

**Capturing the value of flexibility in public sector
capital investment projects: Evidence from New
Zealand local government organizations**

Jianjing Fu

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Capturing the value of flexibility in public sector capital investment projects: Evidence from New Zealand local government organizations

Jianjing Fu

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Attestation of Authorship

“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

Signed:

Jianjing Fu

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Abstract

In today's fast-changing business environment, many capital investment projects involve future, uncertain events that lead to differences between expected and actual returns. While projects with inherent flexibility provide valuable options for responding to changes in the business environment, it has been noted that conventional investment appraisal analysis methods neglect to capture the value of this flexibility within capital investment projects.

Real options analysis (ROA) has emerged as an appropriate and useful investment appraisal technique for addressing the limitations of traditional analysis methods, since it helps decision-makers to identify uncertainty and to recognize the value of embedded project flexibility, such as the options to expand a successful project or to abandon a failing project. Taking embedded project flexibility into account is important when evaluating capital investment choices because it allows financial decision-makers to proactively adjust investment decisions and, thus, to maximize value to the organization.

However, ROA is recognized as being complex and challenging in practice, and questions have arisen as to how well project flexibility is assessed within organizations. Although some studies have examined the use of ROA-type approaches in the private sector, few have investigated their use in the public sector.

To better understand how public sector financial decision-makers deal with project flexibility, this study seeks to examine how New Zealand local government organizations (LGOs) take account of project flexibility when assessing capital investment projects, including whether they use ROA-type thinking or approaches. The focus is on New Zealand LGOs as a sub-set of the public sector, all of which has a significant concern with capital investment analysis and decision-making.

To achieve the objectives of this study, a survey questionnaire and follow-up interviews were used to explore LGO financial decision-makers' experiences of, and attitudes towards, assessing project flexibility in investment appraisal. The study extends the scope of current literature by looking at how flexibility is considered, rather than just focusing on the formal use of ROA techniques. The findings reveal that LGO financial decision-makers do recognize that project flexibility has value and seem to take it into account to some extent.

However, ROA-type thinking or procedures were not well known amongst the respondents and no evidence was found of their use in practice. Therefore, ROA appears to have a long way to go to establish a meaningful place in their capital investment analysis practices.

This is the first empirical study to examine this issue in the NZ public sector context. In sum, the findings of this study fill a gap in the literature and may also be useful to financial decision-makers concerned with assessing project flexibility in public sector capital investment.

Chapter One: Introduction

1.1 Introduction

This chapter provides a brief overview of the nature and scope of this dissertation. First, the aims of the research are outlined. Second, contextual background information to the research topic is provided, followed by a list of the research questions. The structure of the dissertation is then outlined.

1.2 Aims of the research

Given the increased complexity and uncertainty of today's fast-changing business environment, it has been argued that traditional capital investment appraisal methods are no longer adequate in evaluating capital investment projects, since they neglect to capture the value of the flexibility embedded in such projects (Adler, 2000; Cheung, 1993; Copeland & Howe, 2002; Hammer, 2002; Pike et al., 1989; Myers, 1984; Slagmulder et al., 1995). Real options analysis (ROA) has been advocated as an emergent investment appraisal method for addressing the limitations of traditional analysis methods because it both recognizes project flexibility and quantifies its value (Amram & Howe, 2002; Anderson, 2000; Barnett, 2005; Benaroch & Kauffman, 1999; Busby & Pitts, 1998; Cheung, 1993; Dixit & Pindyck, 1994; Trigeorgis, 1993; Trigeorgis, 1997). Thus, by improving business upside profits while limiting downside losses, ROA creates substantial value to organizations (Alkaraan & Northcott, 2006; Schubert & Barenbaum, 2007; Yeo & Qiu, 2003).

In recent years, real options analysis and its related topic – the importance of recognising project flexibility, have been well investigated in the private sector: the manufacturing, pharmaceutical, financial services, and IT industries (Adams, 2004; Busby & Pitts, 1997; Chen et al., 2009; Hartmann & Hassan, 2006). However, there have been few studies of these issues in public sector organizations, even though capital investment decisions are amongst the most important made in the public sector (Chan, 2004; Kensinger & Crawford, 2010; Schubert & Barenbaum, 2007).

Many public sector investment projects are strategic and long-term in nature, and require massive amounts of investment capital, with multiple sources of uncertainty that include changes in user demand, technology, public priorities and political agenda (Kensinger & Crawford, 2010; Schubert & Barenbaum, 2007).

Local government, like other public sector organizations, play an important role in setting macroeconomic policy, and have responsibility for improving living quality by offering various services, such as infrastructure, transportation and health care services (Brealey et al., 1997). They are highly likely to encounter uncertainty in their capital investment decision-making processes (Chan, 2004). For most government projects, maximizing net benefit (or at least minimizing costs) is always a significant consideration; hence, if flexibility exists in these projects, its ability to reduce future cost ought to be taken into account (Brealey et al., 1997; Schubert & Barenbaum, 2007).

In order to fill the gaps, the purpose of this research is two-fold: to explore how New Zealand local government financial decision-makers take account of flexibility when evaluating capital investment projects; and to investigate whether they use ROA-type approaches or thinking in practice. Local Government Organizations (LGOs) which have significant concerns with capital investment analysis and decision-making will be studied as a sub-set of the public sector. This will be the first empirical study to examine this issue in the NZ public sector context.

1.3 Background to the research

Most capital investment decisions involve three characteristics in varying degrees depending on whether they are ‘operational’ or ‘strategic’ in nature (Dixit & Pindyck, 1994). First of all, the investment is at least partially irreversible because the investment expenditure (sunk costs) cannot be retrieved once the money has been paid to exercise it (Cheung, 1993; Dixit & Pindyck, 1994), and it cannot be reversed without penalty at any time (Busby & Pitts, 1998).

Second, uncertainty surrounding the investment over future events has a great impact on the level of rewards of that investment (Alkaraan & Northcott, 2006;

Dempsey, 2003; Dixit & Pindyck, 1994, Slagmulder, 1997). All a decision-maker can do is to assess the possible ways in which the investment project might develop in the future to produce higher or lower profits (or losses) for the organization (Anderson, 2000; Busby & Pitts, 1998; Dixit & Pindyck, 1994; Gotze et al., 2008). However, this risk analysis does not take away the inherent uncertainty of current unforeseeable events (Dixit & Pindyck, 1994).

Third, there is some ‘leeway’ about the timing of the investment (Dixit & Pindyck, 1994). For example, a capital investment can be delayed, which usually means that more information will become available about its likely future outcomes. The ability to delay is usually valuable because future events become more certain before making large, irreversible investment commitments (Dixit & Pindyck, 1994; Busby & Pitts, 1998). As a consequence, the decision-maker will not have to make unnecessary decisions and the uncertainty may be partially resolved as time passes (Busby & Pitts, 1998). Although there may be a cost in delaying an investment, such as the risk of pre-empting by competitors, or the cost of forgoing the initial outlay, it has been suggested that the benefit of waiting for new information is often larger than the cost of delay (Busby & Pitts, 1998; Dixit & Pindyck, 1994). The interaction of these three important characteristics, therefore, should be factored into optimal investment decisions (Dixit & Pindyck, 1994).

“Capital investment projects may be relatively ‘operational’ in nature or have a more ‘strategic’ focus” (Alkaraan & Northcott, 2006, p. 150). The ‘operational’ investment decisions tend to occur on a daily basis (Hopper et al., 2007). Often these projects can be implemented based on programmed decision-making procedures. Their likely future outcomes tend to sustain current operating activities and risks are well known by decision-makers (Gotze et al., 2008). Typical examples include expansion of existing assets, renewal or replacement of existing facilities, and investment in products or services which are related to the current operations of the organization (Gotze et al., 2008).

On the other hand, ‘strategic’ investment decisions tend to be directly related to business aims or objectives, and have a significant impact on the corporate future direction (Hopper et al., 2007). These projects tend to carry high levels of

uncertainty, produce unquantifiable outcomes, and affect the long-term corporate performance of the organization (Alkaraan & Northcott, 2006). Examples of strategic projects include the introduction of new production lines, the introduction of advanced technologies, acquisitions and mergers, research and development and e-business ventures (Block, 2007; Gotze et al., 2008; Hopper et al., 2007; Slagmulder, 1997; Van Cauwenbergh et al., 1996).

Organizations today face unexpected and fast changes in economic conditions, market developments and advanced technology. Many capital investment decisions involve substantial uncertainty and risks that result in the difference between their real cash flows and their expected cash flows from capital investments (Hammer, 2002). Capital investment conditions are often uncertain in reality because of the interaction of the listed three characteristics (Gotze et al., 2008). Both operational and strategic capital investment projects involve risk, but particularly strategic projects since their outcomes are less easily predicted and controlled, and lead to challenges for financial decision-makers in evaluating whether the project should be sanctioned under uncertainty (Abdel-Kader & Dugdale, 1998; Alkaraan & Northcott, 2006; Dempsey, 2003; Slagmulder, 1997). Managers as active agents in capital investment decision-making have great responsibility in planning for, managing and controlling capital investments effectively in a complex and uncertain business world (Cotter et al., 2003).

Traditional investment appraisal methods, such as the Discounted Cash Flow (DCF) rule assumes a static environment where the life of an investment is fixed and the expenditure pattern of the investment is predetermined (Majd & Pindyck, 1987). These methods ignore uncertainty and do not account for the effects of unforeseeable future events (Cheung, 1993). Such traditional methods tend to bias decision-makers against projects with build-in flexibility (Cotter et al., 2003). Therefore, traditional DCF-based analysis methods have been criticised for neglecting to value the flexibility embedded in some capital investment projects (Adler, 2000; Cheung, 1993; Copeland & Howe, 2002; Hammer, 2002; Pike et al., 1989; Myers, 1984; Slagmulder et al., 1995). Moreover, some alternative approaches such as sensitivity analysis and decision trees are not appropriate for evaluating

flexible projects under uncertainty, since such risk analysis methods fail to capture the inherent flexibility associated with capital investment projects (Busby & Pitts, 1998; Cotter et al., 2003).

Capital investment projects with high uncertainty, or likely qualitative outcomes, need investment appraisal methods different from those with foreseeable or financial outcomes (Gotze, et al., 2008). Further, where a capital investment project incorporates the possibility of flexibility, the value of this flexibility ought to be factored into the investment decision (Gotze, et al., 2008).

Real options analysis has been recommended as the most appropriate method to evaluate projects with high levels of uncertainty since it recognizes the value of project flexibility (Amram & Howe, 2002; Anderson, 2000; Barnett, 2005; Benaroch & Kauffman, 1999; Busby & Pitts, 1998; Cheung, 1993; Dixit & Pindyck, 1994; Trigeorgis, 1993; Trigeorgis, 1997). The concept of real options was initially derived from the financial option-pricing model in 1973 (Black & Scholes, 1973; Cox et al., 1979). Real options are associated with substantial investments in real assets such as property, plant, equipment, production lines and machinery whereas financial options are associated with investments in financial securities such as shares and bonds (Busby & Pitts, 1998).

ROA measures the value of flexibility (i.e. options) embedded in strategic projects, such as the potential to expand, defer, temporarily close down or abandon a capital project (Trigeorgis, 1993). Taking flexibility into account is important when evaluating capital investment choices because it allows managers to maximize future opportunities and minimize future losses as more information comes to hand (Barnett, 2005). The more flexibility within a capital investment project, the more value the project's inherent 'real options' produce (Schubert & Barenbaum, 2007). On the other hand, if a project lacks flexibility, an organization will be less able to make adjustments to it in response to strategic and competitive opportunities (Alkaraan & Northcott, 2006).

1.4 Research questions

The main purpose of this research is to examine how NZ Local Government Organizations take account of flexibility when evaluating capital investment projects, including whether they use ROA-type approaches. The research purpose is supported by six research questions to be examined via a survey questionnaire and follow-up interviews:

1. Have flexibility options been encountered in the capital investment projects of NZ LGOs and, if so, how many times does each type of option present annually?
2. Are the financial decision-makers of NZ LGOs interested in taking account of flexibility in capital investment projects?
3. Do NZ LGOs have any formal procedure or routine for identifying and/or assessing flexibility options when evaluating a capital investment project?
4. Are NZ LGO's financial decision-makers aware of the factors driving the value of project flexibility, and the terminology of real options?
5. What investment analysis methods are currently used to evaluate capital investment projects in NZ LGOs?
6. What investment appraisal methods are currently used to assess flexibility options, when evaluating a capital investment project in NZ LGOs?

1.5 Structure of the dissertation

The remainder of this dissertation is structured as follows. Chapter two will review and discuss the literature on flexibility and real options. It will focus on the issues associated with the recognition of flexibility embedded in capital investment projects and the value of real options in capital investment projects. Gaps will then be identified in the literature, thus establishing the need for this study.

Chapter three will detail the research methodology of this study and the use of both quantitative and qualitative research methods for data collection. Chapter four will

present the findings of the survey questionnaires and follow-up interviews, together with a discussion of the findings. Chapter five will present the study's conclusions, along with a review of its limitations and suggested directions for future research.

1.6 Summary

This chapter has provided an overview of the research objectives and background and outlined the dissertation structure. The next chapter will review the previous academic literature on flexibility and real options and related issues.

Chapter Two: Literature Review

2.1 Introduction

This chapter aims to review the literature on the flexibility inherent in capital investment projects, along with a review of how real options analysis recognizes that inherent flexibility, and captures the value of having flexibility in capital investment projects. First, the chapter discusses the importance of recognizing project flexibility when facing uncertainty, and introduces the different forms of flexibility embedded in capital investments. Next, the chapter explores the shortcomings of traditional appraisal analysis techniques and the shortcomings of alternative approaches in capital investment appraisal. Third, the chapter introduces an emergent appraisal technique – ROA, followed by a discussion of its origin, characteristics, types, value, limitations and challenges. The chapter concludes with an exploration of the usage of ROA in practice.

2.2 Recognition of the existence of flexibility in capital investments

2.2.1 The importance of having project flexibility

It is important to recognize embedded flexibility in capital investments since it can make a substantial difference to capital investment decisions (Copeland & Keenan, 1998). There are many uncertainties about variables in an organization's environment. Economic conditions of the business, market demands for a new product, and prices of raw materials, change constantly and unexpectedly (Anderson, 2000; Gotze, et al., 2008). Due to the effects of uncertainty, the real cash flows of many capital investment projects can be very different from what was expected initially (Hammer, 2002). However, for example, some sorts of uncertainty can be resolved by waiting, and managers are able to time a capital investment to take account of new information (Barnett, 2005; Busby & Pitts, 1998; Cheung, 1993; Yeo & Qiu, 2003). As new information comes to hand making future events become more certain, managers may be able to defer, expand, contract, or abandon capital

investments based on the extra information, in response to future market conditions (Hammer, 2002; Yeo & Qiu, 2003).

Flexibility is inherent in any capital investment project (Trigeorgis, 1993). The term ‘flexibility’ grants managers the capacity to adapt capital investment decisions quickly in response to a complex and uncertain environment (Trigeorgis, 1997). Busby & Pitts (1998) consider that without flexibility in managing capital investments, people would have to make irreversible commitments, because the initial expenditure of capital projects is unlikely to be recovered. It is risky making irreversible commitments in capital investments when facing uncertainty; being flexible in capital investment decision-making as new information arrives can help to mitigate the risk (Copeland & Keenan, 1998). The term ‘flexibility’ is therefore defined as *“situations where, for a time, we can avoid making irreversible commitments in the face of uncertainty”* (Busby & Pitts, 1998, p. 2). The identified flexibility will allow managers to change a course of action rather than remaining locked into it (Busby & Pitts, 1997; Busby & Pitts, 1998; Copeland, 2001; MacDougall & Pike, 2003).

The benefit of flexibility is expressed as *“keeping our options open”* (Busby & Pitts, 1998, p. 8). Flexibility grants managers some degree of freedom to achieve better outcomes than were initially expected (Bengtsson, 2001). It also gives managers opportunities to observe future events and to acquire further information before making irreversible investment decisions (Copeland & Howe, 2002) and allows them to re-plan an investment program to make the most profitable investment decision in the face of uncertainty and complexity (Cotter, et al., 2003). Being flexible in managing capital investment projects, grants managers the ability and influence to minimize the possibility of downside loss and to maximize a project’s operating cash flows over time (Yeo & Qiu, 2003).

2.2.2 Forms of flexibility

There are several forms that project flexibility can take, such as the ability to wait to see future events unfold, the ability to scale up or scale down the capacity of the project, or to switch between outputs or inputs of products or materials (Copeland &

Keenan, 1998). These forms of flexibility need to be taken into account since their value can be real (Mills et al., 2006).

Flexibility over the timing of a capital project is a common form for flexibility to take (Busby & Pitts, 1998). Timing is important in making an optimal decision for starting, altering, or abandoning a capital project (Anderson, 2000; Busby & Pitts, 1998; Trigeorgis, 1993; Trigeorgis, 2005). Most capital investments are at least partly irreversible and some decisions cannot be undone (Cheung, 1993). Managers' ability to 'wait to see' before making a crucial investment decision, and the ability to delay the implementation of a capital project are two key forms of managerial flexibility in the capital investment decision, as the optimal investment decision depends on choosing the right timing to start up capital projects (Cheung, 1993; Busby & Pitts, 1998).

Managers may be able to 'wait to see' what happens to prices or consumer demand patterns in the near future before making an irreversible decision to invest in a capital project (Cheung, 1993). The flexibility to 'wait to see' is valuable since it enables managers to make a decision about the optimal time to invest by giving the opportunity to discover future uncertain events (Brookfield, 1995). By ignoring the flexibility to 'wait to see', managers may make a wrong decision to carry out a capital project which could be costly to reverse should the outcomes of the investment turn out to be worse than expected (Busby & Pitts, 1998). For example, flexibility to 'wait to see' can be exercised when a particular product type is introduced in a marketplace. Managers can wait to see what happens to future market conditions, the product's prices, and market demands (Busby & Pitts, 1998). Managers do not have to make unnecessary decisions when some future uncertainty can be resolved just by waiting (Busby & Pitts, 1998).

Managers may be able to defer the implementation of a capital project until more favourable market conditions occur and a greater potential for achieving a high return of the investment presents (Anderson, 2000; Trigeorgis, 1993; Yeo & Qiu, 2003). *"Future decisions will be contingent on the arriving information."* (Hammer, 2002, p. 7). The flexibility to defer enables management to gather further information to make a more valuable investment decision (Yeo & Qiu, 2003).

Waiting for rich information might also allow managers to learn new ways of thinking and acting in response to future uncertain and risky events (Boehlje & Gray, 2004) and to watch the potential for market conditions to upturn (Yeo & Qiu, 2003). Several academic studies demonstrate that it is valuable for capital projects to be deferred because the deferment of investment creates new investment opportunities as new information arrives, and some of the uncertainty may be resolved thereby (Cheung, 1993; Kester, 1984; Trigeorgis, 2005; Yeo & Qiu, 2003). Busby & Pitts (1998) consider the flexibility to defer as sometimes the best course of action in the face of unexpected changes.

Changing the scale of capital projects is another form of flexibility (Busby & Pitts, 1998). Managers can scale up an existing capital project when it goes better than expected because market conditions are more favourable or market demand increases. An economy coming out of recession can also be seen as an opportunity to make expansionary decisions in order to maximize profitable opportunities (Anderson, 2000; Busby & Pitts, 1997; Trigeorgis, 1993; Yeo & Qiu, 2003). Alternatively, managers may be able to scale down a project or even abandon it in midstream when market conditions turn out to be worse than initially anticipated, in order to minimize losses (Busby & Pitts, 1998; Trigeorgis, 1993).

A further form of flexibility may be the flexibility to switch aspects of a production process (Busby & Pitts, 1998). Managers may be able to switch inputs or outputs during the course of a capital project to meet changing market demand, such as altering the input material of a production process depending on costs, or altering the output forms of products (Trigeorgis, 1993) so that the project's net payoff will be increased (Bengtsson, 2001; Cheung, 1993).

In the ways described, the value of a capital project can be affected by managerial flexibility (Mills et al., 2006). The more flexibility within the project, the more value it has to the organization (Busby & Pitts, 1998). Ignoring inherent flexibility in a capital project may result in managers making serious mistakes by undervaluing it (Feinstein & Lander, 2002). However, although flexibility in managing capital investments has the potential to mitigate the effects of complexity and uncertainty, conventional investment appraisal methods fail to capture its value (Busby & Pitts,

1998; Dixit & Pindyck, 1994).

2.2.3 Limitations of conventional investment appraisal methods

For decades, many empirical studies have found that conventional discounted cash flows (DCF) methods, such as Net Present Value (NPV) and Internal Rate of Return (IRR), are widely used in practice as the measurement of a capital project's desirability. This is especially true of the NPV method which was, and still is, the central capital investment appraisal method used in practice (Alkaraan & Northcott, 2006; Arnold & Hatzopoulos, 2000; Graham & Harvey, 2001; Ryan & Ryan, 2002). The DCF method is used widely by organizations, because its decision rules are sound and its calculation is relatively easy and straight-forward (Dixit & Pindyck, 1995).

These conventional investment appraisal methods suggest that capital investment decision-making should be based on the expected net present value of the project (Mills, 1995). The DCF rules anticipate future cash flows from a capital project, discounting them back to the present value at a risk-adjusted rate and subtracting the initial investment costs to estimate the net present value of the project. If the present value exceeds the project's investment costs that means the project has positive net present value (Copeland & Keenan, 1998). Under the DCF method, a capital project is deemed acceptable when the project gives a positive net present value, or has a high return, or a short payback period; otherwise, the project should be rejected (Busby & Pitts, 1998). However, many academic studies have criticized the DCF method as being inadequate for evaluating capital investment projects since it fails to capture the value of flexibility embedded in a capital investment (Adler, 2000; Cheung, 1993; Copeland & Howe, 2002; Hammer, 2002; Pike et al., 1989; Myers, 1984; Slagmulder et al., 1995). Cheung (1993) points out that "*DCF is likely to be biased against projects that have built-in flexibility.*" (Cheung, 1993, p. 1).

The DCF method assumes a static environment, where the life of a capital project is fixed and its expenditure pattern is predetermined without any consideration of the effects of uncertainty and changes that may influence the project's adoption (Cotter et al., 2003; Dixit & Pindyck, 1994; Hammer, 2002; Kaplan, 1986; Majd & Pindyck,

1987). The DCF method assumes a “now or never” proposition that means either a capital investment will be taken now, or will never be taken in the future (Dixit & Pindyck, 1994; Copeland & Keenan, 1998). These two assumptions imply that managerial commitment to the capital investment is passive and follows a fixed course of action during its economic life (Trigeorgis, 1993; Xie, 2009). In addition, the realization of cash flows is often opposite to what was expected originally (Parthasarathy & Cenatempo, 2001). The DCF method gives no guide in managing the course of a capital project from beginning to end when facing the uncertainties of changing market conditions (Copeland & Keenan, 1998). For example, there is no guide as to when to start a project, whether to alter the project once new information comes to hand, or whether to close down the project in midstream in response to future economic conditions (Mills et al., 2006).

The DCF model is highly formulated, and more useful for projects with well-defined cash flows over a short-term period in a stable environment than for evaluating projects which are strategic in nature and located in unpredictable changing environments (Cheung, 1993). The DCF method does not take the value of managerial flexibility into account but rather focuses on the estimated net present value of the project and, consequently, some strategic projects are systematically undervalued by these conventional methods since flexibility drives the value of the projects up or down (Copeland, 2001).

In practice, to overcome this shortcoming, organizations often combine the DCF method with other methods such as sensitivity analysis and decision tree analysis in order to better understand the effect of complexity and uncertainty (Busby & Pitts, 1998).

2.2.4 Limitations of alternative approaches in capital investment appraisal

Sensitivity analysis is a risk analysis technique that has been widely used in practice to assess the risk of capital investment projects (Arnold & Hatzopoulos, 2000; Pike, 1996). The technique examines how risky a project could be by identifying each of the determinants to which the project is most sensitive, and where more control

needs to be applied (Busby & Pitts, 1998; Gotze, et al., 2008). However, risk and uncertainty are two different concepts. The effect of risk can be quantified with a measureable probability, while uncertainty implies an effect that cannot be anticipated, measured and controlled (Savage et al., 2006). The risk analysis technique cannot compensate for conditions of uncertainty, for example, it does not account for the value of 'flexibility to withdraw' if facing economic recession (Busby & Pitts, 1998).

Decision tree analysis is another popular method to evaluate flexible capital investment projects since it reflects the range of flexibility embedded in projects (Busby & Pitts, 1998). Decision tree analysis provides a tree structure showing all possible outcomes of a project's cash flows, and shows the probability of occurrence of each potential outcome explicitly (Cotter et al., 2003). However, decision tree analysis is quite complex and cumbersome because a large number of potential outcomes and alternatives need to be considered when using this method to assess project flexibility options (Busby & Pitts, 1998; Cotter et al., 2003). Therefore, this method is only feasible in situations where few uncertain measures are incorporated (Gotze et al., 2008).

It has been noted that since conventional investment appraisal methods neglect to value the project flexibility, ROA has been advocated as an emergent analytical method to address the limitations of these conventional methods, as ROA recognizes the value of project flexibility and, therefore, creates value to organizations (Alkaraan & Northcott, 2006; Amram & Howe, 2002; Anderson, 2000; Barnett, 2005; Benaroch & Kauffman, 1999; Busby & Pitts, 1998; Cheung, 1993; Dixit & Pindyck, 1994; Trigeorgis, 1993; Trigeorgis, 1997; Yeo & Qiu, 2003). The following paragraphs will introduce the origin of real options, and explore more fully how real options can exist in capital investments and how the ROA method can value flexibility (i.e. options) embedded in capital projects.

2.3 Real options associated with capital investments

2.3.1 Origin of ROA

The concept of real options was initially derived from the financial option-pricing model of investment appraisal to determine the value of capital projects (Black & Scholes, 1973; Cox et al., 1979). In the field of finance, an option allows its holder to buy or sell a share of stock at a predetermined price within a certain time period (Copeland & Keenan 1998). A call option entitles the right to buy a stock, and the opposite is a put option which gives the right to sell (Copeland & Keenan 1998). The holder exercises an option only when the execution of the option can bring profits for the holder (Cheung, 2003).

By analogy, a real option gives managers a right, but not an obligation, to acquire an underlying capital investment (Barnett, 2005; McGrath & Nerkar, 2004). A real option creates the value of rights to future decisions (Copeland & Keenan, 1998). Managers may be able to cease an option if things go poorly and thus minimize the downside loss associated with capital investments, or may be able to exercise an option if things go well and thereby maximize future growth opportunities (Amram & Howe, 2003). Likewise, managers exercise an embedded real option in capital investments only when it has positive cash flow effects (Cheung, 2003).

Financial options are associated with investments in financial securities such as shares and bonds, whereas real options are associated with substantial investments in real assets such as property, plants, equipment, production lines and machinery (Busby & Pitts, 1998). The call option is most relevant to capital investment appraisal (Yeo & Qiu, 2003).

Myers was one of the first proponents of the term ‘real options’ (Myers, 1977). His study considered that ROA should recognize and capture the extra value arising from flexibility which was ignored by the conventional DCF methods in evaluating project investments. Dixit & Pindyck (1994) and Trigeorgis (1997) are two major textbooks considering real options theory. According to these authors, capital projects should not be launched merely to earn the opportunity cost of capital (Yeo

& Qiu, 2003). There are great opportunities for managers to choose the characteristics of capital investment projects, and to create many types of embedded options, thereby increasing their value (Yeo & Qiu, 2003).

2.3.2 Characteristics of real options

Real options have a close relationship with project flexibility. When a form of flexibility exists, real options thereby arise (Brookfield, 1995). Real options are defined as “*manifestations of managerial flexibility, each enabling management to respond to changing business and economic conditions.*” (Busby & Pitts, 1998, p. 17). Real options drive the value of a capital project over time in the uncertain business world (Copeland, 2001). Real options include actions that postpone a capital investment timing, expand or contract the production capacity of an capital project, alter the project in different stages over its life or abandon the project in midstream (Boute et al., 2004), as well as the selection of specific technology, products and markets (Yeo & Qiu, 2003).

Busby & Pitts (1998) point out that the value of a capital investment consists of “*value of investment if management had no flexibility of action plus value of managerial flexibility*” (Busby & Pitts, 1998, p. 7). Traditional DCF-based techniques are only able to account for an investment which has no flexibility, whereas ROA is able to apply to the total real investment since it also values the investment which has ‘built-in’ flexibility (Trigeorgis, 2005; Van Putten & MacMillan, 2004). The role of ROA is to identify and quantify the value of crucial decision choices in regard to flexible projects (Busby & Pitts, 1998). This value is viewed as the option premium, which is the cost of acquiring the valuable real option(s) (Busby & Pitts, 1998). In return for this payment, real options offer the organization an opportunity to take advantage of managerial flexibility in response to uncertainty (Busby & Pitts, 1998).

ROA represents extra value in the underlying asset investments, since managers have the right to exercise the project under favourable market conditions or lapse the project under unfavourable conditions (Anderson, 2000). ROA also recognizes the effects of uncertainty: the higher the uncertainty during the economic life of a

capital project and the higher the volatility of the project's future cash flows, the more valuable the options, since they will result in more value added to the capital project (Cotter et al., 2003). ROA allows managers to exploit investment opportunities by exercising only those flexibility options it expects to have positive cash flow effects (Mills et al., 2006). Therefore, their value always exceeds, or is at least equal to zero (Gotze et al., 2008).

2.3.3 Types of real options

Typically, the investment process starts in a business scenario by identifying an opportunity to make a capital investment (stage 1: identify investment opportunity); then a decision is formed to begin the investment associated with this investment opportunity (stage 2: form an investment decision); an action related to investment in real assets is taken by purchasing new equipment or taking on internal developments (stage 3: implement the decision); and afterwards, a substantial asset is put into use (final stage: operate the asset). Investment behaviour is normally expected to produce an outcome of generating profits, or saving costs, for the organization (Busby & Pitts, 1998).

There are different types of real options to match the various types of project flexibility discussed earlier. They occur at different stages during the process of the capital investment: before the investment starts up, an option to postpone can be exercised; once the investment is carried out, an option to expand, contract, stage, or even abandon the investment can be exercised (Busby & Pitts, 1998). These options are viewed at the outset of the investment appraisal analysis of a capital project and throughout its entire life (Copeland, 2001). The following paragraphs will explore these main types of real options which often present in a capital investment project.

- **The option to postpone a capital investment project**

Before a capital investment is carried out, there is an option to postpone the investment (Busby & Pitts, 1998). The option is valuable because it allows the management an opportunity to postpone the investment until the uncertainty is resolved by waiting, instead of committing to an irreversible investment in the face

of uncertainty (Cotter et al., 2003). Cheung (1993) pointed out that this option implies that the decision-maker should not miss the opportunity to take into account the alternative of investment at a future date, even if it is considered worthwhile to invest in the capital project at present. The postponement option is a useful way to consider an optimal time to start up an underlying asset investment (Anderson, 2000). The life of the option to postpone can be very flexible, either over a short-term period, such as when to enter a new market, or over a relatively long-term period, such as when to extract exhaustible natural resources like petroleum and minerals (Bowe & Lee, 2004).

The postponement option can also be exercised in real estate development (Trigeorgis, 1993). There may be a case for exercising the option to postpone when an organization has an opportunity to purchase a piece of land. A decision-maker might wait to see what happens to the output prices before developing the land so that the costs of development can be justified (Trigeorgis, 1993). The value of the option to postpone an irreversible investment in the face of uncertainty has been justified by some academic studies; including Brennan & Schwartz (1985), Ingersoll & Ross (1992), and Paddock et al., (1988).

- **The option to abandon a capital investment project**

Once a project investment is carried out, there may be an option to abandon the investment (Busby & Pitts, 1998). The option to abandon gives the management an opportunity to abandon a current investment in midstream if the outcome of the investment is presumed to be severely costly, and market conditions are extremely unfavourable (Trigeorgis, 1993). This option is valuable because it gives up future cash flows in exchange for the scrap value of this project and, in consequence, the scrap value of the project will be saved and future losses avoided (Copeland & Keenan, 1998). In such situations, the objective of value maximization is to minimize the project's downside loss by liquidating the project early (Cotter et al., 2003).

Before launching a capital project, the project's profitability level is always predetermined; if the outcome of the project is below the profitability level, then the

project will be ceased and the remaining resources will be redeployed in another project or resold in second-hand markets (Fichman et al., 2005; Trigeorgis, 1993). McDonald & Siegel (1986) imply that an alternative way to deal with such situations would be that the abandonment decision be postponed until the project's value is substantially lower than the project's scrap value. However, under the worst market environment, the earlier the abandonment option is exercised, the higher the resale value of the assets (Cheung, 1993). This option is important in airlines, railroads and similar capital intensive industries, new production introductions, and merger and acquisition projects (Trigeorgis, 1993). The value of the option to abandon a project has been justified by studies including Grinyer & Daing (1993) and Myers & Majd (1990).

- **The option to expand or contract a capital investment project**

Once a capital investment project is initiated, there is an option to expand it (Busby & Pitts, 1998). The option to expand is expressed as *"if things go well, then we'll make the next investment"* (Amram & Howe, 2003, p. 10). This option is valuable as it confers upon the management an opportunity to scale up an investment or accelerate resource utilization if the initial investment turns out beyond expectations with more favourable market conditions (Busby & Pitts, 1998). The decision to expand is based on the arriving information, with the objective of maximizing the potential return of the project (Hammer, 2002). This option can be exercised in infrastructure projects, high technology projects and research and development (R&D) projects, all of which create future growth opportunities by generating a new product or accessing a new market (Cheung, 1993). The option to expand the investment can be viewed as a part of the total return if the investment generates future cash flows (Cheung, 1993).

The option to contract is the opposite of the option to expand. This option is valuable in that it gives the decision-maker an opportunity to scale down a capital investment if the initial investment turns out to be worse than expected owing to less favourable conditions in the marketplace, thus saving at least a portion of the costs of implementing the project (Trigeorgis, 1993). Sometimes an organization is suffering a disappointing outcome or an unfavourable market environment and, in

these circumstances, the organization typically prefers to contract the size of the production plant or equipment (Trigeorgis, 1993). By scaling down the capacity of the plant or equipment, the organization will be able to reduce maintenance costs (Trigeorgis, 1993).

The value of options to expand or contract an investment has been justified in some academic studies including Brennan & Schwartz (1985) and McDonald & Siegel (1985).

The options to expand, contract and abandon a capital project can be viewed as operating options since they deal with the operation of real assets. These options offer the decision-maker a great deal of power to revise the scope, scale and timing of an underlying investment (Cheung, 1993; Trigeorgis, 1993; Trigeorgis, 2005).

- **The option to stage a capital investment project**

The option to stage can be viewed as a series of investment outlays that enable a decision-maker to make further investment decisions at different stages of the project (Trigeorgis, 1993). This option is valuable since it confers an opportunity to save investment resource by making a portion of the investment in one period, and holding the rest of it to the next period (Trigeorgis, 1993). Moreover, the management has the opportunity to abandon the investment in midstream if further information is less favourable than expected and, thereby, to save investment resources and minimize the possibility of loss eventually (Trigeorgis, 1993). This option can be exercised in R&D intensive industries, such as new drug development and large-scale construction plants (Trigeorgis, 1993). The value of the option to stage an investment project is confirmed by studies including Herath & Park (2002) and Majid & Pindyck (1987).

- **The option to switch the input or output mix of a production process**

The option to switch the input or output mix depends on changes in market prices or market demands (Trigeorgis, 1993). The option to switch inputs gives the management an opportunity to change the input mix (process flexibility) by altering the production materials such as electric power, sourcing and chemicals (Trigeorgis,

1993). The option to switch outputs gives the management an opportunity to change the output mix (product flexibility) by altering the forms of products (Trigeorgis, 1993). Cheung (1993) observes that the wider the choice of input or output of a production process, the more value resides in each option to switch and, thereby, the more productive the asset is. Computer-integrated manufacturing industries can be viewed as a good example of exercising this option (Cheung, 1993). The value of the option to switch input or output mix is considered by the study of Kaplan (1986).

- **The growth option**

Kester (1984) considers that because technology grows and the environment changes so rapidly, the value of many leading organizations will come mostly from future investment opportunities rather than from current ones. Cheung (1993) considers that *“a project may generate future growth opportunities in addition to cash flows. Such growth opportunities are commonly referred to as growth options.”* (Cheung, 1993, p. 13).

Strategists consider that some capital investments may not produce profits at present but have potential strategic benefits, and such benefits enable the organization to gain long-term benefits and financial success (Cheung, 1993). These projects are often leading-edge technology intensive. High-risk, R&D intensive, and infrastructure-based industries, are typically not-so-profitable initially, but tend to pave the way for entering a new market in the future, enabling organizations to earn future growth opportunities and long-term strategic benefits (Cheung, 1993; Hayes & Garvin, 1982; Trigeorgis, 1995). From the strategic perspective, the opportunity offered by growth options can be worth even more than the current net present value of the project (Kester, 1984). Therefore, these presently not-so-profitable investments may be thrown away inappropriately (Busby & Pitts, 1997).

For example, there may be a case for exercising a growth option when an initial investment in a computer network to send and receive email and to share blog diaries, creates an option to extend the network and to establish shared databases as a result of the increased hit rate and market demand (Busby & Pitts, 1998). Such an option can be exercised in high-tech, R&D and infrastructure-based projects

(Trigeorgis, 1993). The value of the growth option has been justified by some academic studies including Kester (1984) and Trigeorgis (1988).

All of above real options are valuable in a capital project as they give a wider choice for exercising the embedded flexibility and add extra value to the investment (Busby & Pitts, 1998). This extra value can be viewed as establishing some fundamental insurance for the initial investment project (Busby & Pitts, 1998).

2.3.4 Value of real options

Real options analysis (ROA) provides formal procedures for evaluating embedded options in capital investments: the Black-Scholes option pricing model (Black & Scholes 1973) and the binomial model (Cox et al., 1979) are two common ROA methods (Block, 2007). A binomial model will produce two outcomes by either upward or downward changes in the value of the underlying capital investment over a certain period of time (Busby & Pitts, 1998). The Black-Scholes model is more complicated than the simplistic binomial model and requires five variables: the value of the underlying asset, the exercise price, the risk free rate of interest, the length of time to maturity or expiration date, and the volatility of the underlying asset (Block, 2007). The following five key factors are all present in the Black-Scholes calculation and therefore are brought to the attention of the managers (Busby & Pitts, 1998; Block, 2007).

The price of the underlying asset represents the present value of the capital project without the value of any inherent project flexibility (Copeland, 2001). The present value of the cash flows from the project without flexibility is the most unbiased estimate of the market value of the project (Copeland & Antikarov, 2001). This is because, for example, once an expansion option is exercised, the future operation of the project will scale up, which will lead to a new value of the project at the cost of the additional investment (Copeland, 2001). The greater the price of the underlying asset, the more valuable the option will turn out to be since the underlying asset's market price will be higher than the exercise price of the asset (Schubert & Barenbaum, 2007).

The exercise price represents the initial cash outflow of the option to be exercised (Copeland, 2001). The lower the cash outflows payable, for example, for the option to expand the investment, the more valuable the option to expand is (Copeland, 2001). On the contrary, the higher the cash outflows, the less valuable the option is (Gotze et al., 2008).

The risk-free rate of interest has a positive influence on the present value of an exercisable option (Copeland, 2001). When the level of interest rates goes up, the discount rates will go up, and the present value of future cash flows for the underlying asset will go down, because the exercise price can be paid in the future (Copeland, 2001). Therefore, the higher the risk free rate of interest is, the greater the value of the exercisable option (Schubert & Barenbaum, 2007).

The length of time to maturity represents the maximum time over which a capital investment project can be postponed with positive influence on the value of flexibility (Copeland, 2001). For example, the longer the option to postpone exists, the greater the opportunities to observe future unforeseeable events before the irreversible commitment needs to be made and, therefore, the more valuable the option is (Schubert & Barenbaum, 2007).

The volatility of the cash flows of a capital project has a positive influence on the value of an exercisable option(s) (Copeland, 2001). For example, managers will scale up the investment project only if the value of the option to expand is higher than the cost; the option to expand will otherwise be worthless (Copeland, 2001). However, a situation where the value of expansion can exceed the cost often occurs if the value is volatile (Copeland, 2001). Therefore, the higher the level of volatility, the more valuable the option (Schubert & Barenbaum, 2007).

The five factors above need to be taken into account because they are likely to affect the value of real options when a flexible project is assessed and analysed (Gotze et al., 2008). Even where the value of the real option (i.e. flexibility) is not calculated using formal ROA analysis, a manager who is aware of how these factors might affect the value of a capital project is likely to make a better informed decision when valuing the potential investment. Hence, awareness of ROA concepts is a useful tool

in capital investment decision-making (Busby & Pitts, 1998; Copeland, 2001).

2.3.5 Limitations and challenges of real options

While ROA is theoretically preferred when accounting for inherent flexibility associated with capital investment projects, several empirical studies show that practitioners still prefer to use conventional techniques in capital investment appraisal (Alkaraan & Northcott, 2006; Block, 2007; Bowman & Moskowitz, 2001; Busby & Pitts, 1997). Cotter et al., (2003) point out that since ROA is a relatively new analysis tool and its calculations are mathematically complex the wide use of ROA has yet to become a reality in many organizations. The following paragraphs will explore several barriers to the use of ROA identified by Block (2007).

The first main reason is that top-ranking management may not support the use of real options (Block, 2007). The ROA is conceptually difficult and incorporates a number of complicated calculations. Corporate managers are, therefore, discouraged from employing an investment appraisal technique which they cannot follow step by step (Busby & Pitts, 1997). However, Amram & Howe (2002) suggest that the real options approach can be made very simple and useful to managers. The structure of real options can be simplified as “*pay now, decide later*” (Amram & Howe, 2002, p. 10).

The second reason is that NPV remains the preferred investment appraisal method because it is a proven technique in project evaluation (Block, 2007).

The third reason is that the ROA requires a high degree of technical sophistication (Block, 2007). Managers with a background in engineering or the sciences may show more willingness to employ ROA than managers with an accounting or commerce background (Block, 2007).

The last one is that real options may encourage extra risk-taking (Block, 2007). This reason is consistent with Van Putten & MacMillan’s (2004) study, which found that CFOs viewed ROA as over-estimating the value of projects with high uncertainty, thus encouraging managers to over-invest in them.

Although ROA is not fully accepted by many organizations, many top-level managers are aware of the importance of identifying inherent flexibility in capital investment projects and do use real options thinking to assess embedded flexibility in an intuitive or qualitative way (McGrath & Nerkar, 2004).

2.4 Real options in practice

As outlined, although ROA has been advocated as the most appropriate technique in evaluating capital investment projects under uncertainty, its use in practice remains weak (MacDougall & Pike, 2003) and the formal approach of ROA methods has not been applied by most organizations (Busby & Pitts, 1997; Cotter, 2003). However, there is some evidence that heuristic ROA-type thinking is used in practice.

A survey conducted by Howell & Jagle (1997) observed how managers price options into their investment projects. A group of managers were given several case studies regarding investments which have embedded growth options in order to examine how these managers would value the options. The study found that managers recognized the embedded options associated with capital investment projects and understood the effect of them on the value of projects. However, the study also found that these options were generally undervalued or overvalued by managers. Their study thus suggested that managers may recognise project flexibility but they generally were unable to value project flexibility accurately.

Busby & Pitts (1997) conducted a survey regarding how financial decision-makers assess flexibility in capital investments, along with an investigation of the use of real options in practice. The study found that the surveyed managers generally assess project flexibility when evaluating a capital investment project to be sanctioned, and in about half the cases, the project flexibility had been considered as necessary for the underlying investments. However, the surveyed managers rarely incorporated the abandonment option into the project evaluation. The study also found that academic studies focused on methods with mathematical solutions to the value of real options, rather than acknowledging the potential benefits of ROA-type heuristics.

More recently, Block (2007) conducted a survey to investigate real options usage in practice and to analyze resistance to the use of real options. His key findings indicated that only 14.3% of the respondents were real options users, and they were located mainly in technology, energy and utilities industries. The real options method was mainly used in new products introduction, and research and development, since these two areas present a high degree of uncertainty. 85.7% of the responders did not use real options, mainly because of a lack of top management support, and managers preferred to use discounted cash flow analysis. However, 43.5% of Block's nonuser respondents said they would consider employing real options in the future.

2.5 Summary

Given the increased complexity and uncertainty in today's competitive environment, it has been argued that traditional DCF capital investment analysis methods are inadequate since they neglect to value the flexibility embedded in some capital investment projects.

Real options analysis has been advocated as a means of addressing the limitation of DCF since it identifies uncertainty and recognizes the value of the flexibility inherent in some capital investment projects. Taking flexibility into account is important when evaluating capital investment choices because flexibility adds value by allowing managers to maximize future opportunities and minimize future losses as more information comes to hand (Barnett, 2005). The more flexibility within a strategic project, the more value its 'real options' produce (Schubert & Barenbaum, 2007).

Several papers discuss the use of ROA in the private sector and these studies have found that flexibility produces real value to organizations (e.g., Adams 2004; Block, 2007; Busby & Pitts, 1997; Chen et al., 2009; Hartmann & Hassan, 2006). However, while flexibility is often inherent in capital investment projects and influences how financial managers appraise them, few managers seem to understand the term 'real options' or to use formal procedures to appraise flexibility when making a capital investment (Busby & Pitts, 1997).

In the public sector, there have been few studies of how flexibility is taken into account in evaluating strategic capital investment projects, even though capital investment decisions are amongst the most important made in the public sector (Schubert & Barenbaum, 2007). Many public sector investment projects are 'strategic and lengthy' with multiple sources of uncertainty, including changes in user demand, technology, public priorities and political agenda (Schubert & Barenbaum, 2007). Therefore, taking flexibility into account is important when evaluating public sector investment choices.

The purpose of this research is two-fold: to explore how NZ local government decision-makers take account of flexibility in their capital investment decision-making; and to investigate whether they use ROA-type approaches in practice. This will be the first empirical study to examine this issue in the context of New Zealand public sector organisations. The method used to carry out this study is outlined in the next chapter.

Chapter Three: Research Methodology

3.1 Introduction

This chapter explores and discusses the research methodology applied to investigating the research questions outlined in the introductory chapter. First, the research approach is explored, along with a discussion and explanation of the particular research strategy used. Second, the research design is developed, followed by a consideration of ethical issues associated with the selected research methods. Next, the dual data collection approach is described. Finally, the approaches used to analyze the information gathered are discussed.

3.2 Research approach

This study aimed to examine how financial decision-makers take account of project flexibility, and to explore their perspectives on using ROA-type principles/thinking to assess project flexibility as part of investment appraisal in a public sector context. ROA has been introduced in practice because of its unique merits, its ability to recognize and quantify the value of project flexibility. There has been no research exploring the experience of dealing with project flexibility in NZ LGOs and no research on understanding different attitudes towards assessing project flexibility in investment appraisal, or of using ROA-type principles/thinking in NZ LGOs: hence the impetus for this research.

The purpose of investigating people's behaviour on project flexibility and real options falls within the category of exploratory or descriptive research. The purpose of exploring people's perspectives on project flexibility and real options tends to be explanatory or analytical in nature. A quantitative approach typically allows for a breadth of knowledge since it uses large sample sizes to test hypotheses and provides generalizations from samples to populations, while a qualitative approach enables a depth of knowledge as it uses small samples to develop theories and provides deep insights from one setting to another (Bryman & Bell, 2007). This research called for mixed methods, integrating quantitative and qualitative

approaches within a single project in order to address questions established in the Introductory chapter (Bryman, 2008). A quantitative method as the primary method was employed to explore or describe people's behaviour on the issue of dealing with project flexibility when evaluating capital investment projects. A qualitative method, as follow up, was applied to explain or analyse attitudes towards taking account of the flexibility associated with capital investments and ROA-type thinking in practice.

A triangulation approach was applied. This approach combined the mixed methods' findings so that they could be mutually reinforced or corroborated, giving greater confidence in the overall research findings (Bryman, 2008). A triangulation approach can also be described as a process of cross-checking findings deriving from mixed methods, as used in this study (Bryman, 2008).

3.2.1 Survey questionnaire

It is important to choose an appropriate research strategy to achieve the purposes of the research (Altinay & Paraskevas, 2008). There are two common research strategies applied in quantitative research methods: one is the survey approach, the other is experimentation approach (Altinay & Paraskevas, 2008). The survey approach was applied in this research since it was appropriate for gathering cross-sector information from a large number of individuals in a relatively short period (Marshall & Rossman, 1999). The survey approach helped to measure financial decision-makers' behavior and thoughts in a quantifiable term, providing a convenient way to generalize about capital investment decision-making practice in the NZ local government context (Collis & Hussey, 2003). A descriptive survey approach was employed to achieve this research purpose since it helped to produce well-defined findings from the primary data collection and these findings could be portrayed and/or explained in a numerical manner (Singleton Jr. & Straits, 1988; Collis & Hussey, 2003). Moreover, the descriptive survey helped to find out the views of NZ LGOs decision-makers on the issue of project flexibility and ROA-type principles in investment appraisal (Collis & Hussey, 2003).

The use of the questionnaire survey was intended to collect data across the LGO sector in an objective way, therefore minimising personal bias (Sarantakos, 1998). Some empirical studies on real option analysis and related themes such as Busby & Pitts (1997) and Block (2007) have used similar questionnaire surveys to explore the use of ROA-type principles in evaluating capital investment projects. Respondents were asked to answer a written set of structured questions aimed at finding out what they do (Collis & Hussey, 2003). The survey questionnaire is able to gather sector-wide information from a large number of individuals quickly at a relatively cheap cost (Singleton Jr. & Straits, 1988). This survey questionnaire was mailed to 86 responding LGOs in New Zealand at the same time in various locations (Bryman & Bell, 2007). It was a convenient and flexible method for these 86 NZ LGOs, since they could complete the questionnaire at any time, anywhere (Bryman & Bell, 2007).

3.2.2 Follow-up interview of semi-structure

Although the survey approach is capable of producing precise numerical results, and provides generalization, this method fails to provide insights of people's views and thoughts (Bryman, 2008). Also, this quantitative approach may fail to provide opportunities for probing and clarifying respondents' answers and does not allow respondents to discuss further relevant issues that are salient to them (Bryman & Bell, 2007). In order to overcome these potential problems, this study also used a qualitative interview approach, which has been widely employed in qualitative research for the purpose of gaining in-depth and rich information (Taylor & Bogdan, 1998).

For this research, a follow-up interview of a semi-structured nature was employed to probe the interviewee's response and obtain more in-depth information about real life situations concerning LGO decision-makers: how they deal with the flexibility of capital projects; and their perspective on the use of ROA-type thinking (Taylor & Bogdan, 1998, de Vaus, 2002). The follow-up interview was conducted by telephone. The major benefits of conducting telephone interviews are saving costs and securing interviewees' safety (Bryman, 2003). Some interviewees feel relaxed and comfortable if the interviewer is not presenting face-to-face. However, a potential

limitation of all interviews is that the researcher cannot assume what an interviewee says in one situation is what he or she will say in another (Taylor & Bogdan, 1998). This potential problem is reduced in this study since the research does not rely solely on data collected from interviewing, but also triangulates with data gathered from the questionnaire.

3.3 Research design

3.3.1 Sample size

The sample consists of all 86 NZ local government organizations, including regional councils, city councils and district councils. In order to achieve the aims of this research, the population sample is further defined as financial directors (CEOs, CFOs, financial managers or senior accountants). The rationale for surveying financial directors is that they are the people in the organization most likely to be involved in capital investment decision-making and who are therefore the most knowledgeable and appropriate people to complete the questionnaire.

For the follow-up interviews, 5 financial directors were selected from respondents who had completed the questionnaire, used ROA-type approaches in their LGO, and were willing to participate in the follow-up interviews. As financial decision-makers within local government organizations, they were an important source of relevant information for this research. Interviewing the selected financial directors was directed at providing information that might not have been apparent from the earlier questionnaire survey, but that was likely to be useful in answering the research questions for this study.

3.3.2 The design of the questionnaire

The questionnaire comprised 6 main questions which were then divided into 18 sub-questions. See Appendix D for a copy of the questionnaire. The first question explored the frequency of occurrence of types of flexibility (real options) in capital investment projects in NZ LGOs. The second question asked about whether the financial decision-makers of NZ LGOs are interested in dealing with inherent

flexibility in capital investment projects. The third question asked about any formal procedures or routines used to identify and/or assess flexibility options when a capital investment project is being evaluated. The fourth question examined the financial decision-makers' awareness of factors driving the value of project flexibility, as well as the awareness of real option terminology and related terms (operating options and growth options). The fifth question explored the investment analysis methods currently used to evaluate capital investment projects in NZ LGOs. The last question asked what investment appraisal methods are currently used to assess different types of project flexibility.

Three forms of response were used in the questions: numerical ratings, yes/no answers and open-ended responses. The closed questions were intended to make it easier for respondents to complete the questionnaire, and facilitated the processing of respondents' answers since they were pre-coded (Bryman & Bell, 2007). The closed questions also helped to enhance data comparability (Bryman & Bell, 2007). The open-ended questions allowed respondents to give their answers in their own words, thus exploring new perspectives that might not have been anticipated by the researcher (Bryman & Bell, 2007).

3.3.3 The design of the follow-up interviews

Several questions emerged from the questionnaire responses which needed to be followed up using semi-structured interviews. The interview guide appears in Appendix G. The selected interviewees were encouraged to recall an example of any capital investment project undertaken by their organization which had elements of flexibility, and to describe how the project's flexibility was considered. The interviewees were also encouraged to describe their own experience in dealing with any sort of capital investment project where flexibility might be important and valuable. Next the interviewees were asked to describe their own experience in using any investment analysis method to evaluate a capital investment project. Finally, the interviewees were encouraged to give their own views or thoughts as to the need for analysis tools in assessing the flexibility embedded in some capital investment projects.

3.4 Ethical considerations

Since this research involved human participants, ethical approval was required. An application for low-risk ethics approval was submitted to AUTECH before data collection began (please see Appendix A). A covering letter was sent to each respondent in order to explain the purposes and conduct of this research, along with an enclosed questionnaire (or interview guide) and the associated Participant Information Sheet (which further explained the respondents' rights and privacy related to this research). The Participant Information Sheet for questionnaire participants appears in Appendix B and the Participant Information Sheet for interviewees appears in Appendix E. In addition, each respondent was required to complete and sign a Consent Form and return it to the researcher in enclosed pre-paid envelope (refer to Appendix C). Respondents were invited to ask any questions related to this research if they had any (refer to Appendix F).

3.5 Data collection

3.5.1 The survey questionnaire

The data collection was carried out after an application for ethical approval had been accepted by AUTECH. Before mailing the questionnaire, a phone call to each LGO was made to explain the purpose of this research and how it would proceed. Then the set of formal written papers (described in section 3.4) was mailed to all 86 LGO financial directors to fill out. The respondents were given 17 days (from 07th April to 23rd April 2010) to complete the questionnaire and then return it with the signed Consent Form. A list of anticipated respondents was established in a spreadsheet in order to keep records of those who returned their completed questionnaire and signed Consent Form to the researcher, as well as to keep records of those who did not do so by 23rd April. It took five weeks to process the distribution and collection of questionnaires, from 01st April to 05th May 2010.

Since a mail questionnaire typically results in relatively low response rates, two tactics were employed to maximize the response rate to the mailed questionnaire. A cover letter was enclosed to explain the purpose of this research and to guarantee the

confidentiality of the information provided by respondents (Bryman & Bell, 2007). Also, follow-up emails were sent to non-respondents, reminding them to return their questionnaire (Bryman & Bell, 2007). One reminder email was sent to each anticipated respondent in the second week of the research period. Following 28th April, a second email was sent to remind those who had not yet returned their questionnaires. A soft copy of the questionnaire was attached to the second reminder email, in case the hard copy of the questionnaire sent initially had been lost.

In total, only 21 out of 86 LGOs returned their questionnaires, giving a response rate of 24.4%. Most of the completed questionnaires (19 of the 21) came through the post, while 2 were collected via email. Of the 21 LGOs, 14 LGOs indicated in their questionnaire responses that they were willing to participate in follow-up interviews and 5 of them were invited to participate in follow-up interviews by telephone during 17 to 28 May 2010. These selected 5 had all indicated in their questionnaires that they tended to use ROA-type approaches or thinking to evaluate capital investment projects. This study achieved a low but acceptable response rate of 24.4%, which is comparable to other studies in this field (e.g. Alkaraan & Northcott, 2006; Block, 2007). An explanation for non-responses was given via email by some non-respondents. Some non-respondents provided emailed explanations for their decisions not to participate. These reasons can be summarized into three main categories: (1) their organization was a small council with no major capital investment projects, (2) their organization had no time to complete the questionnaire due to high workloads at the time, (3) neither the financial decision-maker of their organization, nor any other person who might have been able to complete the questionnaire, was available.

3.5.2 The follow-up interviews

Before conducting the follow-up, semi-structured interviews, an email was sent to each selected interviewee to arrange a time for their interview. All five interviews were conducted by telephone from a room provided by AUT University, and lasted for 20-30 minutes each. The purpose of this research, interviewees' rights, and privacy during the interviews, were explained briefly before the interview began.

An interview guide was used to develop interview questions for each interviewee and to explore different ways to get them to enlarge upon 'yes' or 'no' answers (Taylor & Bogdan, 1998). The list of questions was sent to each interviewee in advance so that they could prepare. The interviews were tape-recorded where the interviewee permitted, to allow the researcher to capture more data than would be possible if she were relying on memory (Bryman & Bell, 2007). Interviewees' statements were cross-checked with their questionnaire responses for triangulation purposes (Taylor & Bogdan, 1998). After the five interviews, all tape-recorded responses were transcribed and analyzed.

3.6 Data analysis

"Analysis of data provides researchers with facts and figures that allow them to interpret results in the context of the community and to make statements about the significance of the findings for the individual and society." (Sarantakos, 1998, p. 328). During the process of data analysis, researchers gain a better understanding of the study they carried out while gathering in-depth data information, so that they are able to refine their interpretations continually (Taylor & Bogdan, 1998).

3.6.1 Quantitative data analysis

Descriptive statistics were employed to explore the data gathered from the questionnaire survey and numerical results were presented in graph, table, or chart form (de Vaus, 2002). Tabular analysis (such as frequency tables) and graphical analysis (such as bar charts and pie charts) are two common types of descriptive statistical method presentation used to help analyze univariate data (de Vaus, 2002). Tabular analysis and graphical analysis can be viewed as a language for communicating the distribution of numerical data effectively (de Vaus, 2002). Moreover, the data presented by these methods are simple and easy to understand (Nardi, 2006). Microsoft Excel 2007 was used to produce and present the data for this research.

During the process of data analysis, the first step was data preparation: namely, to code and categorize data from responses to questions by processing those into

summary variables in order to better address the aims of this research (Sarantakos, 1998). In this research, a numerical coding system was used to convert responses of closed questions into numbers. Likert scale responses, such as the frequency of consideration of project flexibility and the importance of project flexibility, were already in numerical form (de Vaus, 2002). Some questions such as the occurrence of project flexibility, the necessity for having project flexibility, and so on, were framed to draw a 'yes', 'no', or 'don't know' answer, and such answers were then simply coded as 1, 2, or 3 (de Vaus, 2002). For responses to open-ended questions presented in the questionnaire, coding was done by developing a descriptive coding scheme based on the themes of responses that arose (de Vaus, 2002). 'Missing data' codes were employed where the question was not answered (de Vaus, 2002). In this research, questions with no answers were considered as missing data and excluded from the data analysis.

The second step was data-editing and data-checking. Before moving on to the step of data presentation, it was essential to ensure responses appearing on a completed questionnaire were clear, legible and appropriate (Sarantakos, 1998). Moreover, all coded data were double-checked by the use of 'double entry data entry' in order to prevent any inconsistencies or bias (Sarantakos, 1998). The second entry data were matched with those entered the first time, and any inconsistencies or bias were therefore resolved on the spot (de Vaus, 2002).

The last step was grouping and presentation, namely to group the data and then present the distribution of the data in the form of frequency tables, pie charts or bar charts (Sarantakos, 1998). In this research, frequency tables were produced from analyses of Likert scale questions because they helped to show the frequency of each response offered by the survey participants to each question (Nardi, 2006). Well-designed pie charts and bar charts were used to present the analyses of other closed questions since they were a better way to visually present the proportions of responses in the two categories (Nardi, 2006).

3.6.2 Qualitative data analysis

For the follow-up interviews, a 5-steps data analysis model outlined by Sarantakos

(1998) was employed as follows. Since the 5 follow-up interviews were tape-recorded, the first step was to manually transcribe participants' responses verbatim from the tape. The next step was to check and edit the transcripts by resolving contradictions in the text or deleting typographical errors. During this step, notes and questions were labeled to assist the subsequent data analysis process. The third step was data analysis and interpretation: namely to develop categories, coding and data reduction. Coding is important for analyzing and following-up interview responses since these responses better reflect respondents' own language and understanding (Bryman & Bell, 2007). In this research, descriptive codes were generated by assigning a symbol or keyword to a section of text and categorizing the findings of the individual interviews into groupings based on the themes that emerged from the survey responses. The fourth step was to generalize the data by identifying similarities and differences in the interviewees' responses. The last step was verification: namely, checking the validity of interpretations by reviewing the transcripts and notes again, and then triangulating with data gathered from the questionnaire.

3.7 Summary

This chapter has outlined the research approach and described the two research methods used to gather data for this study. The use of a questionnaire survey was appropriate since it gathered sector-wide information from which to generalize about practice in NZ LGOs. The semi-structured follow-up interviews helped to probe individuals' experience in dealing with project flexibility and their perspectives on the use of methods for assessing project flexibility in the LGO context. This chapter has also outlined how these two forms of data were analysed.

The next chapter presents the findings derived from this analysis.

Chapter Four: Findings & Analysis

4.1 Introduction

As mentioned, the purpose of this study is to investigate how NZ LGOs take account of flexibility when assessing capital investment projects, including whether they use ROA-type thinking or approaches in practice. Chapter Three detailed the data collection and analysis process undertaken in this study. This chapter presents the findings and data analysis of the study, thus providing the information necessary to achieve the research objectives described in Chapter One.

4.2 Descriptive characteristics of respondents

4.2.1 Respondent demographic profile

The questionnaire respondents were asked to specify the type of LGO they worked for and their job titles. The results show that 3 regional councils, 4 city councils and 14 district councils participated in the survey (see Figure 1). The majority of the respondents were financial managers (12 i.e. 57%), followed by corporate accountants (including a financial planner and a controller) (5 i.e. 24%), with the remainder (19%) being Chief Executives, Chief Financial Officers, or General Managers. All respondents indicated they had an accounting and finance background. As explained in Chapter Three, these financial decision-makers are the best source of appropriate information for this research area and their input was expected to provide relevant answers to the research questions for this study.

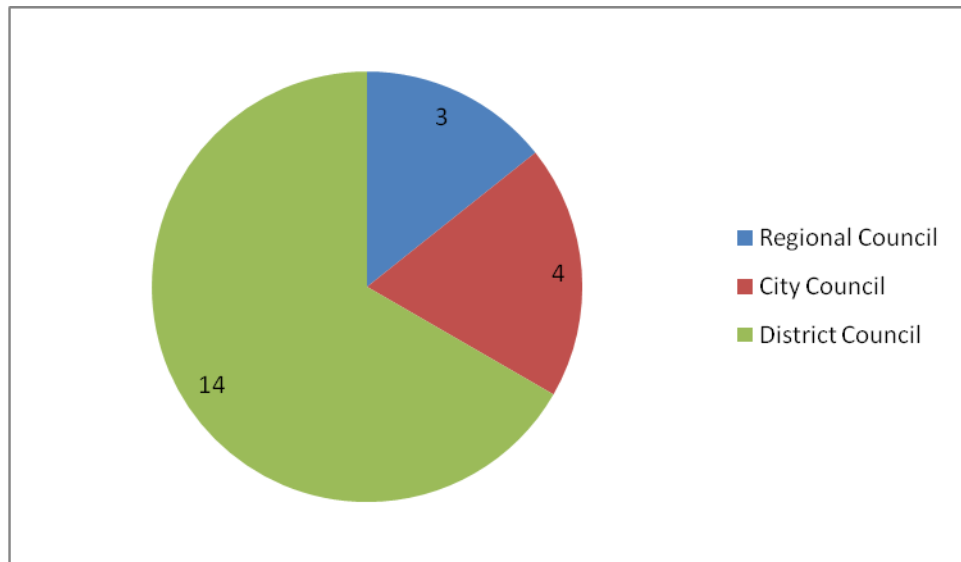


Figure 1: Types of LGOs responding to the questionnaire survey

4.2.2 Capital investment projects for LGOs

The respondents were asked to indicate the annual capital investment budget for their LGOs. The results are shown in Table 1.

Annual capital investment budget	% of responding LGOs
Under \$1,000,000	19%
\$1,000, 001 - \$15,000,000	39%
\$15,000,001 - \$30,000,000	14%
\$30,000,001 - \$45,000,000	14%
Over \$45,000,000	14%

Table 1: Annual capital investment budget ranges for responding LGOs

The respondents were then asked to specify the types of capital investment projects undertaken by their LGOs and their frequency (see Figure 2). Respondents were also allowed to make their own categorisations as to types of capital investment projects. The results indicate that various types of capital investment projects were undertaken in LGOs: nineteen out of twenty-one respondents indicated at least three types of capital investment were launched annually in their LGO. Most respondents were able to indicate the average number of capital investment projects their LGOs undertook annually, while two claimed to be unsure of the average number.

The most common type of capital investment project, constituting 47.5% of the total annual capital investment projects carried out in the 21 LGOs, was the “expansion of existing services or facilities”. Conversely, “mergers or partnership with another organization” were the least common form of capital investment in LGOs, carried out only 4 times (0.2%) a year on average across all the responding LGOs. The second least common form of capital investment in LGOs was R&D or technology improvement projects which constituted 0.5% of total capital investment projects implemented in LGOs, followed by divestments (0.9%). Respondents were encouraged to identify any other type of capital investment project undertaken in their LGOs annually. All indicated that the renewal or replacement of existing assets was carried out frequently in their LGOs, and these constituted 36.2% of total projects. Meanwhile, 2 indicated that the major focus of their capital investment program was plant and equipment, such as new water quality meters and infrastructure-type projects. Figure 2 indicates that strategic capital investment projects (such as merger or partnership and R&D projects) were undertaken relatively less often annually in the responding LGOs than were operational projects.

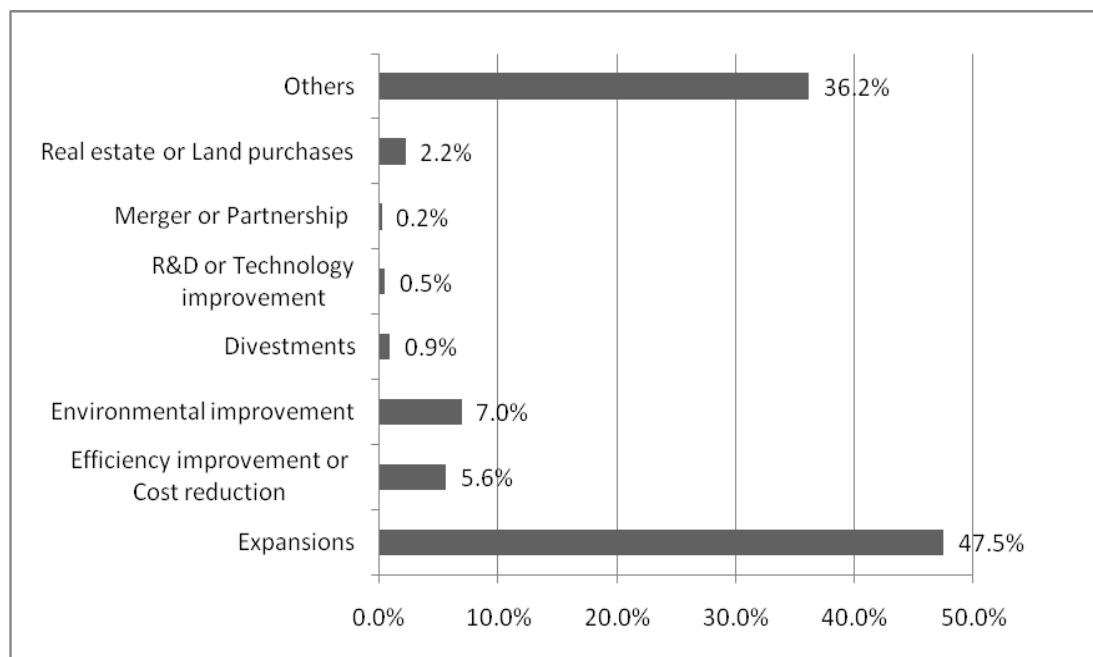


Figure 2: Types (and average annual proportions) of capital investment projects undertaken by the responding LGOs

Organizations with a high proportion of strategic capital investment projects (such as R&D projects, and acquisition or merger projects) would be expected to be better aware of the significance of flexibility in capital investment appraisal since strategic projects with high uncertainty have less easily predicted and controlled outcomes compared with ‘operational’ projects. Figure 2 suggests that there were more ‘operational’ capital investment projects (such as expansion of existing facilities or services and renewal of existing assets) launched in LGOs. Thus, it is possible that LGOs may lack knowledge of dealing with project flexibility and real options in capital investment appraisal.

4.3 Results from questionnaire survey and follow-up interviews

This section reports on several significant issues that emerged from the results of the questionnaire survey and further information obtained via follow-up interviews, and explores some narrative questions that encouraged respondents to describe their own experience with thinking of capital investment flexibility in their LGOs.

4.3.1 Consideration of flexibility in capital investment appraisal

Project flexibility is important in investment planning because it increases the initial project value: a flexible project will produce more monetary value than a rigid project (Feinstein & Lander, 2002). Table 2 summarizes how often the responding LGOs took the seven types of project flexibility options into account. The frequency of consideration was represented on a scale of 1 to 5, where a score of 1 represented project flexibility ‘never’ being considered (the lowest consideration), while a score of 5 represented project flexibility ‘always’ being considered (the highest consideration). The ‘don’t know’ answer was given a score of 0 and omitted from the weighted score calculation. The consideration of the given flexibility options is presented as a percentage of the total number of responses. Overall, each of the responding LGOs took into account at least 2 stated types of flexibility options in their capital investment assessments.

Table 2 suggests that the consideration of postponement options or staging options were the most frequent (as measured by the percentage reporting scores of 4 and 5), while the consideration of contraction options or abandonment options were the least frequent (as measured by the percentage reporting scores of 1 and 2). Expansion options or growth options were taken into account most of the time since most respondents (38%) assigned the scale of 4. 10% of the respondents assigned a score of 0 to abandonment options because they were not sure whether they had considered a project which could be abandoned later.

Importance (Score)	Staging	Expansion	Contraction	Postponement	Abandonment	Growth	Technical change
1	0	0	14	0	14	0	5
2	19	29	52	19	48	14	33
3	24	29	19	19	19	29	38
4	48	38	14	52	10	38	19
5	10	5	0	10	0	19	5

Table 2: Frequency of consideration of types of flexibility options in capital investment appraisal (percentage responses)

The option to postpone was the most commonly considered flexibility option, while the option to abandon was the least common. A similar trend is found in the empirical study of Busby & Pitts (1997), where the postponement option was the most frequent and the abandonment option was the least frequent in capital investment practice (Busby & Pitts, 1997). It is possible that the abandonment options were taken into account less often compared with other types of project flexibility, because this action was interpreted as project failure, or a fear of solid organizational commitment to investment projects. As a result, decision makers might have felt there was no need to create of an opportunity to abandon a project, even where this might have eventually proved a sensible alternative. The same suggestion applies to contraction options.

In this research, the option to stage was rated as the second most commonly considered flexibility option (measured by the percentage reporting scores of 4 & 5). It is likely that the responding financial decision-makers understood that this option

confers an opportunity to save investment resource by making a portion of the investment in one stage and holding the reminder to the next stages (Trigeorgis, 1993).

4.3.2 Existence of flexibility in capital investment projects in LGOs

Flexibility is inherent in any capital investment project (Trigeorgis, 1993). The respondents were asked to indicate whether the stated types of flexibility option existed for any of their LGOs' capital investment projects within the past 5 years. Figure 3 presents these results as a percentage of the total number of responses.

Capital investment staging options, expansion options and postponement options were identified as being relevant to 90% of the responding LGOs. Growth options also achieved a strong result, with 85% of respondents claiming to recognise them in their capital projects, while only 50-60% claimed that contraction or abandonment options had existed for their capital investment projects in the past 5 years. Five to ten percent of respondents were not sure whether abandonment options, contraction options, growth options or technical change options had existed in their LGOs' capital investment projects.

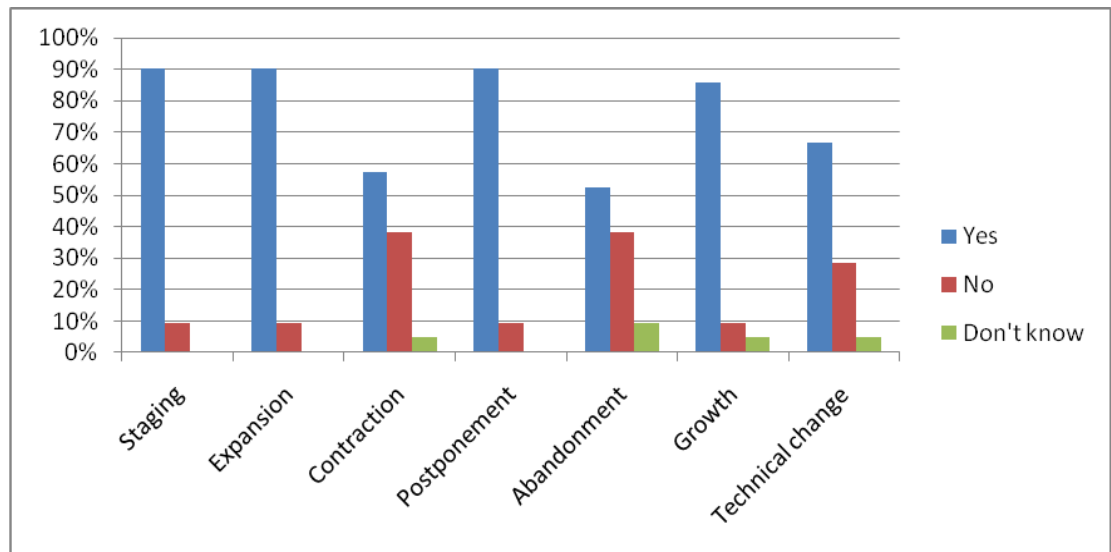


Figure 3: Existence of types of flexibility options in LGOs in last 5 years

Comparing the results with those in Table 2, the types of flexibility option that are taken into account most often also occur most often in the organization and vice versa, as one would expect.

Respondents were encouraged to recall any other type of flexibility associated with capital investment projects that were not listed above. Table 3 summarizes survey responses recording the additional types of project flexibility and the number of times they were mentioned. Three respondents indicated that funding options were always taken into account when evaluating a capital investment project. Two responses concerned timing issues regarding the completion of a project. One respondent mentioned asset ownership and service delivery options as part of many different determinants on the decision-making path. A further response mentioned scope options regarding the size of projects. However, the consideration of funding options, asset ownership options and service delivery options are a matter of financial and strategic factors, not related to the field of real options (Trigeorgis, 1993; Busby & Pitts, 1997; Busby & Pitts, 1998).

Other types of project flexibility	Number
Funding options	3
Timing options	2
Asset ownership options	1
Service delivery options	1
Scope options	1

Table 3: Additional types of project flexibility mentioned by survey respondents

The five selected interviewees were encouraged to specify types of capital investment project launched during the past 5 years that had inherent valuable project flexibility. The following are some examples of quotations by the interviewees regarding their experience in taking flexibility into account when evaluating capital investment projects.

“We are building a new art gallery and museum building, but the project is deferred as the result of the global recession last year...we have flexibility on the start date and we have flexibility on how we are going to fund it. So there was a whole lot of

flexibility we needed to think about.”

(Council Financial Director, Telephone Interview, 28th May 2010)

“We are doing an extension project which includes the provision of an ice rink. I think we had to abandon the ice rink because of the costing for it ... we had to change the project in that respect in order to mitigate losses.... We don't regularly abandon a project without a lot of consideration and discussion with the affected people. In this case, the ice rink was an add-on that would be nice to have if that could work financially, but in the end, we couldn't make it work financially, so it just had to fall off the project.”

(Council CFO, Telephone Interview, 26th May 2010)

“We have a plan to purchase a piece of land that we need for building a new pond...The initial proposal said ‘that's the piece of land that we want’, but that piece of land is too expensive so we cannot afford it. We will have to defer this project proposal and see if the future price of the land will be decreased.”

(Council Financial Manager, Telephone Interview, 28th May 2010)

“We have a project related to water supply. We are investing in changing consumer behaviour. For example if we can reframe it from wasting water that is in the network by making sure the network is maintained and the links are contained and also modifying consumer behaviour so that they are restricting their use in times of high demand and we can put off the capital investment indefinitely.”

(Council Financial Manager, Telephone Interview, 26th May 2010)

“We've got a big project which ... incorporates improved technology for the treatment of waste water. The project provides a higher environmental standard...There is the opportunity to build into the project that we can add to the treatment plant and the waste water disposal fields when that additional capacity is required, so we make sure that we are keeping up with the increased demand.”

(Council General Manager, Telephone Interview, 26th May 2010)

Table 4 summarises the types of flexibility (options) identified by these five interviewees.

Types of investment projects	Inherent flexibility
An art gallery and museum building	Postponement
Ice rink	Abandonment
A project related to water supply	Expansion
Land purchasing	Postponement
New treatment plants for waste water treatment	Technical changes

Table 4: Types of capital investment projects associated with inherent flexibility during the past 5 years (summarized from 5 telephone interviews)

4.3.3 Importance of flexibility

Table 5 summarizes the perceived attractiveness of each type of capital investment project flexibility option. The score of 1 to 5 represents the degree of importance of flexibility: a score of 1 represents project flexibility perceived as absolutely unimportant to the attractiveness of an investment opportunity, while a score of 5 represents project flexibility being extremely important. A score of 0 represents the ‘don’t know’ answer and this option was omitted from the weighted score calculation. The importance of the listed flexibility options were presented as a percentage of the total number of responses. In general, most respondents indicated their desire to have flexibility in capital investment projects. Only a few respondents did not consider any of the listed project flexibility types to be important. 5% of the respondents assigned a score of 0 to all listed flexibility options because they were not sure whether the capital investment projects would be made more attractive by the listed project flexibility types.

Of those who scored this issue 5 (extremely important), 19% of respondents showed their greatest desire for growth options, while no respondents showed their desire to have contraction options. A high number of respondents (52%) indicated that it was very important to have expansion flexibility in capital investments, followed by

growth flexibility, which was supported by 48% of respondents, and staging flexibility, which was picked by 43% of respondents. On the contrary, the desirability of flexibility to abandon and flexibility to contract were considered unimportant in capital investment projects by 19% and 14% of the respondents respectively.

These results suggest that organizations that desire project flexibility might be more likely to employ ROA-type thinking /principles than those that desire it less. This is because ROA is designed to capture the value of flexibility in capital investment projects. However, Howell & Jagle (1997) found that managers recognize inherent project flexibility in a capital investment, but they could not accurately value the project flexibility which resulted in undervaluing or overvaluing the project.

Importance (Score)	Staging	Expansion	Contraction	Postponement	Abandonment	Growth	Technical change
1	0	0	10	0	19	0	0
2	5	10	43	14	43	5	19
3	33	29	24	29	14	24	33
4	43	52	19	43	14	48	38
5	14	5	0	10	5	19	5

Table 5: Importance of flexibility options to the attractiveness of a capital investment opportunity (percentage responses)

Comparing Table 2 and 5, a positive relationship is evident between the frequency with which a certain type of flexibility is taken into account and the perceived importance of that type of flexibility. It would appear that the more frequently a flexibility option is considered, the more important it is deemed to be. It seems likely that financial decision-makers are more inclined to recognize project flexibility in the types of project that they consider to be important. Alternatively, it might be that financial decision-makers consider the types of project flexibility that occur most frequently in their investment appraisal to be the most important ones.

4.3.4 Advantage of having flexibility in capital investment projects

The benefits of having flexibility in capital investments were outlined in Chapter Two. Respondents were asked to indicate whether their organization was able to benefit from inherent flexibility in any capital investment project during last 5 years (see Figure 4 below). The results show that at least 33% confirmed perceived benefits in having the stated types of flexibility associated with capital investment projects.

Over 85% of the respondents indicated that they had taken advantage of the staging option and the postponement option in organizational capital investment projects in the past 5 years. The contraction and abandonment options emerged as the least likely to be used, with more than 45% of respondents claiming no advantage was gained from having these two types of project flexibility. At least 10% of respondents were unsure whether abandonment, contraction or growth options had been exercised in their organization's capital investment projects in the last 5 years.

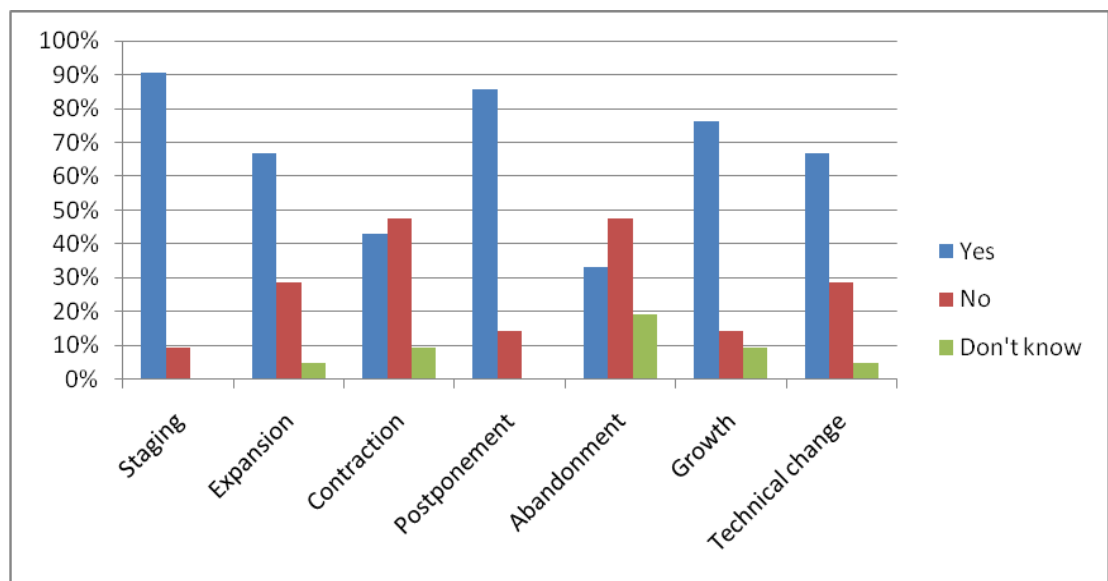


Figure 4: Has any advantage been gained from project flexibility in the past 5 years?

Figure 4 implies that financial decision-makers understand that the option to stage or to postpone an investment assists the evaluation of future uncertainty when they

expand or merge and, thereby, avoids costly errors (Brookfield, 1995). However, they appeared to seldom understand the abandonment or contraction of an investment to be an option in situations where future market conditions are worsening.

4.3.5 Creation of flexibility

Figure 5 summarizes the LGOs' usage of procedures or routines for identifying and/or assessing different types of flexibility when a capital investment project is being evaluated. Surprisingly, the results demonstrate that over half of the respondents (11 out of 21 respondents) claim that their LGOs have certain procedures or policies for assessing embedded flexibility, while 7 respondents indicated they did not have such established procedures. Three respondents were uncertain about whether their LGOs have procedures or routines to deal with flexibility assessment. However, none of the respondents specified the established procedures they used to assess 'built-in' flexibility.

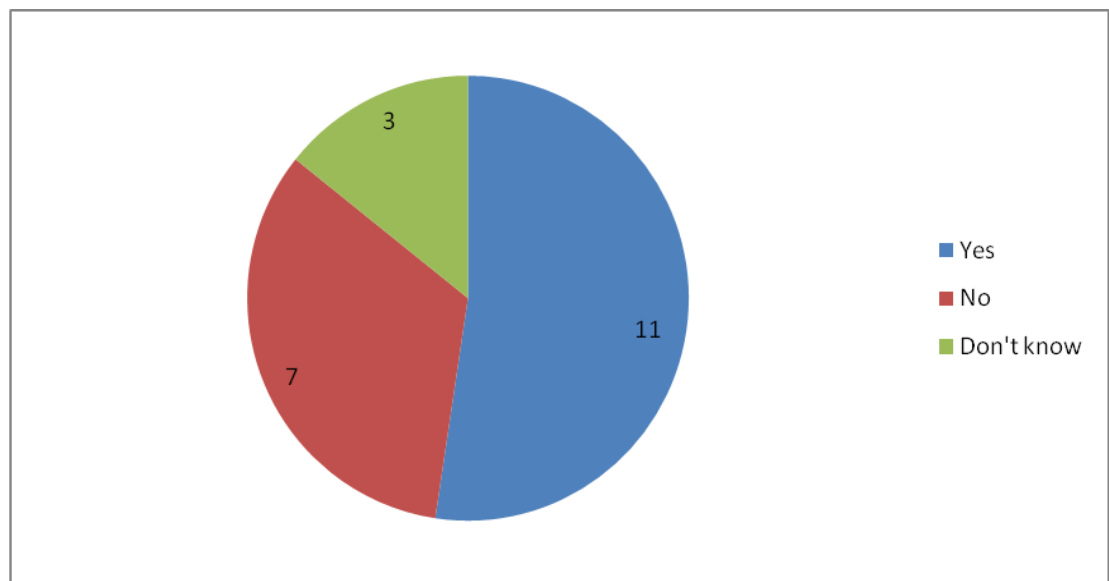


Figure 5: Existence of LGO procedures/routines to assess inherent flexibility

This question was then passed to five interviewees to further probe how the LGOs assess project flexibility by the established procedures or routines, if any. However, none of them had any established procedures for assessing project flexibility in

investment appraisal in their organizations. One stated that:

“We don’t have a formal process, but we’ve got experienced people involved in these projects, and they have got the technological knowledge to know what options are available and we put forward the best options.”

(Council Financial Manager, Telephone Interview, 28th May 2010)

Interestingly, most of them appeared to misunderstand the difference between financial options and real options, even though the definition of real options had been provided in the questionnaire. The follow-up interviews showed the lack of clear understanding these interviewees had about the meaning of the term ‘real options’.

Figure 6 summarizes the responses to a question that asked whether flexibility had been necessary for a capital investment project to be approved during the last 5 years. The results of this question implicated the attitudes and the extent of preparation that financial decision-makers had towards project flexibility.

Overall, Figure 6 shows substantial variation in responses across different types of flexibility. Significantly, a high number of the respondents (95%) considered the option to stage necessary for a capital investment project to be accepted. 90% of respondents indicated that growth options had been necessary for a project to be approved (the remaining 10% were unsure whether it had been deemed necessary). Similarly, 90% of respondents indicated that the postponement option was necessary for a project to be approved. Also, 86% of respondents considered the expansion option to be necessary for a project to be approved. On the contrary, over half (57%) indicated that the option to abandon was not necessary, followed by the option to scale down a project (43% negative responses) and the option to make technical changes (29% negative answers). However, there were still 33% of respondents who indicated the occurrence of abandonment options and 52% indicated the occurrence of contraction options as necessary when evaluating whether to launch a project. Fewer than 10% of respondents indicated that they did not know for any of the flexibility types. This result confirms the finding that financial decision-makers view project flexibility to be important and desirable.

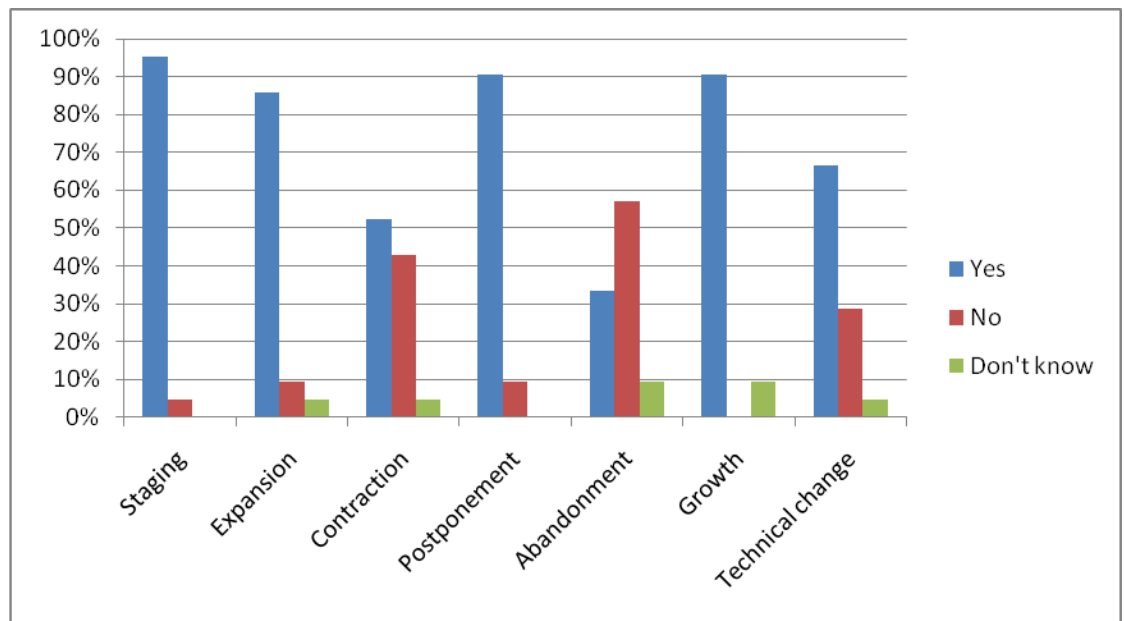


Figure 6: Is flexibility necessary for a capital investment project to be approved?

The five interviewees were encouraged to talk about their own perceptions and judgments on project flexibility. One interviewee suggested that flexibility was a negative thing that upset the entire capital budgeting analysis, because initial determinations were made as to what the costs of the project would be and what income it was going to generate on certain dates. Another stated that flexibility was just a single item among lots of factors (statute requirements, environmental issues, financial issues, and the size of the community) that would be taken into account in evaluating a project. The following are some illustrative quotations by interviewees:

One considered that flexible projects were considered more valuable because the future could not be 100% certain.

“There are uncertainties that we can’t be 100% certain about, so we need to value flexibility [which is inherent in projects] to be able to respond to those [uncertainties]”

(Council CFO, Telephone Interview, 26th May 2010)

One interviewee stated that their LGO had a policy of using periodic review for capital investment projects:

“We use periodic review of projects to look at what drives the need for the capital project.... We go back over the reasons and rationale for doing the capital projects in the first place and we see if that still applies currently.”

(Council General Manager, Telephone Interview, 26th May 2010)

Another interviewee indicated that although to some extent it was important to use analysis techniques when evaluating a capital investment project, managers should not place too much emphasis on project flexibility:

“It’s generally done on a case by case basis using the experts that we have as staff.”

(Council Financial Manager, Telephone Interview, 28th May 2010)

These statements reveal that there is variation between individual perceptions of project flexibility and behaviour in dealing with project flexibility. This finding is consistent with Busby & Pitts (1997), who found wide variation between different managers’ views and thoughts about real options.

4.3.6 Factors driving the value of flexibility options

Table 6 summarizes the extent to which respondents agreed with the relationship between four given factors and the value of flexibility options. The respondents were asked to consider: whether there was a negative relationship between the cost of exercising a flexibility option and the value of that option; whether there was a positive relationship between the available exercise period for a flexibility option and the value of that option; whether there was a positive relationship between the degree of uncertainty over future market conditions and the value of a flexibility option; and whether there was a positive relationship between current interest rates and the value of a flexibility option. The respondents were asked to tick one box (from “strongly disagree” to “strongly agree”) for each statement. In addition, a

“don’t know” box was included for those who were uncertain about the relationship between the given factors and the value of flexibility options. These four factors affecting option value were drawn from the study by Busby & Pitts (1997). Their study indicated that *“these statements reflected the most basic predictions of theory...the theory considers only the economics of investment, and ignores organizational and psychological matters”* (Busby & Pitts, 1998, p. 33).

	Costs to exercise project flexibility	The period for which project flexibility is available	Uncertainty over future conditions	Current interest rates
Strongly disagree	5	5	5	0
Disagree	10	10	5	10
Neither agree nor disagree	14	10	5	48
Agree	48	67	52	24
Strongly agree	24	10	33	14
Don't know	0	0	0	5

Table 6: Agreement with factors driving the value of flexibility options (percentage responses)

Grouping the ‘agree’ and ‘strongly agree’ answers together, a large majority of respondents (over 70%) agreed with the statements, except that nearly 48% remained neutral (neither agreed nor disagreed) on the relationship between current interest rates and the value of project flexibility.

The first two statements corresponded with the perspective of theoretical studies. In terms of the first statement, the value of flexibility options is said to be substantially determined by the settlement prices of the flexibility options (Gotze et al., 2008). Accordingly, the more it costs to exercise project flexibility when it is necessary, the less valuable the project flexibility is. In terms of the second statement, there is said to be a positive correlation between the life of flexibility options and their value (Gotze et al., 2008), namely the longer the period for which project flexibility will remain available, the more valuable the project flexibility is.

In terms of the third statement, the relationship between uncertainty and the value of project flexibility, 33% of respondents strongly agreed and another 52% moderately agree with the assertion that the greater the uncertainty over future market conditions, the greater the value of project flexibility. This result strongly conforms to prior theory, which asserts that *“uncertainty about future developments is a key factor: with increasing uncertainty, the value of an option rises ceteris paribus”* (Gotze et al., 2008, p. 297). However, these results are inconsistent with the empirical findings of Busby & Pitts (1997), where nearly one third of respondents indicated disagreement and only a half indicated agreement.

The last statement asserted that the higher current interest rates are the more valuable project flexibility is. Most respondents (48%) adopted a neutral position on this issue, neither agreeing nor disagreeing with the statement. However, 38% of respondents agreed with that there is a positive relationship between interest rates and the value of flexibility options, while only 10% disagreed. These findings conform to those of Busby & Pitts (1997).

4.3.7 Types of uncertainty that may drive the value of project flexibility

Respondents were asked to describe the sorts of uncertainty they thought their LGO was exposed to, that might make project flexibility valuable. Twelve respondents considered political interference and changes in legislation to be significant determinants of the value of capital investment projects since Community Boards and Councils can change every 3 years, and that can make a real difference depending on the capital investment strategy and priorities of new Council.

One interviewee noted

“In most governments, uncertainty is mostly politically influenced – that is where all our uncertainty comes from.”

(Council CFO, Telephone Interview, 26th May 2010).

According to the survey responses, some respondents stated that changes in technology, changes in demand for service or assets, and suitability of construction material, are the sorts of uncertainty that can occur in projects. Two respondents deemed increasing environmental standards to be another source of uncertainty. One stated that future economic recession is a big issue, since it would cause debt limits, funding constraints, population decline, staff turnover and tourism decline. Others indicated that increases in environmental standards, tourism cycles and population changes were substantial uncertainty factors influencing the value of their capital investment projects.

The findings on this issue were interesting, as respondents (both survey participants and interview participants) showed that councils do face substantial amounts of quite unique uncertainty, such as political changes, population changes and environmental standards, while also having to grapple with other sorts of uncertainty (such as staff turnover, recession, funding constraints) that are common to many other types of organizations. The multiple uncertainties faced by councils indicate that it is important for them to be taking account of the value of project flexibility. This finding confirms the study of Schubert & Barenbaum (2007), where there are many sorts of uncertainty surrounding public sector capital projects and public sector managers can employ real option modelling to improve the efficiency of the project appraisal process.

4.3.8 Awareness of real options terminology

Figure 7 shows the results of whether the terminology of real options was being discussed and/or evaluated in LGOs. The respondents were asked to indicate whether the terms ‘real options’, ‘growth options’, and ‘operating options’ are used when a capital investment project is being discussed and evaluated. If so, respondents were encouraged to give the definition of these terms, although a guiding definition of the term ‘real options’ was provided at the beginning of the questionnaire. The results reveal that more respondents discussed growth options and operating options than discussed real options. Of the 21 respondents, 11 claimed they had never discussed real options, 5 did not discuss growth options and 6 did not

discuss operating options.

Of those respondents who indicated they used this real options terminology, none were able to give examples to illustrate the term ‘real options’. The meanings of real options they provided did not conform to the definition used frequently in academic literature to describe investment flexibility. This finding suggests that knowledge of real options is still under-developed in New Zealand local government organizations. Although this finding may appear negative, it did not indicate that respondents failed to recognise inherent flexibility associated with capital investments. Several respondents’ awareness of real option-type thinking was probed via follow-up phone interviews.

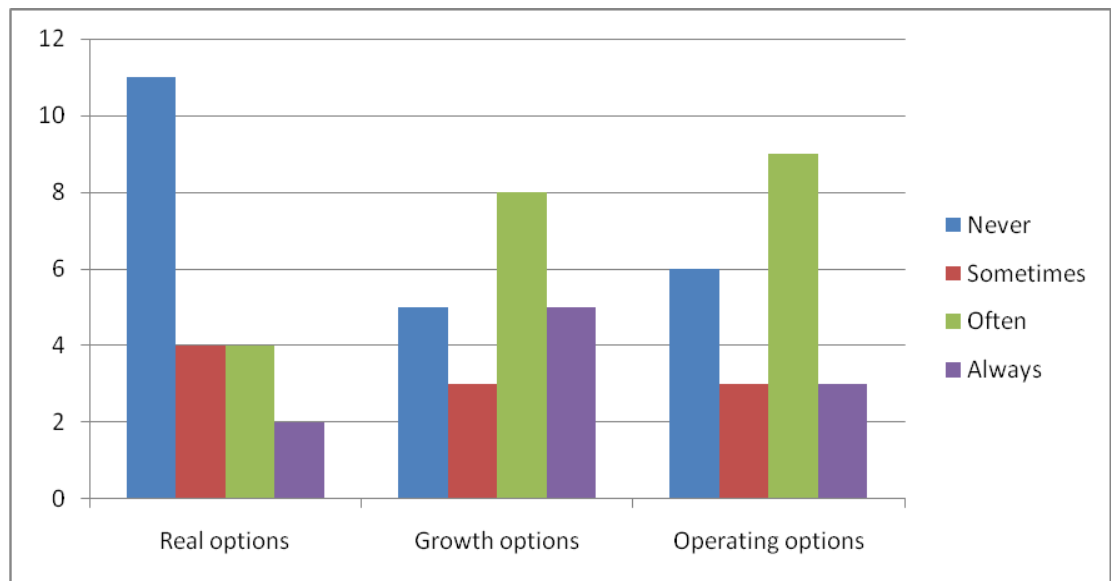


Figure 7: Extent of use of real options terminology

4.3.9 Financial analysis technique used in capital budgeting

As a way of placing LGOs’ use of real options ideas in the context of their overall capital investment appraisal approaches, the respondents were asked to identify which of several named appraisal methods their organisation used to evaluate capital investment projects. Their answers were requested on a scale from ‘never used’ to ‘always used’ (see Figure 8). Of 21 responding LGOs, almost all (18) used at least three appraisal methods in evaluating capital investment projects, with one being used as the primary technique and the others as secondary techniques. This finding

indicates the prevalent use of multiple analysis techniques in LGO capital investment appraisal. The finding also suggests that multiple analysis techniques are used in most LGOs to ensure the validity of their capital investment decisions. Two LGOs claimed to use only the life cycle method (which was mentioned under ‘other appraisal methods’) as their primary investment appraisal technique. Seven LGOs indicated they used at least 4 methods, with NPV being the primary technique. This finding is consistent with previous empirical studies, such as Alkaraan & Northcott (2006) which found that *“98% of respondents used more than one financial analysis technique when evaluating investment projects and 88% used three or more techniques”* (Alkaraan & Northcott, 2006, p. 160). This finding was also consistent with the study of Arnold & Hatzopoulos (2000).

Figure 8 demonstrates clearly that NPV is used most frequently in practice, with 86% of respondents claiming to use it. NPV was and still is advocated as the superior technique for evaluating capital investment projects compared with other common appraisal methods (Busby & Pitts, 1997). The Payback period (PB) method was the second most popular technique with 81% usage amongst responding LGOs, followed by Return on Investment (ROI) or Accounting Rate of Return (ARR) (76%) and the Internal Rate of Return (IRR) method (62%). These findings indicate that financial decision-makers favour DCF-based techniques (NPV and IRR) over ROA approaches, perhaps because these methods require less sophisticated calculations. Regardless of its theoretical shortcomings, the PB method is still used widely in practice, perhaps because of its focus on liquidity, which is considered its most important benefit for capital investment decision-making (Alkaraan & Northcott, 2006). The Economic Value Added (EVA) method was found to be used the least frequently, with only 29% usage in LGOs.

The overall use of these financial analysis techniques for capital investment projects was consistent with the findings of a recent survey conducted by CIMA in 2009 and a survey conducted by Alkaraan & Northcott in 2006, where NPV, PB and IRR remain the top three most popular investment decision-making techniques and are used widely in practice (Alkaraan & Northcott, 2006; Arnold & Hatzopoulos, 2000; Ryan & Ryan, 2002). This finding suggests that LGOs are no less sophisticated in

their use of capital investment analysis techniques than firms examined in prior studies. So, the LGOs are expected to be no less aware of advanced approaches, such as the benefit of assessing project flexibility.

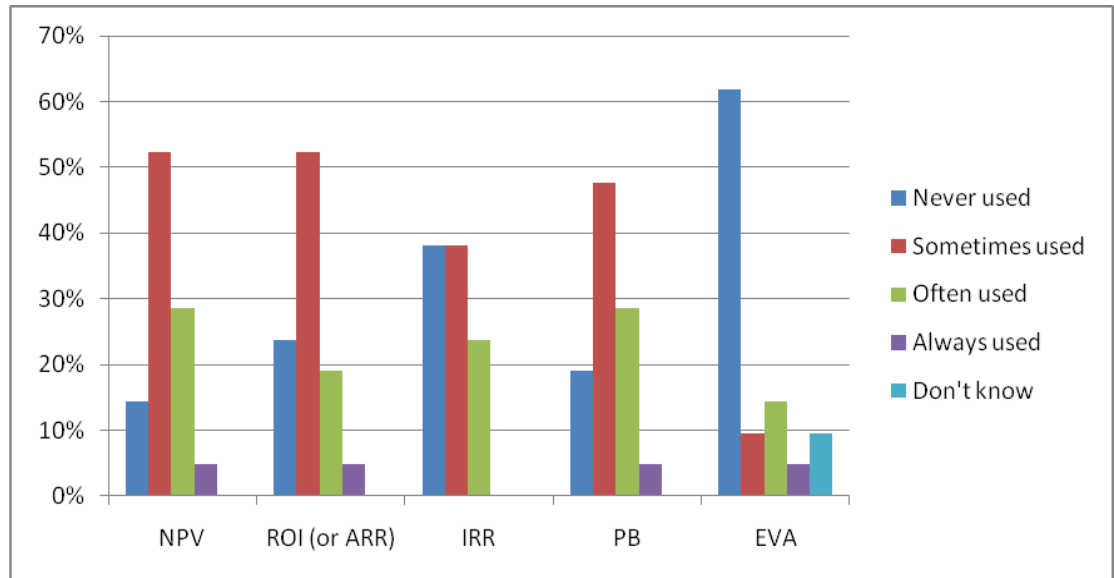


Figure 8: Financial analysis techniques used in capital budgeting

4.3.10 Techniques used to assess flexibility in investment appraisal

Figure 9 summarizes how frequently analysis methods were used in LGOs to assess flexibility embedded in capital investment projects using a ranking from 1 (never used) to 4 (always used). ‘Don’t know’ was available as an answer if the respondent was not aware of the methods. Apart from real options analysis (which was the only method valuing project flexibility), the methods used neither recognized nor evaluated any type of project flexibility (Busby & Pitts, 1997), but were still suitable for evaluating capital investment projects (Gotze et al., 2008).

81% of the respondents indicated that sensitivity analysis was the most widely used method for assessing the inherent flexibility in capital investments. The wide usage of sensitivity analysis is probably due to its “perceived simplicity” and “intuitive appeal” in nature (Alkaraan & Northcott, 2006). However, as explained in Chapter Two, although sensitivity analysis can reveal how risky a project could be, it fails to recognise and value any embedded flexibility in that project (Busby & Pitts, 1997). Certainly, sensitivity analysis can be employed to at least identify crucial

correlations between particular factors along with the probable success of a potential project, and this identification can be incorporated into the examination of project flexibility, minimizing downside risk eventually (Busby & Pitts, 1997).

One interviewee stated that

“We often use sensitivity analysis to evaluate the scope of the project, so we would look at whether you have a range of options that may deliver the outcome we want of the projects.... we would look at what the cost is for all of those options of building a certain size, building it bigger, and ... compare with what outputs we are going to get, and we do some sort of sensitivity analysis on what is the better option to run with.”

(Council General Manager, Telephone Interview, 26th May 2010)

Respondents were asked to specify any ‘rules of thumb’ used (i.e. less formal analytical methods developed for easy use in assessing project flexibility). Rules of thumb were indicated as the next most commonly used tool to assess flexibility in managing projects by 15 respondents (71%).

Real option analysis was the least used technique, rated as ‘never used’ by nearly half of respondents (48%). This result is not surprising. Despite its theoretical preference, the less frequent usage of real option analysis is probably due to its mathematically complex nature (Block, 2007). Moreover, it is not surprising that 10% of respondents had never heard of real option analysis. Real option analysis is still a new subject to the organizations and the wide usage of real option analysis needs time to become a reality (Cotter et al., 2003). Surprisingly, 44% of respondents indicated that real option analysis was employed to assess project flexibility in their LGOs, rating it as ‘sometimes used’ (29%), ‘often used’ (10%), and ‘always used’ (5%).

Based on the results of this survey, follow-up interviews were then conducted with these respondents to acquire further information about the use of real option analysis in practice. Five respondents were selected for the follow-up interviews, because

their questionnaire responses showed their LGOs used ROA to assess flexibility in capital investment appraisal. They were asked to describe a situation where real option analysis was employed in evaluating project flexibility. However, none could recall such a case. Therefore, the result did not appear to represent formal real options analysis use in LGOs, but perhaps some kind of real option-type thinking (i.e. an underlying awareness of the value of flexibility) was considered when evaluating capital investment projects.

Interestingly, the decision tree was the second least-used analysis technique in assessing flexibility in projects as indicated by 48% of the respondents. Moreover, there were 10% of the respondents who claimed they were not aware of this technique. Despite its practical difficulty in deciding the level of risk, Busby & Pitts (1998) considered that decision tree analysis reflected the range of project flexibility. Therefore, decision tree analysis might be expected to be useful in recognizing the inherent flexibility in capital investment projects. However this expectation was not supported by the survey findings.

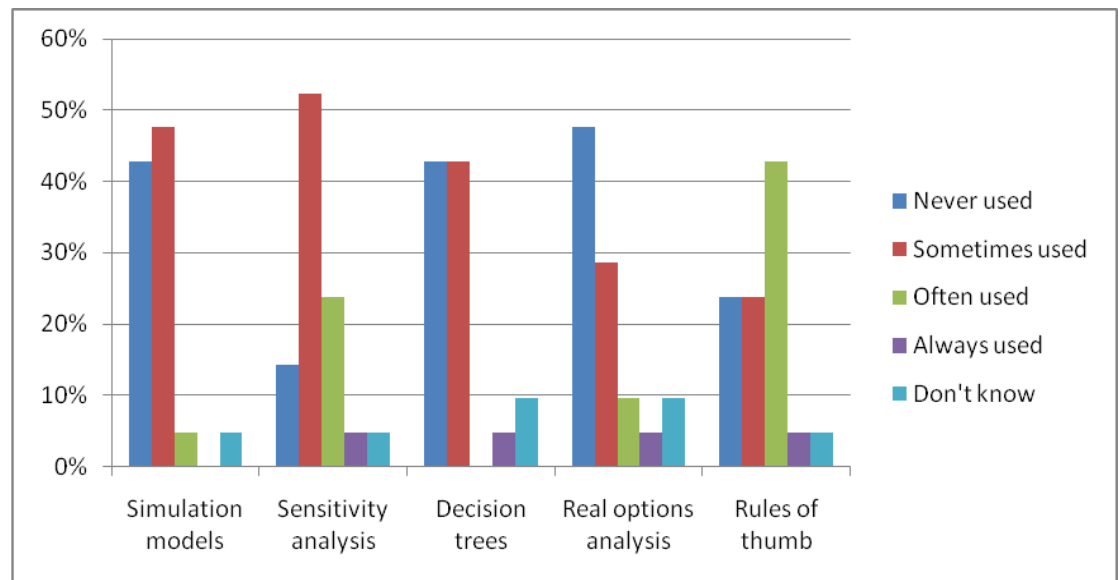


Figure 9: Techniques used to assess flexibility in capital investment projects.

Further, the five interviewees were encouraged to describe any methods which were employed to assess project flexibility when evaluating a project to be sanctioned. One indicated that a periodic review of projects was conducted every three years in the council. Another stated that

“We look for the lowest cost for each option; there would always be numbers of options that are available. So we will evaluate on the basis of whether they are achieving the environmental outcomes and life cycle costs”

(Council Financial Manager, Telephone Interview, 28th May 2010).

One interviewee stated that *“We look for the lowest cost for each option; there would always be numbers of options that are available. So we will evaluate on the basis of whether they are achieving the environmental outcomes and life cycle costs”*

(Council Financial Manager, Telephone Interview, 28th May 2010).

Before a capital project can be started, all five interviewees indicated that they liked to wait and see what happened about future events, mainly regarding consumer behaviour, future demands, future prices and political interference. This suggests that they prefer to postpone a project where possible, thus taking advantage of a timing option within the project to improve likely future outcomes.

Interviewees were asked to give their viewpoints on whether there was a necessity to employ a method to value project flexibility. Two agreed with the idea of introducing a method to value project flexibility in their organizations, while two disagreed. One stated that he neither disagreed nor agreed with employing a method to value flexibility, and expressed concern about whether such a method would be complex in nature.

The following are some illustrative quotations by the interviewees.

“Yes, definitely. We need to have enough flexibility in that to get over changes in environment or changes in resource during the planning of the project”

(Council CFO, Telephone Interview, 26th May 2010)

“Yes, I think so. With some of projects there have uncertainties we know right from the outset there are going to be things that we can't be 100% certain about it, so we need to build enough flexibility in to be able to deal with those”.

(Council CFO, Telephone Interview, 26th May 2010)

“If the method is sophisticated and complicated, it is not going to work in local government, because the variables are too uncertain.”

(Council Financial Director, Telephone Interview, 28th May 2010)

“It is not necessary to employ an additional method to value project flexibility. In our industry we are not actually in most cases looking for a return as such. The community is actually asking us to provide a facility. So just working out the net present value or returns on that is not what we use.”

(Council General Manager, Telephone Interview, 26th May 2010)

“We are satisfied with the current procedures used in our organization, which seem to serve our needs at the moment.”

(Council Financial Manager, Telephone Interview, 28th May 2010)

4.4 Summary

This chapter summarized the findings derived from an analysis of the survey responses and follow-up interviews, along with a discussion of the implications of the results. The findings of this research indicate that various types of capital investment project are undertaken by LGOs, most of them ‘operational’ in nature.

Most respondents could recall at least one type of capital investment project with ‘built-in’ flexibility.

The options to postpone, expand or stage an investment project were frequently considered, while options to abandon or contract an investment were regarded as the least useful forms of flexibility. Financial decision-makers may view such options as a project failure. The findings also indicated that the types of project flexibility that occurred most frequently were also regarded as the most important by respondents.

None of responding LGOs had established procedures to assess project flexibility, even though most felt that it was necessary for a capital investment project to be approved. Most respondents had a good understanding of the factors driving the value of project flexibility, but lacked knowledge of what ‘real options’ meant. No respondent indicated that ROA-type thinking or procedures were in use, even though they showed awareness that project flexibility has value. This finding is perhaps surprising given that LGOs are no less sophisticated in their use of other capital investment analysis techniques (e.g. NPV) than firms examined in prior studies. The LGO respondents seemed to employ mainly sensitivity analysis as a way to assess project flexibility, while some used periodic review.

The follow-up interviews revealed that surveys could be a problematic way of gathering information about the ways by which decision makers take account of flexibility and real options, because they revealed some survey answers as being based on a lack of knowledge of what such options were. In summary, although financial decision-makers in LGOs do seem to take project flexibility into account to some extent, the findings of this research suggest that real options analysis has a long way to go to establish a meaningful place in their capital investment analysis practices.

Chapter Five: Conclusion

5.1 Introduction

Chapter five presents the conclusions of the study, along with a review of its limitations and recommendations for future research. First, an overview of the study is provided as a review of its aims, research methods and main findings. Next, the limitations of the study are identified. The chapter ends with some suggestions for future research.

5.2 Overview of the study

5.2.1 Aims of the study

Real options analysis (ROA) has been advocated as the most appropriate analysis technique in capital investment appraisal, since it captures the value of ‘built-in’ flexibility in investments. An important associated issue is the technical assessment of project flexibility in investment appraisal. Thus, project flexibility and real options are viewed as topics of current interest within management accounting research. Many academic studies of ROA usage have been conducted in manufacturing and other private sector organizations. However, there have been few studies of these issues in public sector organizations. In order to fill this gap, this study aimed to examine how financial decision-makers take account of inherent flexibility in capital investment appraisal, and to investigate whether ROA-type principles or approaches are employed in one area of the New Zealand public sector: local government organizations (LGOs). This was the first empirical study to examine this issue in the NZ public sector context.

5.2.2 Methods for data collection and data analysis

Both quantitative and qualitative approaches were employed to collect and analyse the research data. A survey questionnaire and follow-up interviews were undertaken, with 21 LGO financial directors taking part in the survey investigation, and 5 of them participating in the follow-up interviews. Hence, the research did not rely solely on data collected from the questionnaire or from interviews, but triangulated these two sources of data. Descriptive statistics were used to analyse the data gathered from the survey questionnaire, and numerical results were presented in frequency tables, pie charts and bar charts. A 5-step data analysis model outlined by Sarantakos (1998) was employed to explore the data gathered from the follow-up interviews, and the findings were then triangulated against data gathered from the questionnaire.

5.2.3 Main findings of the research

The findings of this research indicated that most of respondents could recall at least one type of capital investment project with 'built-in' flexibility. The options to postpone, stage, or expand an investment project were frequently taken into account by most financial decision-makers when evaluating capital investment projects. However, the options to abandon or contract an investment were considered as the least useful forms of flexibility. Such options might be viewed as failure, or as indicating a lack of organizational commitment to the investment project.

Over 90% of respondents indicated that postponement options, staging options or expansion options occur quite often in capital investment projects, while abandonment or contraction options were the least common forms of project flexibility. The findings suggest a positive relationship between the frequency and the importance of these flexibility options. The types of project flexibility that occurred most frequently were also regarded by financial decision-makers as the most important to a capital investment's attractiveness, and vice versa. Moreover, the types of project flexibility that were considered most important were also regarded as the most beneficial.

None of responding LGOs had established procedures to assess project flexibility even though most felt that some forms of flexibility were necessary for it to be approved. Most respondents had a good understanding of the factors driving the value of project flexibility. They admitted the cost of exercising project flexibility, the period for which it is available, and future uncertain events, had significant impacts on its value and, in turn, influence future profits (or losses) for the organization. The findings suggested that various sorts of uncertainty are encountered by councils; such as political interference, population and environmental standard changes, economic recession, funding constraints and staff turnover. These multiple uncertainties indicate that it is important for councils to evaluate project flexibility. However, no respondent indicated that ROA-type thinking or procedures were in use, and most respondents lacked knowledge of what 'real options' meant.

The findings indicate that NPV and PB were two commonly used techniques for capital budgeting. This suggests that LGOs are no less sophisticated in their use of capital investment analysis techniques than the firms examined in prior studies. Thus, LGOs might be expected to be similarly aware of advanced approaches, such as the benefit of assessing project flexibility. In terms of investment appraisal techniques, the respondents seemed to employ mainly sensitivity analysis as a way to assess project flexibility, while some used periodic review methods to assess flexibility in investments.

Overall, the results of this research demonstrate that various types of project flexibility occur in capital investment projects in the NZ public sector context, and that NZ local government financial decision-makers recognize project flexibility and take it into account to some extent, but ROA-type thinking or procedures were not well known amongst respondents. Real options analysis has a long way to go to establish a meaningful place in their capital investment analysis practices in New Zealand.

5.3 Limitations of the research

This study has several limitations. First, although the response rate for the questionnaire was similar to that found in many prior studies (such as Alkaraan & Northcott, 2006; Block, 2007), it could be considered relatively low at 24.4%, i.e. 21 out of 86 local governments participated in the survey. The use of a mailed questionnaire, and the limited time allowed to respond to the questionnaire, may be two main reasons that resulted in the low response rate, even though two tactics were used to boost response rates: a cover letter and follow-up emails. Some non-respondents gave feedback that they did not return the questionnaire because their councils were small with no major capital investment projects, or because their financial directors did not have time to complete the questionnaire due to high workloads. This research used follow-up interviews to gather broader but deeper data to address the research questions. Consequently, useful information on whether LGO financial decision-makers take account of project flexibility in capital investment, and whether ROA-type principles or thinking were applied in investment appraisal, was obtained in one public sector context in New Zealand.

A second limitation is the relatively small sample for this research. Due to the limited time frame for this study, it was not feasible to investigate the assessment of project flexibility and real options in all public sector organizations in New Zealand. The sample for this research is therefore limited to LGOs as a sub-set of the New Zealand public sector, which restricts generalization of the research findings to public sector organizations as a whole.

Third, the findings of this research focused mainly on descriptive statistical analysis and did not employ any statistical hypothesis testing, such as correlation analysis between variables, because of the small sample size and the nature of the research questions. However, the research used qualitative analysis to explore respondents' perspectives on project flexibility and real options in order to better understand attitudes towards them. Therefore, the findings offer insights into LGO financial decision-makers' experience of dealing with project flexibility in NZ LGOs, and their use of ROA-type principles, or thinking, in making capital investment decisions.

5.4 Future research directions

Although the theoretical real options literature is well developed, the empirical investigation of this topic remains weak (MacDaugall & Pike, 2003). The ROA technique appears to be employed by some sophisticated organizations; such as Stern Stewart & Co., Boeing Co. and the Tennessee Valley Authority (Coy, 1999). However, the associated issue as to whether project flexibility is well assessed in investment appraisal remains unclear. Therefore, future research is required to investigate the issues of assessing flexibility in capital investment and the use of ROA-type principles or approaches in investment appraisal in practice. Based on the findings and conclusions reached in this study, the terminology of real options was not well known amongst New Zealand LGO decision-makers and the use of ROA-type thinking or procedures among New Zealand public sector organizations is limited, so it would be interesting to discover whether an extended survey of other New Zealand organizations (both public and private sector) would deliver significantly different results.

In addition, it might be valuable to conduct research focused on project flexibility in New Zealand organizations, particularly focusing on organizations in, for example, the mining, pharmaceutical, manufacturing or IT industries since their capital investment projects tend to be very capital intensive and to encounter substantial uncertainty. Such industries may therefore provide a rich context for further investigation into how flexibility – a potentially important aspect of capital investment value – can be better evaluated and exploited in New Zealand capital investment decision-making

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Appendices

Appendix A



MEMORANDUM

Auckland University of Technology Ethics Committee (AUTEC)

To: Deryl Northcott
From: **Madeline Banda** Executive Secretary, AUTEC
Date: 1 April 2010
Subject: Ethics Application Number 10/61 **Capturing the value of flexibility in public sector capital investment projects: evidence from New Zealand local government organisations.**

Dear Deryl

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by a subcommittee of the Auckland University of Technology Ethics Committee (AUTEC) that I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTEC's meeting on 10 May 2010.

Your ethics application is approved for a period of three years until 1 April 2013.

I advise that as part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 1 April 2013;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics>. This report is to be submitted either when the approval expires on 1 April 2013 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this. Also, if your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply within that jurisdiction.

When communicating with us about this application, we ask that you use the application number and study title to enable us to provide you with prompt service. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at ethics@aut.ac.nz or by telephone on 921 9999 at extension 8860.

On behalf of the AUTEC and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely

Madeline Banda
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Jianjing (Kristine) Fu kristinefj@hotmail.com, AUTEC Faculty Representative, Business and Law

Appendix B

Participant Information Sheet



Date Information Sheet Produced

07 April 2010

Project Title

Capturing the value of flexibility in public sector capital investment projects: Evidence from New Zealand local government organizations

An Invitation

You have been selected for invitation to participate in this research. It is sincerely hoped that you will accept this invitation.

My name is Jianjing (Kristine) Fu. I am an AUT student studying for a Masters in Business. This research is for my dissertation as a requirement for my Masters degree.

Your participation in this survey is strictly voluntary and you may withdraw at any time.

What is the purpose of this research?

The purpose of this research is two-fold: to explore how NZ local government decision-makers take account of flexibility in capital appraisal; and to investigate whether they use Real Options Analysis (ROA) approaches in practice. As mentioned above, this research project will help me to complete my Masters degree. The findings of this research may be reported in conference presentations, seminars and/or a publication in an accounting journal.

How was I chosen for this invitation?

Because of the nature and aims of this research, all New Zealand regional councils, city councils and district councils are being surveyed to provide the necessary data to answer the proposed research questions. As a local government financial decision-maker, you are the most knowledgeable and appropriate person to complete this questionnaire.

What will happen in this research?

Your participation in this research will involve filling out the attached questionnaire. The questionnaire consists of 18 questions with a combination of numerical ratings, yes/no questions and some open-ended questions where your comments are sought.

What are the discomforts and risks?

Completing this questionnaire is not expected to cause any discomfort or risk to you or your organization, other than the fact that your responses will reveal to the researcher:

- a) Your identity as a financial decision-maker (CEO, CFO or Financial Manager) in your organization
- b) The identity of your local government organization
- c) Some organizational information that you may consider to be sensitive.

How will these discomforts and risks be alleviated?

All data collected for this research will be strictly confidential and accessed only by the research supervisor and the researcher. All data will be stored in password protected computer files in the research supervisor's office. In the event of any publication resulting from this research, your name and the identity of your organization will not be disclosed. Information related to your organization will be presented in an aggregated form along with information collected from the other local government organizations surveyed. Consequently, the specifics of your responses will not be disclosed.

What are the benefits?

For you as a participant: This will be the first study to examine how New Zealand local government financial decision-makers take account of flexibility when assessing capital investment projects. The findings will, therefore, be useful to you in reflecting on how you value flexibility when assessing your own organization's capital investment projects.

For the researcher: the main benefit is the completion of a Masters degree. Also, findings from this research may provide the basis for further research within other areas of the New Zealand public sector.

How will my privacy be protected?

In addition to what has been said above, any publication of the research data will **NOT** identify your name or the identity of your organization.

What are the costs of participating in this research?

The research questionnaire should take no more than 20 minutes of your time to complete.

What opportunity do I have to consider this invitation?

This questionnaire has been sent to you on 08 April 2010. You are asked to complete and return it in the enclosed self-stamped envelope by 23 April 2010.

How do I agree to participate in this research?

By completing the consent form for the questionnaire (enclosed).

Will I receive feedback on the results of this research?

Yes, if you wish. Question 18 in the questionnaire allows you to indicate whether you would like to receive a summary of the survey results, which would be emailed to you in July 2010 (please provide your email address on your questionnaire).

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Professor Deryl Northcott, Deryl.northcott@aut.ac.nz, 921 9999 ext 5850.

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTC, Madