 2007: 65). Financial planners appear to be a population that is mostly ignored in research,

whereas these practitioners are directly involved in investment and decision-making. Lambrecht (2017: 169) critically reveiwed real options and identified four extensive areas for the future: i) the application of real options, ii) the advancement of real option techniques, iii) the need for more empirical studies investigating real options and iv) gauge perceptions of how practitioners assess real options through these objective studies. Therefore, it was essential for the researcher to conduct a study on certified financial planners in the Durban area for the aforementioned reason and for potential future use in research, as existing studies have focused on a few industries.

The conceptual framework of the study will now be illustrated and discussed.

2.7 Conceptual framework

The conceptual framework for the study is as follows:

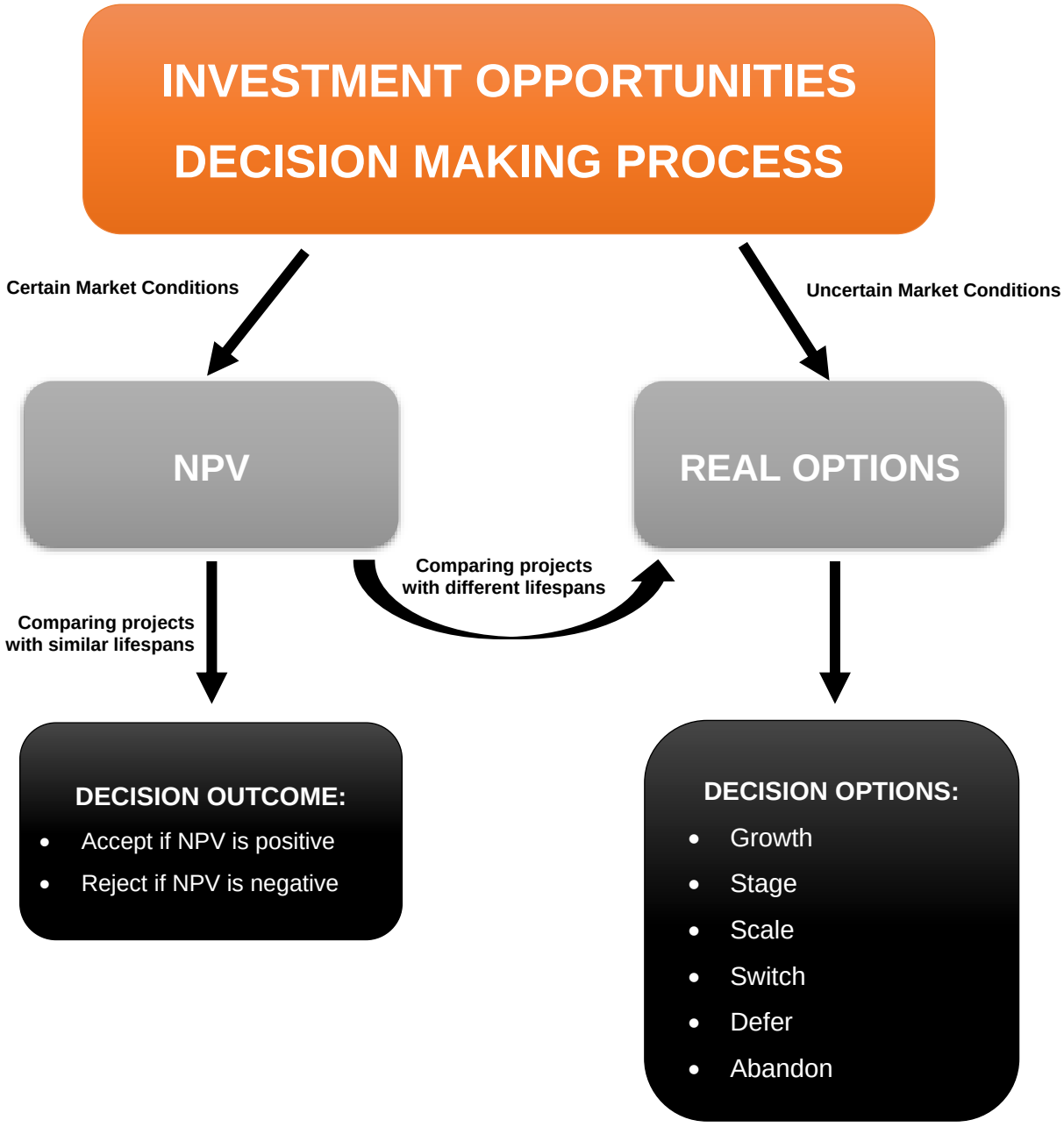


Figure 4: Conceptual framework

Figure 4 shows the conceptual framework of the study, namely, it serves as a linkage between the variables of the study. Typically, when organisations make decisions on investment opportunities, they first determine whether the market conditions are

certain or uncertain. If the market conditions are certain, then the NPV method for investment will be most appropriate due to its simplicity. Nevertheless, when using the NPV method, it is important to use precise values (Hanafizadeh, Kazazi and Jalili Bolhasani, 2011: 525), which can be obtained much more easily under certain market conditions than under uncertain market conditions. However, when the market conditions are uncertain, the real options method becomes more appropriate, as the NPV method of investment opportunity evaluation does not account for uncertainty. Furthermore, if the market conditions are certain but the investment opportunities that are being evaluated or compared have different lifespans, the NPV fails short, as an investment opportunity may have a higher NPV value, but it may take longer for the opportunity to fully mature (Ragozzino, Reuer and Trigeorgis, 2016: 435). In light of this, real options may be used in such instances to evaluate projects with a positive NPV but different lifespans, as shown in Figure 4.

The theoretical framework of the study will now be briefly discussed.

2.8 Theoretical framework

The theoretical framework of the study lies with the inherent issues faced with capital budgeting techniques. According to Kengatharan and Diluxshan (2017: 290), there have been many changes and challenges over the last 20 years in making financial decisions due to the global financial crisis, currency fluctuations, the advancement of technology, risks in interest rates, exchange rates and inflation rates and dynamic changes in the economic and business environment internationally. Thus, there is a need to re-examine capital budgeting practices since they have a considerable impact on investment decision making. The author also noted that investment decision-making is not a simple or straightforward approach and that the uncertainties faced because of the limitations of DCF techniques are a crucial element in making an investment decision.

Correia et al. (2019: 8-3) identified four major DCF techniques, namely, the internal rate of return, NPV, accounting rate of return and payback method. Throughout the years, there has been considerable growth in DCF and risk appraisal techniques.

Notwithstanding the increased growth of more sound DCF techniques, research shows that companies in the UK and US have experienced underinvestment due to the misinterpretation or misapplication of DCF techniques (Drury and Tayles 1997: 86). Most of the issues underlined with DCF techniques are inherent and simply not eradicated; it is for this reason that the literature tends to present gaps in time frames (Benitez and Lima, 2019: 569). Batra and Verma (2017) noted that there has been a paradigm shift in corporate investment practices over the last fifty years in the capital budgeting literature and that this shift made it necessary to relook at existing techniques in an attempt to enhance them.

According to Michelon, Lunkes and Bornia (2020), research suggests that the difference between theory and practice in capital budgeting techniques is caused by practitioners who are unable to adequately apply these techniques. The authors also noted that factors such as cognitive ability, preferences, profile, experience function, and managerial training also have a significant effect on capital budgeting decisions. Business and academic literature have recommended the usage of real options as a capital budgeting technique to analyse real-world investments where uncertainty is present, as traditional valuation methods such as NPV do not account for the effect of managerial flexibility on a project's value (Barton and Lawryshyn 2011: 1; Ragozzino, Reuer and Trigeorgis, 2016: 428-440).

Traditional investment analysis tools ignore the relevant principles that projects may be altered once they have already been started, such as to delay, expand or even abandon (de Souza Scotelano et al., 2017: 505). According to Kengatharan and Diluxshan (2017: 303), the hesitancy to apply real options analysis is rooted in a lack of managerial flexibility and owing to the sophisticated mathematics needed to perform these calculations, which were developed by academics, some of which intend to be addressed with the current research. Traditional techniques such as DCF analysis and NPV can lead to a downward biases towards projects when uncertainty exists and managers have flexibility to change course in the future (Ragozzino, Reuer and Trigeorgis, 2016: 436). This is where the real options enhance the NPV calculations to enable better financial decisions. This study seeks not to discredit the well-established practice of NPV but to enhance the power of NPV using real options.

2.9 Chapter summary

This chapter detailed the literature review of NPV, real options and the linkages between these variables. It also looked at the uncertainty behind decision-making within capital budgeting, empirical studies on real options, before presenting a brief overview of the financial services sector of South Africa and concluding with the conceptual and theoretical framework of the study. This chapter presented a comprehensive and relevant review of the literature regarding NPV and real options.

The next chapter will address the research methodology of this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The chapter will discuss the research methodology of the study. It is divided into twelve sections, which are research philosophy and design, population and sampling, data collection and research instrument, recruitment, consent and data collection procedure, data analysis, delimitations and limitations, validity and reliability, anonymity and confidentiality before concluding with the ethical considerations of the study. This chapter informs the research methodology that is utilised to achieve the aim of capturing the perceptions of financial planners regarding the application of real options in the capital investment decision-making process, namely, the NPV technique in the Durban financial services sector. Before delving into the research methodology, it is important to recap the objectives of the study, which are intended to address the aim of the study:

- To explore whether NPV is sufficient as a standalone capital budgeting technique,
- To examine whether the usage of real options in NPV enhances investment decision-making,
- To explore the reasons why real options are not widely adopted in practice.

The next section describes the research philosophy and design.

3.2 Research design

3.2.1 Research philosophy

The research philosophy of a research study is the set or system of beliefs and assumptions that are related to the development of knowledge; however, there are five main research philosophies: critical realism, interpretivism, positivism

postmodernism and pragmatism (Saunders, Lewis and Thornhill, 2019: 83-90). This study has taken on the positivism research philosophy approach, as the researcher needed to remain independent and objective from the research process. Moreover, positivism research philosophy proposes that factual knowledge gained through observation and measurement is trustworthy (Yin, 2011: 90). In this regard, quantifiable data are used to generate statistical analysis in accordance with the empiricist view, which postulates that knowledge emanates from human experience (Pallant, 2001: 79). Nevertheless, this research study collected data from financial planners independent of the views or interests of the researcher with the aim of examining the perceptions of financial planners on the application of real options as an enhancement tool to the NPV technique.

3.2.2 Research design – quantitative research

The research design describes and outlines how the research will be conducted. There are three main types of research designs: qualitative, quantitative and mixed methods (Creswell and Creswell, 2017: 227; Sileyew, 2019). According to Basias and Pollalis (2018: 93), the quantitative research design is a systematic investigation of phenomena through the use of numerical data collected from research instruments by incorporating statistical analysis such as correlations and hypothesis testing. In line with the positivism research philosophy, this study incorporated a quantitative research design. This quantitative approach allowed the questionnaires to be distributed, collected, and analysed in a relatively shorter time frame. Qualitative and mixed methods were excluded from the study due to the target population being constantly busy with clients, being unable to attend interviews and the time constraints needed to conduct a mixed methods approach (Myers, 2017:78; Dawson, 2019: 123). A discussion of the target population will now be presented.

3.3 Target population

Population refers to the study objects, which may be individuals, groups, organisations, human products and events, or the conditions they are exposed to (Welman, Kruger and Mitchell, 2013: 61; Dawson, 2019: 123). The population of this

study comprised certified financial planners within the Durban central business district financial services sector. Financial planners provide guidance and assistance to clients by enabling them to manage their financial situations better, which is one of the vital services that financial planners offer (Botha et al., 2016:5). Financial planners serve clients by enabling them to make sound financial decisions, and these practitioners are often overlooked in research, whereas they are primarily involved in investment and decision-making (Clayton et al., 2007: 69).

The rationale behind Durban financial planners being selected is due to the limitations of the research, lockdown regulations and their accessibility to the researcher's location. The selection of these planners allowed for the study to be conducted in various other provinces or on a larger scale within South Africa. The sampling size and framework will now be briefly discussed.

3.4 Sampling size and framework

According to the Financial Planning Institute of Southern Africa (FPI), there are currently four thousand six hundred and sixty (4660) certified financial planners in South Africa. In addition, Statistics South Africa (STATSSA (2020) has estimated that Durban is approximately six percent (6%) of the South African population. In view of this, the minimum sample size for this study was 174 financial planners out of an estimated population of 314 in Durban; required to give 95% confidence level and a 5% margin of error as computed from the online sample size calculator (Raosoft, 2022). An emailing list comprising 314 financial planners was confidentially shared with the researcher from a manager at the FPI.

There are two main types of sampling methods: probability and non-probability sampling (Showkat and Parveen, 2017: 5). Probability sampling methods were not suitable for the study, as the researcher needed to carefully select the participants to fulfil the aim and objectives of the study (Myers, 2017: 192). In light of this, the non-probability sampling method was used in this study, as it allowed the researcher to easily access the target population. Non-probability sampling can, however, be divided into four sampling techniques: convenience sampling, purposive sampling, quota

sampling, and snowball sampling (Taherdoost, 2016: 22-23). The sampling method used in this study was purposive sampling. Purposive sampling was used to select the target population to address the research aims and objectives of the study, which can only be achieved by focusing on specific kinds of people who hold important views and ideas about them (Showkat and Parveen, 2017: 7). Purposive sampling is also known as judgemental sampling, and it moves away from random sampling nonetheless is strategically necessary to ensure that specific kinds of cases of those that could be included in the study are included in the study (Campbell, Greenwood, Prior, Shearer, Walkem, Young, Bywater and Walker, 2020: 655).

The main reason for this type of sampling technique was to carefully select the participants based on the affiliations of the participants with the Certified Board of Financial Planners (South Africa) within the Durban area. The researcher remained independent and objective by implementing the research philosophy of positivism and having minimal interactions with the participants when conducting the research. In an effort to improve the representativeness of the sample, quota sampling will further be implemented based on certain biographical characteristics of individuals within the population (Rahi, 2017: 3). A brief discussion of the data collection and research instrument will now be presented.

3.5 Data collection and research instrument

The questionnaire was administered by following all the procedures of research ethics in line with the institutional requirements. The questionnaire was distributed to the target population using a link to Microsoft Forms sent to them via email. The email included a covering letter, a letter of information and consent, as well as an institutional approval letter that stated in detail the authenticity of the study (Appendix A, page 118). The respondents were required to read this information before accessing the Microsoft Form since logging into the Microsoft Form implied that they understood this information. The respondents were given three weeks to complete the questionnaire. In order to increase the representativeness of the sample size, more questionnaires were administered than anticipated.

The first stage of data collection began in November 2021, when 314 questionnaires were emailed to certified financial planners in the financial services sector in Durban, of which only 162 were returned after one week. The first reminder was sent to those who did not respond after week one and 76 questionnaires were received after week two. The last reminder was sent after week two, and 48 questionnaires were received after week three. Accordingly, 286 questionnaires were returned in total and utilised for the data analysis of the study out of 314 distributed. In this regard, the response rate was 91%. The recruitment, consent, and data collection procedures will now be discussed.

3.6 Recruitment, consent and data collection procedures

3.6.1 The measuring instrument

The decision to use a self-administered survey instrument to collect data was made for several reasons. According to Myers (2017: 164), some of the advantages of administering this type of survey are as follows:

- They are computer-assisted to enable easier coding of data. The use of Microsoft Forms enabled easier data collection and coding before the statistical analysis was performed.
- They are usually more cost-effective than other methods, such as interviews.
- These types of research instruments are helpful with anonymity.
- These types of surveys allow the researcher to reach a larger target population, thereby enriching the results needed for data analysis. This study focused primarily on certified financial planners in the financial services sector of Durban only.

Dawson (2019: 92) noted the disadvantages when administering this type of survey, some of which are as follows:

- These types of instruments do not always work when there are time constraints.
- The e-mail addresses need to be accurate to ensure that e-mails are not considered “junk mail.”

- These types of surveys are sometimes prioritised for later and forgotten.
- The researcher constantly needs to follow up in an effort to increase the response rate. This was an issue experienced when administering these surveys electronically, but the constant follow-up does ultimately help achieve this goal.

3.6.2 The types of questions used in the research instrument

The research instrument used closed-ended and Likert scale questions. Close-ended questions are usually limited in terms of choice and are useful when gathering the demographics of participants. These types of questions are encouraged for surveys, as participants do not need to write but merely select an appropriate answer, thus enabling a higher response rate (Myers, 2017: 164). Closed-ended questions were used in the study to enable efficient responses.

The research instrument also made use of a five-point Likert scale with questions that varied from strongly agree to strongly disagree. Another commonly used type of question is that which is useful in gauging the perceptions of participants by asking to what extent they agree or disagree with particular questions (Dawson, 2019: 112). The reliability of the questionnaire was examined with Cronbach's alpha. Cronbach's alpha provides a straightforward way to measure the reliability of a score and internal measure, based on the assumption that there are multiple items measuring the same underlying construct and there are few questions all asking different things which combined provide an overall measure of the research objectives (Shresta, 2021: 5) (change). Cronbach's alpha ranges between 0 and 1. According to Dickinson (2020: 6), a Cronbach's alpha value of more than 0.7 is considered acceptable, which was noted with the questionnaire of the research study.

3.6.3 Format of the questionnaire

The questionnaire had 15 questions that predominantly incorporated a 5-point Likert scale ranging from strongly disagree to strongly agree. The questionnaire design had three sections, which were structured as follows:

Section A – covered the demographics of the study participants, which included gender, age, highest qualification and tenure in the current organisation (background information)
Section B – covered NPV and real options related questions (objectives 1 and 2).
Section C – covered questions related to the implementation of real options (objective 3).

3.6.4 Justification for each question's selection in the questionnaire

The following section defines the reasons for each question's selection in the research instrument. The first section of the questionnaire was used to gather the background information of the target population. This information is needed to provide meaningful data analysis, as it serves as another point at which cross tabulations can be performed to assess whether the demographics of the participants play a significant role in their perceptions regarding the implementation of real options. The questions that follow were used to analyse the backing information of participants:

SECTION A: Demographics

A1. Please select your gender:

Male	
Female	

In order to provide detailed cross tabulation analysis, the gender of the participants was gauged to assess the attitudes towards the real options framework within capital budgeting techniques.

A2. Please indicate your age group:

20 years and below	
21-30 years	
31-40 years	
41-50 years	
51-60 years	
61 and older	

In order to provide detailed cross tabulation analysis, the age of participants was measured against the objectives of the study.

A3. Highest Qualification:

National Senior Certificate (NSC)	
Diploma/ National Diploma	
Bachelor's degree/Advance diploma	
Honours degree/ Post graduate Diploma	
Master's degree	
Doctoral Degree	
Other (Please specify)	

In order to provide detailed cross tabulation analysis, the qualifications of participants were measured against the objectives of the study.

A4. Please indicate the period you have worked in your current employment:

Less a year (less than 12 months)	
1-5 years	
6-10 years	
11-15 years	
16-20 years	
21-25 years	
26-30 years	
Over 30 years	

In order to provide detailed cross tabulation analysis, the period of employment was used as a measure of experience against the objectives of the study.

Section A collected all the relevant demographic details of the participants of the study in order to provide a more detailed cross tabulation analysis against the objectives of the study (sections B and C). The next section seeks to collect information that specifically addresses the main research objectives of the study. The following questions were asked to obtain the perceptions of the participants regarding real options within the NPV decision-making tool:

SECTION B: Net Present Value and Real Options [Capital Budgeting techniques]

Consider the following investment opportunity:
Project X has the following estimated cash flow streams:

Year	0	1	2	3	4	5
Cash flow	(20 000 000)	8 000 000	6 000 000	7 200 000	6 800 000	7 100 000

The cost of the investment is R20m, and this will result in estimated unconventional cash flows during its five-year life span.
The firm's cost of capital (required rate of return) is 14%.
The Net Present Value for Project X before a decision is taken yields a positive value of R 4 207 807.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
B5	Based on the results using Net Present Value alone, I would invest in the project.					

The question serves more of a control question, testing the principle on which NPV calculations are based.

B6	Your reason above was based on the fact that an initial positive Net Present Value amount was reported.					

This question was necessary to reinforce the principle that was tested in question five and to assure that the decision made in question five was due to the principle of NPV alone. The next part of section B looks explicitly at perceptions regarding real options being implemented within the traditional NPV framework:

Now consider the same investment, but some important new information, Real Options, has been given to you after Year 3 has lapsed: *(please refer to the decision tree below)*

Project X had an actual cash flow of R4.68m in Year 1, R3.43m in Year 2 and R3.8m in Year 3 which were far lower than the anticipated cash flows.

Management suggested that there is a 50% probability that the cash flow in Year 4 will be R7m (point **A** on decision tree) and another 50% probability that it may be R4.5m (point **B** on decision tree).

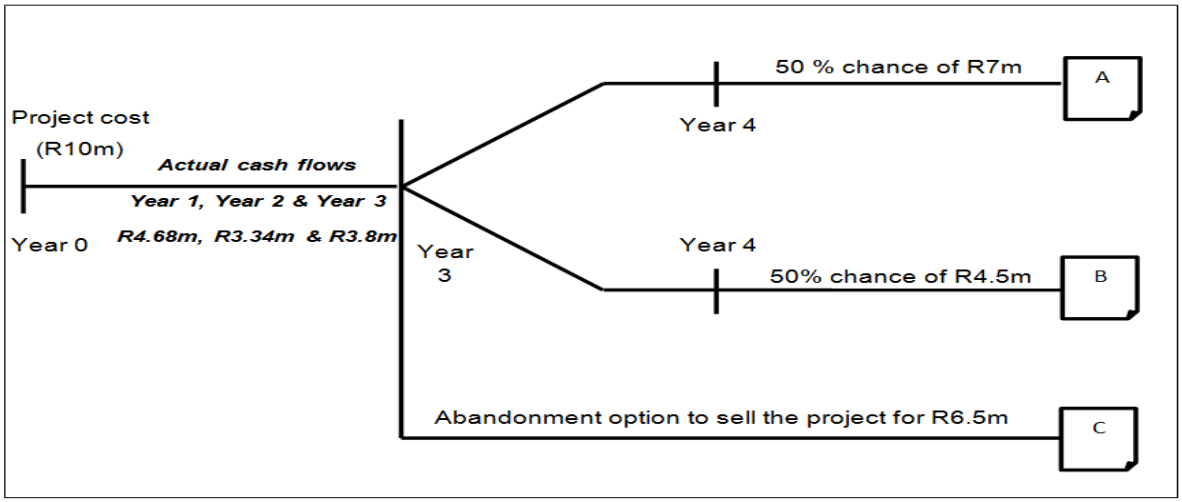
Management has also speculated that the project intends to break-even during Year 5, due to the recession expected in that year.

The firm's cost of capital remained at 14%.

It has also come to light that the project can be sold (abandoned) for R6.5m, deferring all costs at the end of Year 3 (point **C** on decision tree).

Management has suggested that the option to abandon is available.

Using a decision tree, the options would be illustrated as follows:



The revised Net Present Value calculation including Real Options for Project X is computed as follows using points on the decision tree:

Point	Present value of Year 4 cash flow	Abandonment value	Net present value
A	R 6 140 351	R6 500 000	= R (1 949 649)
B	R 3 947 368	R6 500 000	= R (4 232 632)

You are now faced with two options:

Option 1: Abandon the project: At the end of year three, the abandonment value of the project is R6.5m which realized in today's terms is R6.5m.

Option 2: Continue investment in the project: There is only a 50/50 chance that either R 3 947 368 or R 6 140 351 can be earned in Year 4 respectively and this chance is also speculative. Both a high and low expected cash flow outcome will lead us to abandon the project (negative NPV), as these values are far less than that of the abandonment value. Additionally, you would have a wait a whole year before this chance cash flow can be realized. Thus, the opportunity cost of investing the abandonment value of R6.5m must also be considered.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
B7	Based on this revised Net Present Value with a Real Option, I would continue to invest in the project.					

This question was imperative, as it determined whether the implementation of real options had a positive effect on the participants decision-making ability.

B8	I am most likely to discontinue the project based on this revised Net Present Value with a Real Option.					

This question was imperative, as it determined whether the implementation of real options had a negative effect on the participants decision-making ability.

B9	I would have preferred to take the initial NPV decision and disregarded the real options.					

The above question was able to gauge insight into attitudes regarding the use of these real options within the traditional NPV framework.

B10. The use of Real Options within the traditional Net Present Value technique has effectively enhancing your decision-making process?

Yes		No	

Question number ten was necessary to appraise whether the decision-making process was enhanced by the implementation of real options. Section B sought to collect information that specifically addressed the main research objectives of the study (objectives 1 and 2). The next section, Section C, details the questions that were asked to address the last research objective which explores the reasons why real options are not widely adopted in practice. The following questions were asked to ascertain the perceptions hindering the implementation of real options:

Section C: Implementation of Real Options

Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
C11	Expertise					
C12	Applicability to business					
C13	Complexity to apply in practice					
C14	Estimating inputs					
C15	Realistic assumptions					

The above question further extended the use of a five-point Likert scale from strongly agree to strongly disagree, seeking to assess the level of agreement or disagreement regarding the implementation of real options. The questionnaire has now been discussed in detail, and the justifications for the use of each question were succinctly presented. The next section looks at the covering letter of information and consent.

3.6.5 The covering letter of information and consent

A covering letter (Appendix A, page 118) is a letter that accompanies almost all types of documents, namely, applications and surveys. The letter served as a necessary component to survey the questionnaire to provide valuable information regarding the survey and the nature of the survey. This letter of information contained as much information as possible to increase the response rate by providing details such as the research topic, the supervisor's name, the researcher's name, telephone, student number, email address and a contact from the Institutional Research and Ethics Committee (IREC) in case the participant needed further information related to the research study.

According to Manandhar and Joshi (2020: 89), the letter of informed consent, "primarily protects the human participants of research and educates and monitors researchers to ensure a high quality of ethical standard." The information provided to the human participants of the research should be understood by the participant, and the participant should voluntarily decide to participate in the research study. Furthermore, this information should include all the rights of the participants, the full purpose of the study, its potential benefits, and risks and, most importantly, the right to withdraw from the questionnaire at any point at which the participant feels uncomfortable (Hilton, 2017: 25). Informed consent is documentation that is signed and dated by both the researcher and participant of the study, which can be found towards the end of the letter of information and consent of this study. The next section presents the pretesting and simulation of the pilot study.

3.6.6 Pretesting and simulation of the pilot study

The pertinence of pretesting a questionnaire helps researchers determine the overall suitability of a questionnaire by scrutinising the questions to address the research objectives adequately and that the research instrument is clearly understood by the target population (Hilton, 2017: 23). The questionnaire was pretested amongst fourteen managers and supervisors from the target population of certified financial planners. An issue was noted due to the repetition of some questions, but the results of the pretesting were successful.

A pilot study examines the feasibility of conducting a study using a smaller sample of the target population (In, 2017: 602). This gave the researcher the opportunity to adjust the research setting, methodology, and instrument before conducting a full-scale study on the main population. This can improve the quality and efficiency of the study by proactively identifying and resolving issues that may affect the study (In, 2017: 602). Another important aspect of the pilot study is that it simulates the statistical analysis that will be performed on the main study to identify the weaknesses of the survey, which can be amended before conducting the main data collection (Hilton, 2017: 26).

The pilot study was conducted using fourteen (14) participants taken from the target population, and these participants were excluded from the main research study. There was a statistical issue experienced regarding the negative wording of one of the questions, causing some difficulty with the data analysis of the pilot study. The question was ultimately revised to spin it in a positive note and thus overcome the issue. No other issues were identified when performing the statistical analysis on the pretest group. In the next section, the data analysis and statistical measurements are discussed.

3.7 Data analysis and statistical measurements

The data collected were analysed using IBM SPSS Windows version 26 and Statgraphics Centurion version 15.1. The data were populated, and various descriptive and inferential statistics were conducted in line with the study's objectives. The Kaiser-Meyer-Olkin (KMO), Bartlett, and Varimax techniques (Shresta, 2021: 5) (Arokodare, 2020: 7) were applied for the reliability and factor analysis of this study using IBM SPSS Windows version 26. The results were compared with the literature and other previous studies to understand the results indepth. Data has been analysed using descriptive and inferential statistics, as discussed in the next sections.

3.7.1 Descriptive data analysis

According to Allanson and Notar (2020: 376), descriptive statistics are used to organise and summarise quantitative data. Univariate and bivariate analysis are the

most appropriate tools; univariate analysis is concerned with measures of central tendency and measures of dispersion for one variable, whereas bivariate analysis concerns the measurement of two variables at a time (Dickinson, 2020: 31). Descriptive statistics are useful, as they analyse the results for an experiment in more detail, allowing for more research that is constructive (Dawson, 2019: 121).

Descriptive data analysis aims to describe the data by investigating the distribution of scores on each variable and determining whether the scores on different variables are related (Myers, 2017: 234). Discrete data bar charts, pie charts, cross-tabulations, and correlation of the data will be analysed, and the measurements that will inform the descriptive statistics of the study are the nominal, ordinal, interval, and ratio scales (Allanson and Notar, 2020: 378).

3.7.2 Inferential statistics

Inferential statistical analysis is concerned with the testing of hypotheses and confirms the use of specific tests in its application. The independent t-test is the most appropriate parametric test for comparing the means of two groups. It tests any significant difference between the two variables (Dickinson, 2020: 31). A chi-square test is any statistical hypothesis test in which the test statistic has a chi-square distribution when the null hypothesis is true (Myers, 2017: 254). The probability distribution can be made to approximate a chi-square distribution as closely as desired by making the sample size large enough (Dawson, 2019: 142). Primary data were collated and analysed, and comments and concluding discussions are thereafter based on the results obtained.

Inferential statistics analysis allows the researcher to conclude populations from sample data. The most important application in the social sciences of statistical theory around sampling distributions has been significance testing or statistical hypothesis testing; this traditional approach to representing a result requires a statement of statistical significance (Dickinson, 2020: 31). The independent t-test, chi-square goodness-of-fit-test, and chi-square test of independence will be used to inform the inferential statistics of the study.

Factor analysis examines the data set to identify complicated interrelationships among items and group items that are part of integrated concepts, thereby enabling richer data analysis. Factor analysis clusters similar variables into the same factor to identify underlying variables, and it only uses the data correlation matrix (Shresta, 2021: 7). There are two statistical measures to assess the factorability of the data: the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity.

3.7.2.1 Kaiser-Meyer-Olkin's measure of sampling adequacy

The KMO test is intended to measure the suitability of data for factor analysis. It tests the adequacy of the sample size by measuring sampling adequacy for each variable in the model and for the complete model (Shresta, 2021: 5). The KMO measure of sampling adequacy is given by the formula:

$$KMO_j = \frac{\sum_{i \neq j} R_{ij}^2}{\sum_{i \neq j} R_{ij}^2 + \sum_{i \neq j} U_{ij}^2}$$

Where Rij is the correlation matrix and Uij is the partial covariance matrix. According to Arokodare (2020: 7), the KMO value varies from 0 to 1; KMO values between 0.8 and 1.0 indicate that the sampling is adequate, KMO values between 0.7 and 0.79 indicate middling and values between 0.6 and 0.69 indicate mediocre results for the sampling. KMO values less than 0.6 indicate that the sampling is not adequate, remedial action should be taken, and if the value is less than 0.5, the factor analysis results undoubtedly will not be very suitable for the analysis of the data (Arokodare, 2020: 7).

3.7.2.2 Bartlett's test of Sphericity

Bartlett's test of Sphericity tests the null hypothesis; the original correlation matrix is an identity matrix indicating that the variables are unrelated and therefore unsuitable for structure detection (Shresta, 2021: 8). The alternative hypothesis is also tested to determine if the variables are correlated enough to where the correlation matrix

diverges significantly from the identity matrix (Myers, 2017; 252). A significant value < 0.05 indicates that factor analysis may be worthwhile for the data set, and in order to measure the overall relationship between the variables, the determinant of the correlation matrix |R| is calculated (Arokodare, 2020: 8). Bartlett's test of Sphericity is given by:

$$\chi^2 = -\left(n - 1 - \frac{2p+5}{6}\right) \times \ln|R|$$

Where p= number of variables, n= total sample size and R= correlation matrix. Now that the two statistical measurements have been presented, the Varimax rotation method is an important second step in factor analysis. The Varimax rotation method is needed to transform the initial factors into new ones that are easier to interpret for the study's data analysis. Another statistical measure, Varimax rotation method, is now discussed.

3.7.2.3 Varimax rotation method

Factors obtained in the initial extraction phase are often difficult to interpret because of significant cross-loadings in which many factors are correlated with many variables (Shresta, 2021:9). There are two main approaches to factor rotation: orthogonal (uncorrelated) or oblique (correlated) factor solutions. Orthogonal factor rotation is used in this research study, as it results in solutions that are easier to interpret and to report (Dickinson, 2020: 33). The varimax, quartimax, and equimax are the methods related to orthogonal rotation.

The Varimax method, which was developed by Kaiser (1958), is used to minimise the number of variables that have high loadings on each factor. Varimax tends to focus on maximising the differences between the squared pattern structure coefficients of the variables; these loadings are measured at both high and low levels (Shresta, 2021: 9). If the rotated component matrix shows many significant cross-loading values, it is suggested to rerun the factor analysis to obtain an item loaded in only one component by deleting all cross-loaded variables (Arokodare, 2020: 8). The rotated component

matrix was extracted on the sections of the questionnaire that tested the study's variables.

3.8 Delimitations

This study was confined to certified financial planners only among all the different types of financial practitioners found in the financial services sector based in the Durban central business district area and not South Africa. The research instrument was also designed using closed-ended and Likert scale questions in the form of a survey as opposed to open-ended and the use of interviews, as this allowed for the most efficient collection of data within the time constraints of the study.

3.9 Limitations

The research instrument needed to be designed into an online survey to gather more responses from the target audience, even though a reasonable sample was collected from certified planners, this may not be an accurate representation of all financial planners in the city of Durban. A future study that would seek to address the same research objectives to a larger range of diverse types of financial practitioners is encouraged. The time of data collection was limited to three weeks to meet the deadline of this study, which needed to be completed in early 2022. Thus, a rigorous approach to data collection was adopted: sending emails and links multiple times until a sufficient number of responses were concluded.

3.10 Validity and reliability

A valid study has properly collected and interpreted its data so that the conclusions accurately reflect and represent the real world that was studied (Yin, 2011: 86) (Sileyew, 2019). A theory always holds for some or other population of units of analysis and a universal set of conditions. Any implication deduced from a theory and that is subjected to empirical testing is similarly applicable to such a population. These

populations tend to be large, so it may be practically impossible to involve all research project members (Welman, Kruger and Mitchell, 2013: 63; Dawson, 2019; 96). Before conducting the study, the questionnaire went through a pilot study to ensure that the questions being asked extracted the intended information from the respondents (Hilton, 2017: 23).

Reliability is the overall consistency of a measure (Zaroushani and Khajehnasiri, 2020). Reliability here is extremely important, as these results may be applied to different states or continents and yield similar, if not identical, results. Reliability refers to the extent to which obtained scores may be generalised to separate occasions, measurements/test administrators (Welman, Kruger and Mitchell, 2013: 81). In the study, the reliability of the variables was established with Cronbach's Alpha. Similarly, the KMO and Bartlett's test of Sphericity were applied to ensure that the statements comprising each research instrument variable measured what was intended to be measured (Arokodare, 2021: 7). Furthermore, this reduced redundancies between the variables and ensured that the questions measured the study's variables, thus improving the validity of the research instrument (Saunders, Lewis and Thornhill, 2019: 92).

3.11 Anonymity and confidentiality

Certified financial planners have been ensured of the confidentiality and anonymity of their responses. This has been ensured by not asking the participants personal questions such as name, addresses and income brackets; as such information would also be irrelevant to the research. An emailing list comprising financial planners was confidentially shared with the researcher from a manager at the FPI; this list only contained the emails of financial planners and no other personal information. This ensured that the researcher remained independent and objective by not knowing or interviewing the target population. Confidentiality is important if the participants are required to trust the researcher and that the information presented has not been made available to third parties or parties directly involved in competing organisations.

3.12 Ethical considerations

The study followed the university's ethical consideration guidelines. Permission from the relevant authorities to conduct the study was sought from the university ethics committee and the organisations in which the research was to be conducted. In addition, before any respondents were allowed to participate in the study, they were required to sign an informed consent form to indicate that they understood the aim and purpose of the study and that they were not forced to participate in the study. Furthermore, the confidentiality and anonymity of the respondents was preserved throughout the course of this study. In view of this, no personal information or details were collected that would otherwise compromise the identity of the respondents.

Moreover, all data collected in this study were kept in a password protected and encrypted computer, which was only accessible to the researcher. Additionally, to protect the respondents' health and safety, COVID-19 health protocols were observed throughout the study. The data were collected online to minimise contact and maintain social distance. A copy of the ethical clearance letter has been attached to Appendix C (page 127).

3.13 Chapter summary

The study adopted a positivism research philosophy and quantitative research design. The study's target population was certified financial planners residing in Durban, and the sample size was explained. The nature of the research instrument was defined and justified, and the data collection method was detailed. A compact discussion of the pilot study was then presented before concluding the chapter with the data analysis, validity, reliability, and ethical considerations of this study.

The following chapter presents and interprets the results from the questionnaires administered in this study.

CHAPTER 4: DATA ANALYSIS & DISCUSSION

4.1 Introduction

This chapter presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data. It was distributed to certified financial planners in Durban, South Africa.

The data collected from the responses were analysed with IBM SPSS version 26. The results will present the descriptive statistics in graphs, cross tabulations, and other figures for the quantitative data collected. Inferential techniques include the use of correlations and chi square test values, which are interpreted using the p-values. The results analysed using Microsoft Forms have been included in Appendix F (page 130), presenting a simple view of the data analysis of the study.

This chapter will analyse the demographics of the study, provide the factorial analysis of the questions used in the questionnaire, and provide a robust discussion of NPV and real options before concluding with the correlations between the sections of the questionnaire.

4.2 Demographics of the study

This section discusses the demographics of the study, and it has been divided into three subsections, which are gender and age, highest qualification, and work experience within the current organisation of the respondents. These have been discussed in detail in the subsections below.

4.2.1 Gender and age of the respondents

Table 6 shows the gender distribution by age for the study participants. For participants in the 20 years or younger age category, 50.0% were male and 50.0%

were female, as shown in Table 6. Within the category of males (only) and females (only), those who were aged 20 years or less accounted for 0.6% and 0.8% of their total gender category, respectively. However, for this category, males and females between the ages of 21 and 30 years formed 0.3% and 0.3% of the total sample, respectively.

Within the age category of 21 to 30 years, 57.1% were male and 42.9% were female, as shown in Table 6. The category of males (only) and females (only) aged between the ages of 21 and 30 years accounted for 5.1% and 4.7% of their total gender category, respectively. However, this category of males and females between the ages of 21 and 30 years formed 2.8% and 2.1% of the total sample, respectively.

Table 6: Gender distribution by age

		Gender		Total
Age (years)		**Male**	**Female**	
≤ 20	Count	1	1	2
	% Within Age group	50.0%	50.0%	100.0%
	% Within Gender	0.6%	0.8%	0.7%
	% Of Total	0.3%	0.3%	0.7%
21 - 30	Count	8	6	14
	% Within Age group	57.1%	42.9%	100.0%
	% Within Gender	5.1%	4.7%	4.9%
	% Of Total	2.8%	2.1%	4.9%
31 - 40	Count	78	50	128
	% Within Age group	60.9%	39.1%	100.0%
	% Within Gender	49.4%	39.1%	44.8%
	% Of Total	27.3%	17.5%	44.8%
41 - 50	Count	68	65	133
	% Within Age group	51.1%	48.9%	100.0%
	% Within Gender	43.0%	50.8%	46.5%
	% Of Total	23.8%	22.7%	46.5%
51 - 60	Count	3	6	9
	% Within Age group	33.3%	66.7%	100.0%
	% Within Gender	1.9%	4.7%	3.1%

Age (years)		Gender		Total
		Male	Female	
	% Of Total	1.0%	2.1%	3.1%
Total	Count	158	128	286
	% Within Age group	55.2%	44.8%	100.0%
	% Within Gender	100.0%	100.0%	100.0%
	% Of Total	55.2%	44.8%	100.0%

Within the age category of 31 to 40 years, 60.9% were male, and 39.1% were female. Within the category of males (only) and females (only), those who were aged between the ages of 31 and 40 years accounted for 49.4% and 39.1% of their total gender category, respectively. However, for this category of males and females between the ages of 31 and 40 years, 27.3% and 17.5% of the total sample, respectively, was formed

Within the age category of 41 to 50 years, 51.1% were male and 48.9% were female, as shown in Table 6. Within the category of males (only) and females (only), those who were aged between the ages of 41 and 50 years accounted for 43.0% and 50.8% of their total gender category, respectively. However, for this category, males and females between the ages of 41 and 50 years, 23.8% and 22.7% of the total sample, respectively, were formed.

Within the age category of 51 to 60 years, 33.3% were male and 66.7% were female, as shown in Table 6. Within the category of males (only) and females (only), those who were aged between the ages of 51 and 60 years accounted for 1.9% and 4.7% of their total gender category, respectively. However, for this category, males and females between the ages of 21 and 30 years formed 1.0% and 2.1% of the total sample, respectively.

Nevertheless, the overall ratio of males to females was approximately 5:4, indicating that most of the participants were male. However, the number of participants for each gender was roughly the same and would not affect the objectivity of the study. This suggests that the response data were fairly gender balanced and that any differences are likely not to be influenced by gender.

4.2.2 Highest qualification of the respondents

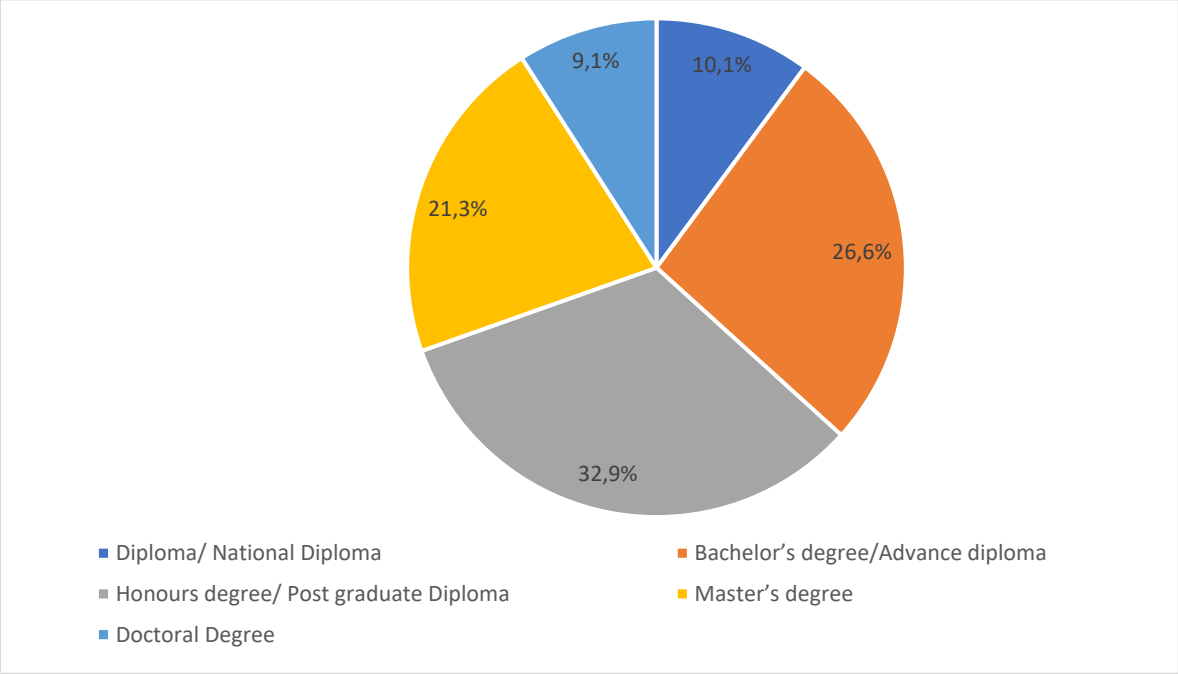


Figure 5: Highest qualification of respondents

Figure 5 indicates that the highest qualification of the participants was diploma/national diploma, bachelor's degree/advance diploma, honour's degrees/postgraduate diploma, master's degree and doctoral degree, which accounted for 10.1%, 26.6%, 32.9%, 21.3% and 9.1%, respectively.

Nonetheless, most of the participants had a master's degree, and these accounted for 26.6% of participants. In view of this, all the participants had at least a diploma as their highest qualification, which suggests that all the participants had sufficient intellectual and reasoning capacity to respond to the questionnaire survey.

4.2.3 Work experience within the current organisation of the respondents

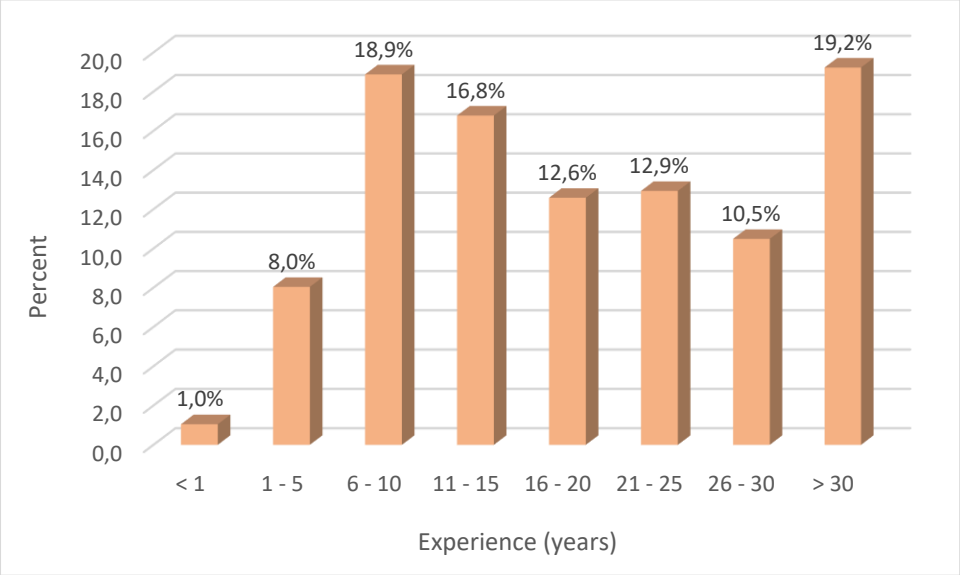


Figure 6: Work experience within the current organisation

Figure 6 shows the work experience of the respondents according to the number of years within the current organisation. Most of the participants had more than 30 years of work experience within their current organisation, and this accounted for 19.2% of the participants. This was closely followed by the participants who had 6 – 10 years of work experience within their current organisation, which represented 18.9% of the participants, as shown in Figure 6. However, the rest of the participants had less than 1 year, 1 – 5 years, 11 – 15 years, 16 – 20 years, 21 – 25 years, and 26 – 30 years, which accounted for 1.0%, 8.0%, 16.8%, 12.6%, 12.9%, and 10.5%, respectively. In light of this, 91.0% of the participants had at least 6 years of work experience within their current organisation, which suggests that the participants had enough work experience in the financial industry and were able to make a meaningful contribution to the study.

4.3 Factorial analysis

This section addresses the factorial analysis of the study. Factorial analysis is a statistical technique with the aim of reducing the redundancy of data. Factorial analysis

is also typically used where a researcher wishes to represent several questions with a small number of hypothetical factors. Accordingly, this section has covered the reliability statistics, KMO, and Bartlett's test and rotated component matrix, which were conducted as part of the factorial analysis process. These have been discussed in detail in the following subsections.

4.3.1 Reliability statistics

One of the most important aspects of precision is reliability, which is computed by taking several measurements on the same subjects. A reliability coefficient of 0.60 or higher is considered "acceptable" for a newly developed construct. Moreover, Pallant (2001: 77) states that Cronbach's alpha values of 0.6 above are considered to have high reliability and an acceptable index, while Daud, Khidzir, Ismail and Abdullah (2018: 1032) consider the Cronbach's alpha value range of 0.60 – 0.80 to be moderate but acceptable. Table 7 reflects the Cronbach's alpha score for sections B and C of the questionnaire, which were used to measure the research objectives.

Table 7: Cronbach's alpha values generated in the study

	Section	**Number of Items**	**Cronbach's Alpha**
B5, B6	Net present value	2	0.866
B7, B9	Net present value with Real Options	2	0.795
C11-C15	Implementation of Real Options	5	0.643

The reliability scores for all sections exceeded 0.6 and were considered as having a degree of acceptable, consistent scoring for these sections of the research.

4.3.2 KMO and Bartlett's Test

Table 8: KMO and Bartlett's test

	Section	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
			Approx. Chi-Square	df	Sig.
B5 – B6	Net present value	0.500	250.932	1	0.000
B7 – B9	Net present value with Real Options	0.500	162.460	1	0.000
C11 – C15	Implementation of Real Options	0.523	481.191	10	0.000

Table 8 shows the values generated in this study using the KMO and Bartlett's reliability tests. KMO values close to one (1) suggest patterns of conclusions that are relatively compact and would yield distinct and reliable factors. In light of this, the KMO values shown in Table 8 show values that are at least 0.5 and were considered acceptable. Additionally, Bartlett's test of Sphericity on the questions in the three sections of the questionnaire were all significant, as shown in Table 8, suggesting that the rotated matrix is not an identity matrix and that there was a relationship between the variables.

4.3.3 Rotated Component Matrix

Table 9: Rotated component matrix for NPV B5 – B6

B5 – B6	**Component**
	1
B5. Based on the results using Net Present Value alone, I would invest in the project.	0.940
B6. Your reason above was based on the fact that an initial positive Net Present Value amount was reported.	0.940

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 9 shows the rotated component matrix for section B of the questionnaire relating to NPV. Principal component analysis was used as the extraction method, and Varimax with Kaiser normalization was used as the rotation method. With this orthogonal rotation method, the number of variables with high loadings on each factor is minimised. It simplifies the interpretation of the factors for factor analysis. Factor analysis/loading indicates the intercorrelations between variables of the study. Related items of questions indicate measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and evaluating the highest or most significant loading for items cross-loaded at greater than this value) can effectively measure the content along the various components.

Table 10: Rotated component matrix for NPV with real options B7 – B9

B7 – B9	**Component**
	1
B7. Based on this revised Net Present Value with a Real Option, I would continue to invest in the project.	0.911
B9. I would have preferred to take the initial NPV decision and disregarded the real options.	0.911

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 10 shows the rotated component matrix for section B of the questionnaire relating to NPV with real options. The statements that constituted sections B5 – B6 and B7 – B9 loaded perfectly along a single component, as shown in Tables 9 and 10, respectively. This signifies that the statements that constituted these sections in the questionnaire perfectly measured what it intended to measure.

Table 11: Rotated component matrix for the implementation of real options C11 – C15

C11 - C15	Component	
	1	2
C11. Expertise	0.083	0.925
C12. Applicability to business	0.136	0.913
C13. Complexity to apply in practice	-0.193	0.209
C14. Estimating inputs	0.922	0.085
C15. Realistic assumptions	0.928	0.095

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 11 shows the rotated component matrix for section C of the questionnaire relating to implementing real options in practice. Nonetheless, it was noted that the variables that constituted Section C, i.e., C11 – C15, loaded along 2 components (subthemes), as shown in Table 11. This means that the participants identified different trends within this section. Component 1 consisted of two items that were estimating inputs and realistic assumptions; these were collectively named “pragmatic estimation of real option inputs.” On the other hand, Component 2 consisted of three items: expertise, applicability to business, and complexity to apply in practice; these were collectively named “practical applications of real options.”

4.4 NPV and real options

This section discusses the NPV and real options corresponding to Section B of the questionnaire (see Appendix B, page 122). It has been divided into three subsections: NPV application for project implementation decision, real options application on project on continuance/abandonment, and real option effectiveness in the decision-making process. These have been discussed in detail in the following subsections.

4.4.1 NPV application for the project implementation decision (B5-B6)

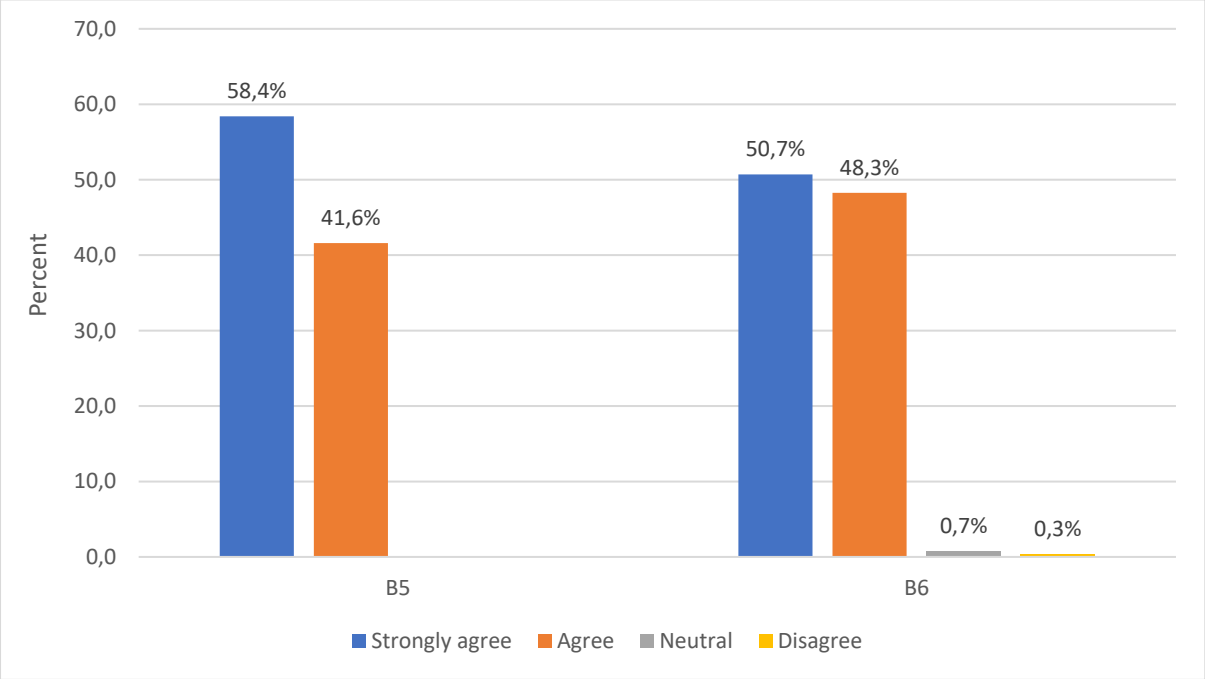


Figure 7: NPV application for the project implementation decision

Figure 7 shows the NPV application for the project implementation decision. The majority of the participants indicated that they either agreed or strongly agreed that they would invest in Project X as it had a positive NPV. However, only 0.3% of the participants indicated that they would not base their decision to invest on the initial positive NPV. However, 0.7% of the participants were neutral on this matter, as shown in Figure 7.

NPV uses the time value of money to compute the difference between all income earned in a project and all cost incurred. Accordingly, projects with a positive NPV are accepted, while projects with a negative NPV are rejected (Correia et al., 2019; 8-6). In view of this, all participants indicated that they would invest in the project, which is in line with the decision that a positive NPV (R 4 207 807) as computed for Project X would suggest. However, in question B6, some of the participants (1.0%) indicated that they did not choose their answer based on a positive NPV value for Project X, suggesting they may have used other means to reach that conclusion. Nevertheless, it can be safely concluded that most of the participants in the study had a good grasp

of the applications of NPV theory to investment decisions as it expected of professional financial planners.

Table 12: Summary of scoring patterns of NPV application for investment decision-making

		Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Chi Square p-value
		N	Row N %	N	Row N %	N	Row N %	N	Row N %	N	Row N %	
Based on the results using Net Present Value alone, I would invest in the project.	B5	167	58.4%	119	41.6%	0	0.0%	0	0.0%	0	0.0%	0.005
Your reason above was based on the fact that an initial positive Net Present Value amount was reported.	B6	145	50.7%	138	48.3%	2	0.7%	1	0.3%	0	0.0%	< 0.001

Table 12 shows the summary of the scoring patterns of NPV application for investment decision-making. To determine whether the scoring patterns per statement were significantly different for each question, a chi square goodness-of-fit test was performed. The null hypothesis claimed that similar numbers of respondents scored across each option for each statement (one statement at a time). Moreover, the alternate hypothesis claimed that there was a significant difference between the levels of agreement and disagreement. The highlighted p-values in Table 12 are less than 0.05 (the level of significance), which implies that the distributions were not similar. That is, the differences between the way participants scored (agree, neutral, disagree) were significant. Table 12 shows that the summary of scoring patterns for questions B5 and B6 and p-values were 0.005 and <0.0001, respectively. In light of this, it was observed that all statements had significantly higher agreement levels and that there were no statements with higher levels of disagreement. This finding is reasonable and expected, as the participants were quite educated and had considerable experience

in the finance industry. As professionals, they would be expected to have higher levels of agreement in regard to investment and financial decision-making.

Table 13: Cross tabulation of question B6 with highest qualification

			Highest Qualification					Total
			Diploma/ National Diploma	Bachelor's degree/Advance diploma	Honours degree/ Post graduate Diploma	Master's degree	Doctoral Degree	
Your reason above was based on the fact that an initial positive Net Present Value amount was reported.	Strongly agree	Count	12	19	51	39	24	145
		% Within Highest Qualification	41.4%	25.0%	54.3%	63.9%	92.3%	50.7%
	Agree	Count	17	56	41	22	2	138
		% Within Highest Qualification	58.6%	73.7%	43.6%	36.1%	7.7%	48.3%
	Neutral	Count	0	0	2	0	0	2
		% Within Highest Qualification	0.0%	0.0%	2.1%	0.0%	0.0%	0.7%
	Disagree	Count	0	1	0	0	0	1
		% Within Highest Qualification	0.0%	1.3%	0.0%	0.0%	0.0%	0.3%
Total		**Count**	**29**	**76**	**94**	**61**	**26**	**286**
		% Within Highest Qualification	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 13 shows the cross-tabulation of question B6 with the highest qualification of the respondents. To further cross-examine the research findings, a cross-tabulation of question B6 with the highest qualification to assess whether participants educational qualifications influenced the responses that the participants made. As such, Table 13 shows that the strongest level of agreement was by participants who had a doctoral degree (92.3%) as their highest qualification participants, while the lowest was among participants who had a bachelor's degree (25.0%). However, it should be noted that the only participants who disagreed (1.3%) were from those who had a bachelor's degree as their highest qualification, and none of the others disagreed. However, only some of the participants who had honour's degree/post graduate diploma took a neutral position on this matter, while none of the others did. Nonetheless, it was found

that all p-values were more than 0.05; there was no significant relationship among the variables.

4.4.2 Real options application on project continuance/abandonment (B7-B9)

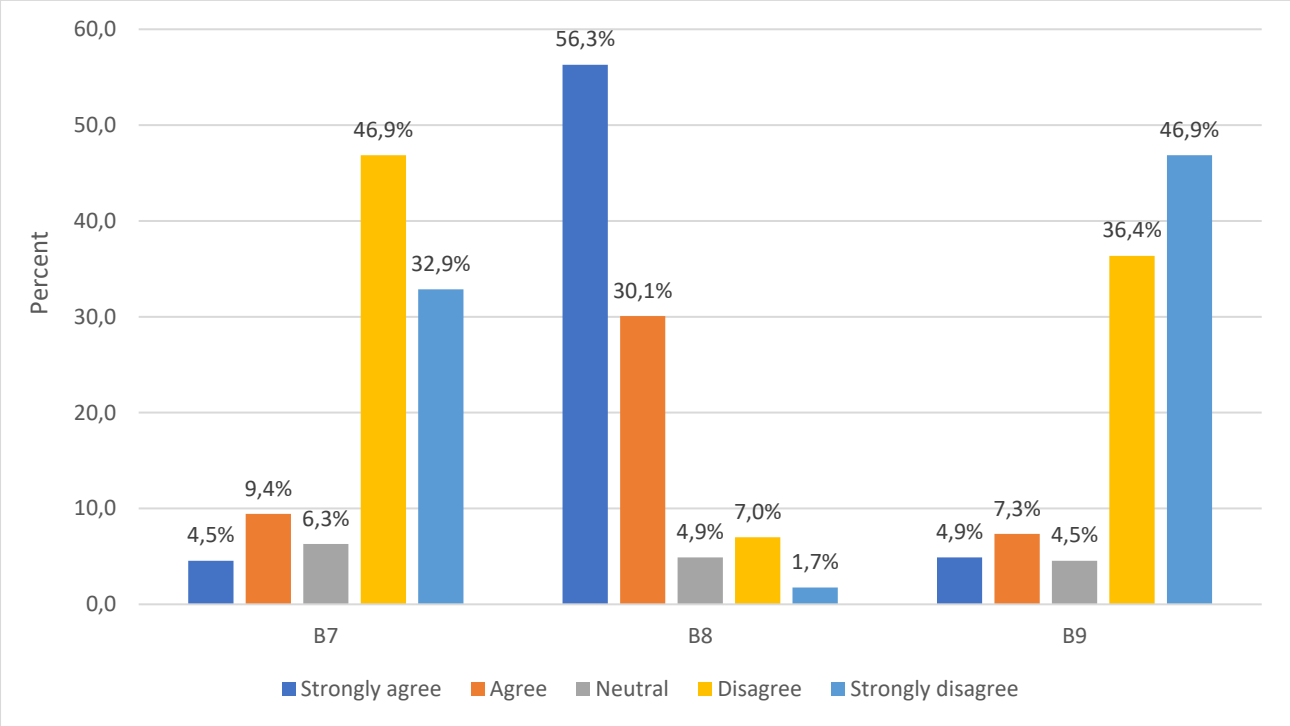


Figure 8: Real options application on project continuance/abandonment

Figure 8 shows the real options application on project continuance/abandonment. The results in Figure 8 for B7 indicated that most of the participants either disagreed or strongly disagreed that they would continue to invest in the project based on the revised NPV with a real option. These accounted for 79.8% of the participants.

However, 13.9% of the participants either agreed or strongly agreed, while 6.3% of the participants were neutral on this matter, as shown in Figure 8 for B7. Considering that options A and B had negative NPVs of – R1 949 649 and – R4 232 632, respectively, according to the NPV rules, these two would be rejected, as recommended by Correia et al. (2019; 8-6). In view of this, the abandonment option would be the best and ideal decision, also considering that the realisation of R7 million

and R4.5 million income for options A and B, respectively, were not guaranteed and were reported to have both a 50% chance of occurring.

Consolidating these points would lead to the abandonment of the project. Interestingly, some of the participants were not of this view, as 13.9% of the participants indicated that they would continue to invest in the project. This suggests a lack of understanding of how real options work by some of the participants, which could have led them to the decision to continue investing in options that would result in negative NPVs. In addition, 6.3% of the participants who remained neutral on this matter could have done so because they may not be familiar with real options and therefore chose not to take a position or decision on the question under consideration.

The results in Figure 8 for B8 indicated that most of the participants either agreed or strongly agreed that they would abandon the project based on the NPV value with the real option. These accounted for 86.4% of the participants. Nonetheless, 8.7% of the participants either disagreed or strongly disagreed, while 4.9% were neutral on this matter.

As stated earlier, the logical decision would be to abandon the project due to the negative NPV computed on options A and B. The results were as expected because it would be logical that the majority of the participants would agree to abandon the project, as that would be the expected decision from professional financial planners. However, 8.7% of the participants who disagreed with project abandonment may have limited knowledge on how to handle real options, which could be why they disagreed. On the other hand, 4.9% of the participants who were neutral on this matter may have been unsure of the answer, which could have led them not to make a decision on this question.

The results in Figure 8 for B9 indicated that the majority of the participants either disagreed or strongly disagreed that they would disregard the real options and adhere to the initial NPV decision, and this accounted for 83.3% of the participants. On the other hand, 12.2% of the participants either agreed or strongly agreed, while 4.5% were neutral on this matter. Disregarding real options and sticking to the initial NPV decision would not be the most logical approach to handle the scenario presented. As

such, a professional financial planner would not be expected to disregard the real options because they account for the sequential nature of the decision-making process and can be used as a tool for analysis (Dixit and Pindyck 1994, Trigeorgis 1996) and as a strategic problem-solving technique (Luehrman 1998: 92, McGrath 1997: 976). In this regard, real options provide financial planners with decision possibilities without an obligation to pursue them (Smith, Driver and Matthews, 2018: 123). This offers financial planners an opportunity to make proper and informed decision-making, which would assist them in making an optimum decision.

Additionally, it would be unreasonable to disregard the real options given that they present explicit criteria for a decision that was not previously available during the NPV decision (Benitez and Lima, 2019: 565). In light of this, the most appropriate decision would not be to disregard the real options as some of the participants had opted to do. This finding suggests that some participants have limited knowledge of how to use and apply real options in decision-making.

Table 14: Summary of scoring patterns for real options application on project continuance/abandonment

		Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Chi Square p-value
		N	Row N %	N	Row N %	N	Row N %	N	Row N %	N	Row N %	
Based on this revised Net Present Value with a Real Option, I would continue to invest in the project.	B7	13	4.5%	27	9.4%	18	6.3%	134	46.9%	94	32.9%	< 0.001
Based on this revised Net Present Value with a Real Option, I would decide to abandon the project.	B8	161	56.3%	86	30.1%	14	4.9%	20	7.0%	5	1.7%	< 0.001
I would have preferred to take the initial NPV decision and disregarded the real options.	B9	14	4.9%	21	7.3%	13	4.5%	104	36.4%	134	46.9%	< 0.001

Table 14 summarises scoring patterns for real options application on project continuance/abandonment. To determine whether the scoring patterns per statement were significantly different for each question B7 to B9, a chi square goodness-of-fit test was performed. The null hypothesis claimed that similar numbers of respondents scored across each option for each statement (one statement at a time). Moreover, the alternate hypothesis states claimed that there was a significant difference between the levels of agreement and disagreement. The highlighted p-values in Table 14 were less than 0.05 (the level of significance), which meant that the distributions were not similar. The differences between the way participants scored (agree, neutral, disagree) were significant. Table 14 shows that the summary of scoring patterns for questions B7 to B9 all had p-values that were <0.0001.

In light of this, it was observed that the B7 and B9 statements had significantly higher levels of disagreement. However, question B8 had substantially higher levels of agreement. This was the expected outcome, as the optimum combination of decisions for questions B7, B8 and B9 were agree, disagree and agree, which is in alignment with the results in Table 14. This suggests that most of the participants were able to make good financial decisions by using NPV with real options, which would be an expected outcome from professional financial planners.

Table 15: Cross tabulation of question B7 with work experience within the current organisation

Cross tabulation										
			Please indicate the period you have worked in your current employment							Total
			< 1	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	> 30	
Based on this revised Net Present Value with a Real Option, I would continue to invest in the project.	Strongly agree	Count	0	1	1	0	3	3	3	2	13
		% Within please indicate the period you have worked in your current employment	0,0%	4,3%	1,9%	0,0%	8,3%	8,1%	10,0%	3,6%	4,5%
	Agree	Count	1	4	5	3	3	2	4	5	27
		% Within please indicate the period you have worked in your current employment	33,3%	17,4%	9,3%	6,3%	8,3%	5,4%	13,3%	9,1%	9,4%
	Neutral	Count	0	1	3	1	2	2	4	5	18
		% Within please indicate the period you have worked in your current employment	0,0%	4,3%	5,6%	2,1%	5,6%	5,4%	13,3%	9,1%	6,3%
	Disagree	Count	1	13	36	32	15	14	8	15	134
		% Within please indicate the period you have worked in your current employment	33,3%	56,5%	66,7%	66,7%	41,7%	37,8%	26,7%	27,3%	46,9%
	Strongly disagree	Count	1	4	9	12	13	16	11	28	94
		% Within please indicate the period you have worked in your current employment	33,3%	17,4%	16,7%	25,0%	36,1%	43,2%	36,7%	50,9%	32,9%
Total		**Count**	**3**	**23**	**54**	**48**	**36**	**37**	**30**	**55**	**286**
		% Within please indicate the period you have worked in your current employment	**100,0 %**	**100,0 %**	**100,0 %**	**100,0 %**	**100,0 %**	**100,0 %**	**100,0 %**	**100,0 %**	**100,0%**

Table 15 shows the cross-tabulation of question B7 and the work experience of the respondents within their current organisations. Table 15 indicates that there were higher levels of disagreement to question B7 relative to agreement levels, and it appears as if work experience did not influence the choice that participants made, suggesting that there may be other factors at play. In this regard, work experience could explain why some of the participants chose to continue with the investment in the project when it was showing a negative NPV, as discussed earlier. However, one of the logical explanations may be that participants were not familiar with using NPV with real options.

4.4.3 Real options effectiveness in the decision-making process (B10)

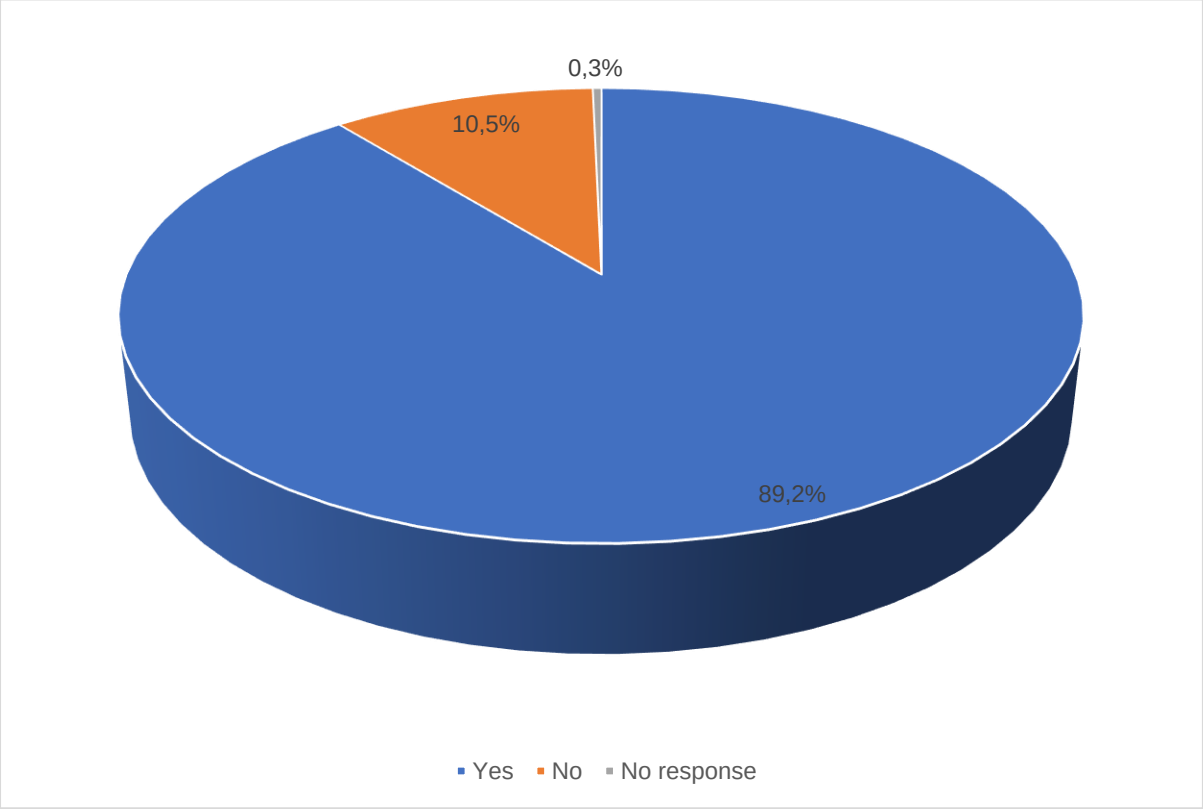


Figure 9: Real options effectiveness in the decision-making process

Figure 9 shows the effectiveness of real options in the decision-making process. The majority of the participants indicated that the use of real options within the traditional NPV technique enhances the decision-making process, accounting for 89.2% of the participants, as shown in Figure 9. However, 10.5% of the participants indicated that they would not, and 0.3% of the participants did not respond to this question.

The results of the study are consistent with the literature that purports that real options enhance the decision-making process by accounting for the time to expiration, uncertainty of estimated cash flows, risk-free interest rate, and value lost over the duration of the project, which the traditional NPV technique does not account for (Leslie and Michaels, 1997: 11).

The results suggest that the majority of the participants had a good command of real options and were able to use real options to enhance the effectiveness of their

decision-making process. Nonetheless, the participants who would not use real options within the traditional NPV technique were more likely unfamiliar with real options and would not prefer to use them in conjunction with the NPV technique.

4.5 Implementation of real options

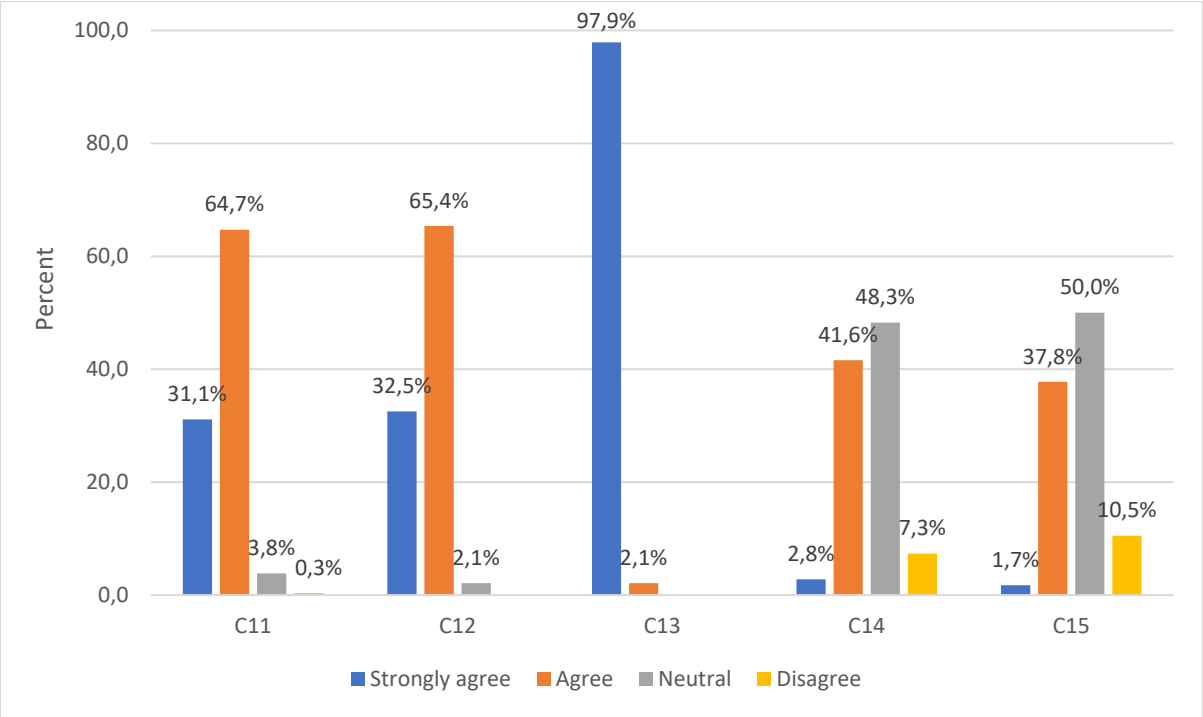


Figure 10: Implementation of real options

Figure 10 reflects the implementation of real options and was divided into two subsections: the practical application of real options and the pragmatic estimates of real options inputs. These are discussed in detail below.

4.5.1 Practical applications of real options

This subsection discusses the practical applications of real options and has been divided into three parts: expertise, applicability to business, and complexity to apply in practice.

4.5.1.1 Expertise

Figure 10 for C11 indicated that the majority of the participants were of the opinion that expertise was one of the crucial factors that improved the implementation of real options, and this accounted for 95.8% of the participants. However, only 0.3% of the participants did not share the same opinion and therefore disagreed that expertise was one of the crucial factors that would improve the implementation of real options. On the other hand, 3.8% of the participants were neutral. In order for an organisation to apply real options, they need talented and skilled human capital that is able to utilise them to improve organisational strategic decision-making. Otherwise, without the expertise, an organisation would not realise the value of real options opportunities.

4.5.1.2 Applicability to business

Figure 10 for C12 indicated that the majority of the participants believed that the level to which real options are applicable to business helps improve their implementation, as organisation will be able to relate to them, and this accounted for 97.9% of the participants. However, 2.1% of the participants were neutral on this matter. This suggests that organisations that see the value and applicability of real options in the business would be more willing to adopt them, but if an organisation cannot visualise how real options would be applied and how they would contribute to organisational efficiency, then their implementation would be lower.

4.5.1.3 Complexity to apply in practice

Figure 10 for C13 indicated that all of the participants believed that complexity to apply in practice is a crucial factor that influences the implementation of real options. This implies that if the real options are less complicated, many organisations would be able to implement them. In contrast, when they are too complicated, it would make them difficult to apply, leading to lower implementation levels.

4.5.2 Pragmatic estimation of real option inputs

This subsection discusses the pragmatic estimation of real option inputs. It has been divided into two parts that have covered the estimating inputs and realistic assumptions regarding real options in practice.

4.5.2.1 Estimating inputs

Figure 10 for C14 indicated that most of the participants had a neutral position on whether estimating inputs would help improve the implementation of real options, which accounted for 48.3% of the participants. In addition, 44.4% of the participants indicated that they were in agreement with those estimating inputs would improve the implementation of real options, while 7.3% of the participants were in disagreement with this.

4.5.2.2 Realistic assumptions

Figure 10 for C15 indicated that most of the participants had a neutral position regarding whether realistic assumptions would help improve the implementation of real options, which accounted for 50.0% of the participants. However, 39.5% of the participants were in agreement that the realistic assumptions would help to improve the implementation of real options, while 10.5% of the participants were in disagreement with this.

4.5.3 Consolidation of findings on implementation of real options

Table 16: Implementation of real options scoring patterns

		Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Chi Square p-value
		N	Row N %	N	Row N %	N	Row N %	N	Row N %	N	Row N %	
Expertise	C11	89	31.1%	185	64.7%	11	3.8%	1	0.3%	0	0.0%	< 0.001
Applicability to business	C12	93	32.5%	187	65.4%	6	2.1%	0	0.0%	0	0.0%	< 0.001

		Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Chi Square p-value
		N	Row N %	N	Row N %	N	Row N %	N	Row N %	N	Row N %	
Complexity to apply in practice	C13	280	97.9%	6	2.1%	0	0.0%	0	0.0%	0	0.0%	< 0.001
Estimating inputs	C14	8	2.8%	119	41.6%	138	48.3%	21	7.3%	0	0.0%	< 0.001
Realistic assumptions	C15	5	1.7%	108	37.8%	143	50.0%	30	10.5%	0	0.0%	< 0.001

Table 16 shows the implementation of real options scoring patterns. To determine whether the scoring patterns per statement were significantly different for each question B7 to B9, a chi square goodness-of-fit test was performed. The null hypothesis claimed that similar numbers of respondents scored across each option for each statement (one statement at a time).

Moreover, the alternate hypothesis states claimed that there was a significant difference between the levels of agreement and disagreement. The highlighted p-values in Table 16 were less than 0.05 (the level of significance), which meant that the distributions were not similar. That is, the differences between the way participants scored (agree, neutral, disagree) were significant. Table 16 shows that the summary of scoring patterns for questions C11 to C15 all had p-values that were <0.0001. In light of this, it was observed that C11 to C13 statements had significantly higher levels of agreement.

However, questions C14 and C15 had significantly higher levels of neutrality. This was an expected outcome, as the optimum combination of decisions for questions C11 to C13 were agree and for C14 and C15 were neutral, which was in alignment with the results in Table 16. This suggests that most of the participants were able to make good financial decisions with an excellent command of real options knowledge.

Table 17: Bivariate correlation

Correlations											
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Spearman's rho	**1**	Correlation Coefficient	1,000									
		Sig. (2-tailed)										
	2	Correlation Coefficient	**.785****	1,000								
		Sig. (2-tailed)	0,000									
	3.	Correlation Coefficient	**-.405****	-.442**	1,000							
		Sig. (2-tailed)	0,000	0,000								
	4	Correlation Coefficient	**.407****	.380**	-.667**	1,000						
		Sig. (2-tailed)	0,000	0,000	0,000							
	5	Correlation Coefficient	**-.296****	-.316**	.630**	-.764**	1,000					
		Sig. (2-tailed)	0,000	0,000	0,000	0,000						
	6	Correlation Coefficient	.359**	.373**	-.325**	.186**	-.260**	1,000				
		Sig. (2-tailed)	0,000	0,000	0,000	0,002	0,000					
	7	Correlation Coefficient	.388**	.416**	-.365**	.322**	-.292**	**.761****	1,000			
		Sig. (2-tailed)	0,000	0,000	0,000	0,000	0,000	0,000				
	8	Correlation Coefficient	0,074	0,049	-.148*	.158**	-.223**	0,082	0,043	1,000		
		Sig. (2-tailed)	0,210	0,413	0,012	0,007	0,000	0,169	0,467			
	9	Correlation Coefficient	.132*	.146*	-0,064	0,049	-0,030	.181**	.232**	-0,038	1,000	
		Sig. (2-tailed)	0,025	0,014	0,282	0,405	0,618	0,002	0,000	0,521		
	10	Correlation Coefficient	0,109	.140*	-0,064	0,025	-0,018	.201**	.215**	-0,073	.739**	1,000
		Sig. (2-tailed)	0,065	0,018	0,283	0,672	0,761	0,001	0,000	0,220	0,000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

1 = Based on the results using Net Present Value alone, I would invest in the project. **2** = Your reason above was based on the fact that an initial positive Net Present Value amount was reported. **3** = Based on this revised Net Present Value with a Real Option, I would continue to invest in the project. **4** = Based on this revised Net Present Value with a Real Option, I would decide to abandon the project. **5** = I would have preferred to take the initial NPV decision and disregarded the real options. **6** = Expertise. **7** = Applicability to business. **8** = Complexity to apply in practice. **9** = Estimating inputs. **10** = Realistic assumptions.

4.6 Correlations

Table 17 shows the bivariate correlation of all the questions contained in sections B and C of the questionnaire. Bivariate correlation was performed using ordinal data to generate the results shown in Table 17. In this regard, the results indicated that positive values indicated a directly proportional relationship between the variables, and a negative value indicated an inverse relationship. However, all significant relationships are indicated by * or ** and are also highlighted in yellow for ease of identification. It is important to note that not all correlations were interpreted as would make the research article would become unjustifiably too voluminous. In view of this, only correlations that were significant at the 0.01 level and could bring interesting insights to the study were discussed, and these were emboldened, as shown Table 17. There was a strong positive correlation of 0.785 between responses for “Based on results using NPV alone, I would invest in the project” and “Your reason above was based on the fact that an initial positive NPV amount was reported”, which was significant at the 0.01 level (2-tailed). This suggests that the participants agreed to invest in Project X would have done so based on an initial positive NPV value recorded.

It was further indicated that there was a moderate negative correlation of -0.405 between responses for “Based on results using NPV alone, I would invest in the project” and “Based on this revised NPV with a real option, I would continue to invest in the project”, which was significant at the 0.01 level (2-tailed). This suggests that participants who agreed to invest in Project X based on the initial positive NPV calculation would not have continued with the project had the revised NPV calculation illustrated with a real option.

In addition, it was indicated that there was a moderate positive correlation of 0.407 between responses for “Based on results using NPV alone, I would invest in the project” and “Based on this revised NPV with a real option, I would decide to abandon the project”, which was significant at the 0.01 level (2-tailed). This suggests that the participants who agreed to invest in Project X based on initial positive NPV were more likely to abandon the project based on the revised NPV with a real option. In addition, it was also indicated that there was a weak negative correlation of -0.296 between responses for “Based on results using NPV alone, I would invest in the project” and “I would have preferred to make the initial NPV decision and disregarded the real options”, which was significant at the 0.01 level (2-tailed). This suggests that the participants

who agreed to invest in Project X based on the initial positive NPV were not willing to continue with the project after obtaining new information and revised NPV with real options.

On the other hand, it was also indicated that there was a strong positive correlation of 0.761 between responses for “Applicability to business” and “Expertise”, which was significant at the 0.01 level (2-tailed). This suggests that an organisation that has expertise in real options is more likely to be able to apply it within its organisation. In this regard, the participants who were of the opinion that expertise in real options would improve its implementation also thought that the applicability of real options to business was also a crucial factor in improving the implementation of real options.

4.7 Chapter summary

It was found that most of the participants in this study had sufficient knowledge about NPV and real options that would enable them to apply it when making financial and investment decision-making. It was also highlighted that the results seem to suggest that some of the participants were not familiar with real options, which could have led them to select responses that were not optimum. In addition, it was indicated that work experience and educational qualification did not have an impact on the choices of the participants, but it seemed that participants who had doctoral degrees had investment decisions that were nearly optimal as those considered to the others in the study.

Taking into account the objectives of this study, the main findings were summarised as follows:

The first objective of this study was to explore whether NPV as a standalone capital budgeting technique was sufficient. It was safely concluded that most of the respondents in the study had a good grasp of the applications of NPV theory to investment decisions as it expected of professional financial planners. In most cases, the respondents believed that NPV was sufficient as a capital budgeting technique on its own.

The second objective of this study was to examine whether the usage of real options in NPV enhances investment decision-making. The results of the study are consistent with the literature that purports that real options enhance the decision-making process by accounting. In almost

all cases, the respondents were impressed by the option of real options and felt that it had enhanced decision-making.

The third research objective was to explore the reasons why real options are not widely adopted in practice. In determining the respondent perceptions regarding the real reasons that real options are not implemented in practice, it was found that all the respondents indicated a significant level of agreement with the statements where expertise, applicability to business and complexity to apply were the reasons that real options are not widely adopted in practice. These can be seen as inherent reasons why real options are not easily adopted in practice and serve as a further justification for the need for this research study. In most other cases, the respondents did not indicate a significant level of agreement, and responses averaged neutrality. The following statements where estimating inputs and realistic assumptions were listed as reasons, due these inherent limitations of traditional capital budgeting techniques and thus did not serve as evidence why real options are not widely adopted in practice.

This chapter discussed the results and data analysis of the study and the next chapter discusses the conclusion and recommendations of the study.

CHAPTER 5: CONCLUSION & RECOMMENDATIONS

5.1 Introduction

This chapter discusses the conclusion and recommendations of the study. It has been separated into seven sections. These sections present the summary of the study, aim of the study, achievement of the research objectives, recommendations, limitations, and areas of future research, contribution, and conclusions of the study.

5.2 Summary of the study

The study found that NPV boasts various limitations that could possibly be resolved by incorporating real options. The limitations include the following:

i) The cash flows used to estimate NPV may change over time, increasing the uncertainty of the project,

ii) The discount rates used are only arbitrary, as they are estimated or decided by the management,

iii) The NPV technique is inappropriate for projects with unequal initial investments and

iv) The NPV technique is inappropriate when projects with contrasting lifespans are compared.

In this regard, real options can possibly serve as both a measure for analysis (Dixit and Pindyck, 1994; Trigeorgis, 1996) and as a logistical problem-solving technique (McGrath, 1997: 974; Luehrman, 1998: 90; Baker, Dutta and Saadi, 2011: 23; Benitez and Lima, 2019: 563), which can enhance the strategic financial and investment decision of an organisation. Furthermore, the implementation of NPV with real options can be used to incorporate a project's expiration time, uncertain future cash flows, the cost of capital needed, and value foregone during the project to reach a revised NPV that can produce optimum outcomes (Leslie and Michaels, 1997: 10; Driouchi and Bennett (2012: 46; Muharam and Tarrazon, 2017: 4; Michelon, Lunkes and Bornia, 2020; Machiels, Compernolle and Coppens, 2021: 448). Additionally, real options can help to update project NPV, as the information becomes available, leading to a more accurate assessment of potential project outcomes against other prospective projects. This would lead

the organisation to decide whether to expand, contract, defer, abandon, or adjust the project during its estimated life.

5.3 Aim of the study

The aim of this research was to examine the perceptions of financial planners on the application of real options as an enhancement tool to the NPV technique in the Durban financial services sector. The aim was successfully attained as the perceptions of these financial planners were gauged and the achievement of the research objectives solidified the aim.

5.4 Achievement of the research objectives

The research objectives of the study were to explore whether NPV was sufficient as a standalone capital budgeting technique, to examine whether real options within NPV enhance investment decision-making and to explore the reasons why real options are not commonly practised. The objectives were aligned to the research aim, and by virtue of the objectives being achieved, so was the aim. The conclusions in this regard are presented for each research objective below:

Objective 1: To explore whether NPV as a standalone capital budgeting technique is sufficient.

The study found that NPV as a standalone capital budgeting technique was not sufficient on its own. Furthermore, the results from the questionnaire revealed that NPV as a standalone capital budgeting technique was unable to account for the uncertainty experienced regarding projected cash flows. Initially, the projected cash flows for the project were R8 mil in the first year, R6 mil in the second year and R7.2 mil in the third year, but the actual cash flows were R4.68 million in the first year, R3.34 million in the second year and R3.8 million in the third year. In view of this, the initial NPV would be subjecting that the project should continue, yet the cash flows released were not as expected. However, the revised NPV with real options gives a broader view of the project status and assesses different options that are available to the organisation.

In light of this, the revised NPV with real options gives a negative NPV for both options A and B, which would lead to making the decision to abandon the project, i.e., option C.

The literature suggests that NPV is only suitable for computing the present value of tangible assets and present value for projected cash flows but fails to incorporate a project's expiration time, uncertainty regarding future cash flows, the rate of return required, and the value foregone during the project (Trigeorgis, 1996; Leslie and Michaels, 1997: 8; Kengatharan and Diluxshan, 2017: 295). These findings are consistent with those of Trigeorgis (1993: 218), Ryan and Ryan (2002: 355), Lazaridis (2004: 428), Vintila (2007: 47-58), Hall and Mutshutshu (2013: 180) Alikram (2020: 266) and Agyei-Mensah (2021: 575). In light of the evidence above, it was concluded that NPV as a standalone capital budgeting technique was not sufficient on its own.

Objective 2: To examine whether the usage of real options in NPV enhances investment decision-making.

The effects of globalisation and short technology lifecycles have resulted in organisations facing volatile marketing conditions in which management is required to make their strategic investment decisions. However, these market conditions discounted cash flows typically employ NPV for investment decision-making, but the problem with NPV is that it is static in nature and therefore does not account for uncertainty. It is important to note that organisations pursue project investments in the hope of generating profits from them, but things do not always go according to plan. In light of this, real options give the organisation the right, for instance, to abandon a project to avoid loss or to channel resources to a more lucrative venture. With this line of reasoning, real options can improve or enhance the investment decisions of an organisation. Considering Project X in the questionnaire of this study, NPV with real options generated revised NPVs for options A and B, which had R1 949 649 and -R4 232 632 NPVs, which were assessed against option C of abandoning the project by selling it for R6.5 million.

Accordingly, the NPV with real options enhanced the investment decision-making by showing that project abandonment was the best option that would not have been realised using NPV alone. Additionally, the real options, unlike NPV alone, can evolve and adapt with changing project conditions, which can help management continuously make better investment decisions. These findings are consistent with those of Barton and Lawryshyn (2011: 260), Ragozzino, Reuer and Trigeorgis (2016: 428-440), de Souza Scotelano et al. (2017: 504),

Andalib, Tavakolan and Gatmiri (2018: 608), Gharib, Berrado and Benabbou (2018: 646), Almeida et al. (2019: 128), Benitez (2019: 565), Michelon, Lunkes and Bornia (2020) and Machiels, Compernolle and Coppens (2021: 451). In view of the evidence above, it was concluded that real options in NPV enhance investment decision-making.

Objective 3: To explore the reasons why real options are not widely adopted in practice.

This study found that the respondents were mainly aware of real options, although expertise, applicability to business and complexity of applying real options in practice were perceived as the main contributors of real options being commonly practiced. However, the respondents did not perceive the estimation of inputs and assumptions to be the causes of real options not being commonly practiced. These findings are consistent with those of Damodaran (2005), Baker, Dutta and Saadi (2011: 23), Grullon, Lyandres and Zhdanov (2012: 1513), Horn et al. (2015: 76), Ampofo (2017: 147), Kozlova (2017: 180-196), Lambrecht (2017: 168), Rigopoulos (2017: 16), Borges et al. (2018; 119) and Nur-Al-Ahad and Fujiwara (2019: 628). In light of this, the real reasons were concluded regarding real options not being commonly practiced.

5.5 Recommendations

The recommendations of the study are as follows:

The results of the study suggest that some of the financial planners who participated in this study were not familiar with or had limited knowledge of real options and therefore were unable to apply them appropriately in the investment decision scenarios presented in this study. In view of this, it is recommended that these participants endeavour to enhance their understanding and command for real options by enrolling in a professional development program on this subject so that they can apply and use real options appropriately in financial and investment decision-making.

The results additionally suggest a lack of implementation of real options within the traditional capital budgeting framework; this would ascertain that real options need to be informed at earlier stages of teaching and learning to circumvent the abovementioned situation in the future.

5.6 Limitations and areas of future research

The study did have one limitation; the sample was restricted to financial planners in Durban, which may not represent all financial planners employed within the financial services sector in South Africa. These findings have provided insight into the application of real options in NPV. The study was confined to financial planners in Durban's central business district in the financial services sector of South Africa. Given this, future studies should explore this same topic using other financial planners from other provinces so that the results may be generalisable in the context of South Africa.

5.7 Contribution of the study

The study contributes to the global literature in the discipline of capital budgeting techniques and real options within South Africa. Considering that very few studies of this nature have been conducted in South Africa, particularly in the Durban region, the findings of this study are expected to add value to financial planners by expanding knowledge of real options in investment opportunities. The findings of this study can be used by policymakers to enhance the NPV technique within the traditional capital budgeting framework by incorporating real options.

5.8 Conclusion

Based on the literature review and empirical research, this study has provided implications for policy and made recommendations based on the reasons why real options are not widely adopted in practice. According to this study, the majority of financial planners are unaware of the existence of real options within the traditional capital budgeting framework. In conclusion, this study accomplished all of its objectives. The recommendations presented in this chapter suggest some possible actions that could advance the methods used in implementing real options in the financial services sector, particularly in Durban.

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APPENDIX A: LETTER OF INFORMATION AND CONSENT

LETTER OF INFORMATION

Title of the Research Study: The application of real options as an enhancement to the net present value technique: A case of the financial services sector

Principal Investigator/researcher: Mr. Kyle Fitzgerald

Co-Investigator/supervisor: Dr. Ferina Marimuthu

Brief Introduction and Purpose of the Study:

Real options theory provides a framework to deal with the uncertainties relating to investment decision-making. Traditional techniques such as Net Present Value (NPV) provide arbitrary decision-making tools at best, accepting projects which yield a positive NPV and rejecting those with a negative NPV. Capital intensive investment projects deal with large sums of cash over a longer period of time, resulting in many uncertainties during the lifespan of the project. A major concern is that models such as NPV do not efficiently deal with uncertainty in an investment, thus being unable to integrate managerial flexibility.

Real options analysis expands on the traditional NPV technique and opens up a wider range of options. Provided that management is flexible regarding decision-making, these options can allow for the most efficient allocation of resources to occur, and account for many uncertainties inherent in traditional capital budgeting techniques.

The main aim of this study is to examine the perceptions of financial practitioners on the application of real options as an enhancement tool to the Net Present Value technique in the Durban financial services sector. Real options theory will be tested for its enhancement value in decision-making.

Outline of the Procedures:

The participant will be required to answer a survey research design instrument. This survey is self-explanatory as all certified financial planners would know or actively be involved in the field of this research. Participants will be used to test a theory by providing decisions before and after the theory has been presented. The survey will take approximately eight minutes to complete and does not ask for the name or any personal details of the participants thereby enhancing the confidentiality aspect.

Risks or Discomforts to the Participant:

The survey research design poses minimal risks or discomfort to the participants as all complex calculations will be performed. Participants may withdraw at any time without a reason given.

Benefits:

The research will benefit the participants by providing an enhancement tool to the decision-making process. For those participants who were unaware of real options, it will provide a knowledge base increase. The research will benefit the researcher by validating the chosen field, thus enabling journal articles to be written thereof and also providing the researcher with a stable topic to base a PhD proposal on.

Reason/s why the Participant May Be Withdrawn from the Study:

The research study does not involve any duress or any negative risks/discomforts to the participant. Participation is also voluntary, so there will be no adverse consequences should a participant wish to withdraw from participating.

Remuneration:

Participants will not receive any form of gratuity or remuneration for this study.

Costs of the Study:

Participants will not be expected to cover any costs of this study, as most results will be personally collected if not scanned and emailed back.

Confidentiality:

Confidentiality will be maintained as participation is voluntary. Anonymity will be enhanced by the research instrument not requiring the names or personal details of the participants. The data will not be accessible to anyone as only the researcher and supervisor(s) will have access. Findings of the study will be used only for the purpose of this study. Once the completed questionnaires have been collected, they will be stored by the researcher in a secured family safe. Once all the data has been analysed, the raw data will remain in the family safe for five years and the soft data will be stored on an external hard drive which will also be kept in the family safe. This raw data will ultimately be disposed of by means of paper shredding and possibly burnt in a controlled fire once the five year period has elapsed. The soft data will be permanently deleted from the external hard drive.

Research-related Injury:

This is not applicable as the research does not involve any duress and minimal risks/discomforts to the participant.

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher on 082 686 4025 or kyleemany@gmail.com, my co-supervisor on (031) 373 5646 or ferinas@dut.ac.za or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the DVC: Research, Innovation and Engagement Prof S Moyo on 031 373 2577 or moyos@dut.ac.za.

General:

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population e.g. isiZulu.

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr. K.C. Fitzgerald, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**
_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level
- use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counselling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. a wrong date or spelling mistake, a new document has to be completed. The incomplete original document has to be kept in the participant's file and not thrown away, and copies thereof must be issued to the participant.

References:

Department of Health: 2004. Ethics in Health Research: Principles, Structures and Processes http://www.doh.gov.za/docs/factsheets/guidelies/ethnics/
Department of Health. 2006. *South African Good Clinical Practice Guidelines*. 2nd Ed. Available at: http://www.nhrec.org.za/?page_id=14

APPENDIX B: QUESTIONNAIRE

This survey is on the 'The application of real options as an enhancement to the net present value technique: A case of the financial services sector'. The main aim of this study is to examine the perceptions of financial practitioners on the application of real options as an enhancement tool to the Net Present Value technique in the Durban financial services sector.

Instructions to respondents

- Please put a tick (✓) the appropriate box for your chosen response.
- Please do not leave any space blank.

SECTION A: Demographics

1. Please select your gender:

Male	
Female	

2. Please indicate your age group:

20 years and below	
21-30 years	
31-40 years	
41-50 years	
51-60 years	
61 and older	

3. Highest Qualification:

National Senior Certificate (NSC)	
Diploma/ National Diploma	
Bachelor's degree/Advance diploma	
Honours degree/ Post graduate Diploma	
Master's degree	
Doctoral Degree	
Other (Please specify)	

4. Please indicate the period you have worked in your current employment:

Less a year (less than 12 months)	
1-5 years	
6-10 years	
11-15 years	
16-20 years	
21-25 years	
26-30 years	
Over 30 years	

SECTION B: Net Present Value and Real Options

Consider the following investment opportunity:

Project X has the following estimated cash flow streams:

Year	0	1	2	3	4	5
Cash flow	(20 000 000)	8 000 000	6 000 000	7 200 000	6 800 000	7 100 000

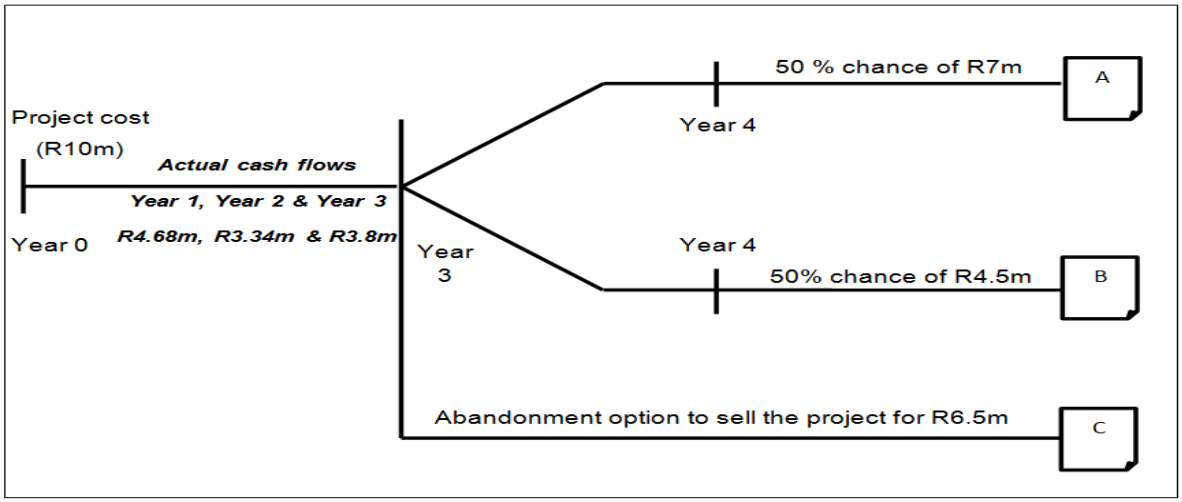
- The cost of the investment is R20m, and this will result in estimated unconventional cash flows during its five-year life span.
- The firm's cost of capital (required rate of return) is 14%.
- The Net Present Value for Project X before a decision is taken yields a positive value of R 4 207 807.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5	Based on the results using Net Present Value alone, I would invest in the project.					
6	Your reason above was based on the fact that an initial positive Net Present Value amount was reported.					

Now consider the same investment, but some important new information, Real Options, has been given to you after Year 3 has lapsed: *(please refer to the decision tree below)*

- Project X had an actual cash flow of R4.68m in Year 1, R3.43m in Year 2 and R3.8m in Year 3 which were far lower than the anticipated cash flows.
- Management suggested that there is a 50% probability that the cash flow in Year 4 will be R7m (point **A** on decision tree) and another 50% probability that it may be R4.5m (point **B** on decision tree).
- Management has also speculated that the project intends to break-even during Year 5, due to the recession expected in that year.
- The firm's cost of capital remained at 14%.
- It has also come to light that the project can be sold (abandoned) for R6.5m, deferring all costs at the end of Year 3 (point **C** on decision tree).
- Management has suggested that the option to abandon is available.

Using a decision tree, the options would be illustrated as follows:



The revised Net Present Value calculation including Real Options for Project X is computed as follows using points on the decision tree:

Point	Present value of Year 4 cash flow	Abandonment value	Net present value
A	R 6 140 351	R6 500 000	= R (1 949 649)
B	R 3 947 368	R6 500 000	= R (4 232 632)

You are now faced with two options:

Option 1: Abandon the project: At the end of year three, the abandonment value of the project is R6.5m which realized in today's terms is R6.5m.

Option 2: Continue investment in the project: There is only a 50/50 chance that either R 3 947 368 or R 6 140 351 can be earned in Year 4 respectively and this chance is also

speculative. Both a high and low expected cash flow outcome will lead us to abandon the project (negative NPV), as these values are far less than that of the abandonment value. Additionally, you would have a wait a whole year before this chance cash flow can be realized. Thus, the opportunity cost of investing the abandonment value of R6.5m must also be considered.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
7	Based on this revised Net Present Value with a Real Option, I would continue to invest in the project.					
8	I am most likely to discontinue the project based on this revised Net Present Value with a Real Option.					
9	I would have preferred to take the initial NPV decision and disregarded the real options.					

10. The use of Real Options within the traditional Net Present Value technique has effectively enhancing your decision-making process?

Yes		No	

Section C: Implementation of Real Options

Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
11	Expertise					
12	Applicability to business					
13	Complexity to apply in practice					
14	Estimating inputs					
15	Realistic assumptions					

Thank you so much for taking the time to complete this questionnaire. Your honest response is sincerely appreciated.

APPENDIX C: ETHICAL CLEARANCE LETTER

Faculty Research Office
Durban University of Technology
26 October 2021

Student: Kyle Clifton Fitzgerald
Student Number:20509517
Degree: Master of Accounting: Management Accounting
Email: 20509517@dut4life.ac.za
Supervisor: Dr F. Marimuthu
Supervisor email: ferinas@dut.ac.za

Dear Mr Fitzgerald

ETHICAL APPROVAL: LEVEL 2

I am pleased to inform you that the Faculty Research Ethics Committee (FREC) following feedback from two reviewers has granted preliminary permission for you to conduct your research '**The application of real options as an enhancement to the net present value technique: A case of the financial services sector**'.

When ethics approval is granted:
You are required to present the letter at your research site(s) for permission to gather data. Please also note that your research instruments must be accompanied by the letter of information and the letter of consent for each participant, as per your research proposal.

This ethics clearance is valid from the date of provisional approval on this letter for one year. A student must apply for recertification 3 months before the date of this expiry.

Recertification is required every year until after corrections are made, after examination, and the thesis is submitted to the Faculty Registrar.

A summary of your key research findings must be submitted to the FRC on completion of your studies.

Kindest regards.

Yours sincerelv

Dr Mogiveny Rajkoomar
FREC Chair
Faculty of Accounting and Informatics
Durban University of Technology
Ritson Campus
Durban, South Africa
4001

APPENDIX D: GATEKEEPER'S LETTER

4 Karanteen Gardens
New Dawn Park
Durban, 4037
30 October 2021

RE: PERMISSION REQUEST TO CONDUCT RESEARCH

Dear Mrs. Pretorius *(Research associate and manager – ABSA/FPISA)*

My name is Mr. K.C. Fitzgerald, a Master of Management Accounting student at Durban University of Technology. My student number is 20509517. My thesis is entitled '***The application of real options as an enhancement to the net present value technique: A case of the financial services sector***'.

I am hereby seeking your consent to undertake part of this research in the Finance department involving the certified financial planners, as voluntary participants. I have provided you with a copy of my research proposal which includes the data collection tools and consent forms to be utilized in the research process. I have also provided a copy of the approval letter which I received from Faculty of Accounting and Informatics Research Committee.

Should you require any further information, please contact me via mobile phone 082 686 4025 or email at kyleemany@gmail.com. My supervisor, Dr. Marimuthu, may be contacted via email at ferinas@dut.ac.za or office phone (031) 373 5646.

Thank you for your time and consideration in this matter. Could you kindly sign below to acknowledge consent to conduct the requested research.

Yours sincerely

K.C. Fitzgerald - Durban University of Technology Masters student

Approved by:

Manager

01/11/2021
Date

APPENDIX E: LANGUAGE CLEARANCE CERTIFICATE

To whom it may concern:

This letter serves to verify that the manuscript detailed below was edited in detail by me, and such improvements which would align the output better with current academic practice were suggested. This output is a thesis for academic purposes and not a paper for presentation nor a lecture as such.

The language used is succinct for the purpose of the output and it is still subject to the internal policies and procedure of the university to which it will be submitted.

The field of study is labelled as the use of real options in Net Present Value within Cost and Management Accounting within the Faculty of Accounting and Informatics and the suggestions of the examiners.

- Date edited: 19 July 2022

- Manuscript Title: The Application of Real Options as an enhancement to the Net Present Value Technique: A Case of the Financial Services Sector.

- Editor's Qualifications: B.Sc.; HED (UNP); B.Com; B.Ed. (UM)); N.H.Dip. Tax (TN); MBA (Wales); D.Tech. Bus Ad. (DUT); N.Dip. Counc (A.I.P.C)

- Manuscript Author: Kyle Clifton Fitzgerald

- Details of Editor: Dr. Graham Trevor Myers

+61 (0) 423 015 007

Myers 52 mail.com

73- 75 Francis Close

Kooralbyn (QId) 4285 Australia

Best Regards.

APPENDIX F: MICROSOFT FORMS DATA ANALYSIS

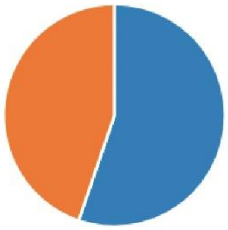
Forms(https://www.office.com/launch/forms?auth=2&from=FormsDomain)

The Application of Real Options as an enhancement to the Net Present Value technique

286	19:00	Active
Responses	Average time to complete	Status

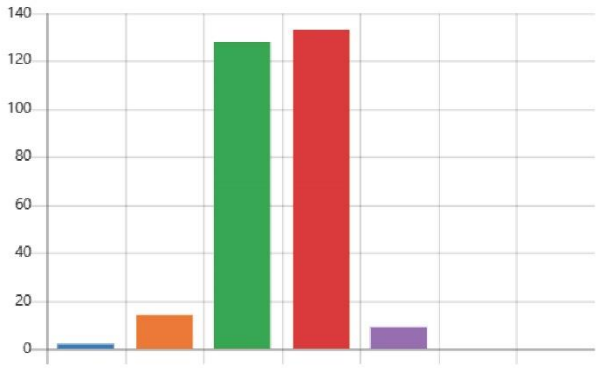
1. A1. Please select your gender:

Male	158
Female	128



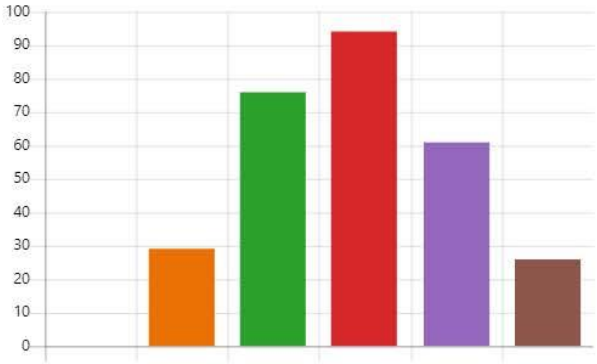
2. A2. What is you highest Qualification:

National Senior Certificate (NS...	2
Diploma/ National Diploma	14
Bachelor's degree/Advance di...	128
Honours degree/ Post graduat...	133
Master's degree	9
Doctoral Degree	0
Other (Please specify)	0



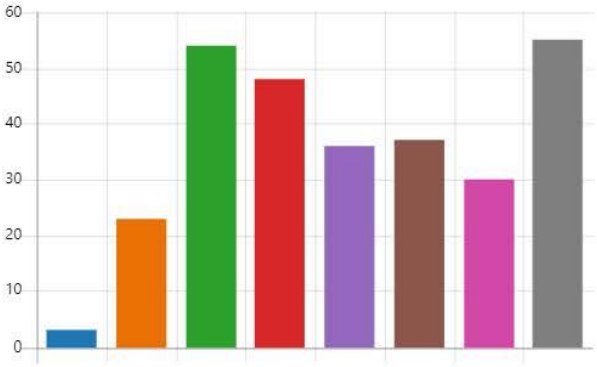
3. A3. Please indicate your age group:

20 years and below	0
21-30 years	29
31-40 years	76
41-50 years	94
51-60 years	61
61 and older	26

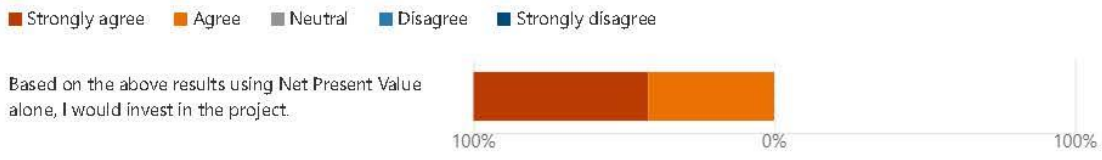


4. A4. Please indicate the period you have worked in your current employment:

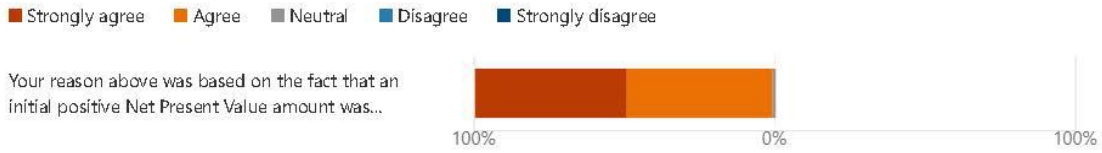
Less a year (less than 12 mont...	3
1-5 years	23
6-10 years	54
11-15 years	48
16-20 years	36
21-25 years	37
26-30 years	30
Over 30 years	55



5. B5.



6. B6.



7. B7. Now consider the same investment, but some important new information, Real Options, has been given to you after Year 3 has lapsed: *(please refer to the decision tree below)*

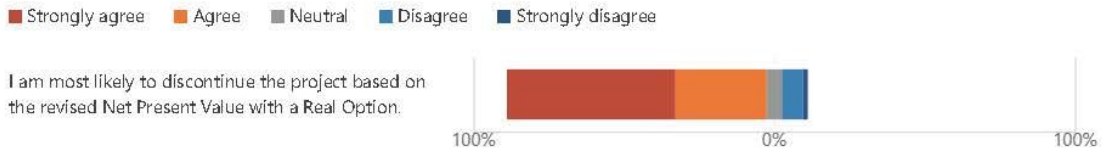
- Project X had an actual cash flow of R4.68m in Year 1, R3.43m in Year 2 and R3.8m in Year 3 which were far lower than the anticipated cash flows.
- Management suggested that there is a 50% probability that the cash flow in Year 4 will be R7m (point **A** on decision tree) and another 50% probability that it may be R4.5m (point **B** on decision tree).
- Management has also speculated that the project intends to break-even during Year 5, due to the recession expected in that year.
- The firm's cost of capital remained at 14%.
- It has also come to light that the project can be sold (abandoned) for R6.5m, deferring all costs at the end of Year 3 (point **C** on decision tree).
- Management has suggested that the option to abandon is available.

Using a decision tree, the options would be illustrated as follows:

8. B8. Now consider the same investment, but some important new information, Real Options, has been given to you after Year 3 has lapsed: *(please refer to the decision tree below)*

· Project X had an actual cash flow of R4.68m in Year 1, R3.43m in Year 2 and R3.8m in Year 3 which were far lower than the anticipated cash flows.
· Management suggested that there is a 50% probability that the cash flow in Year 4 will be R7m (point **A** on decision tree) and another 50% probability that it may be R4.5m (point **B** on decision tree).
· Management has also speculated that the project intends to break-even during Year 5, due to the recession expected in that year.
· The firm's cost of capital remained at 14%.
· It has also come to light that the project can be sold (abandoned) for R6.5m, deferring all costs at the end of Year 3 (point **C** on decision tree).
· Management has suggested that the option to abandon is available.

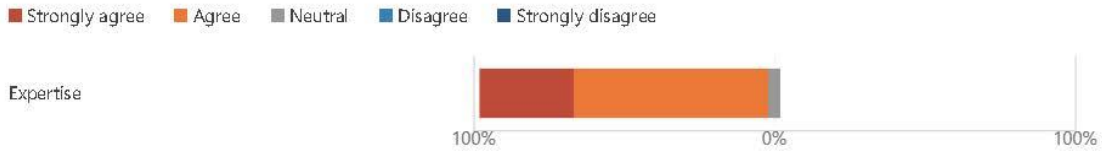
Using a decision tree, the options would be illustrated as follows:



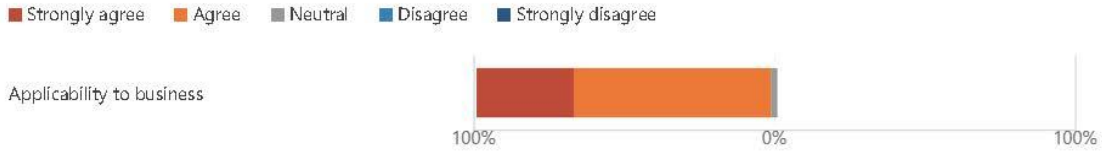
9. B9. Referring to question 8 and 9, answer the following:

10. B10. The use of Real Options within the traditional Net Present Value technique has effectively enhanced your decision-making process?

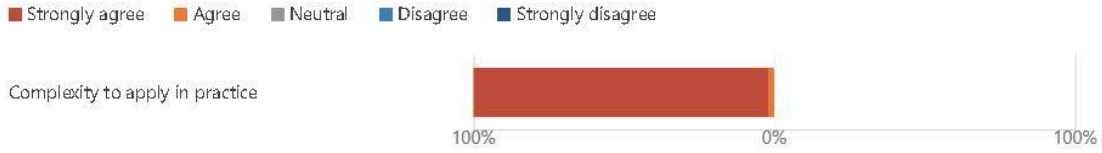
11. C11. Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:



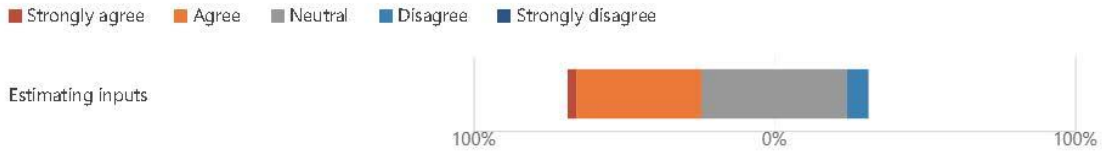
12. C12. Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:



13. C13. Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:



14. C14. Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options:



15. C15. Rate your level of agreement regarding the importance of the factors in terms of improving the implementation of Real Options: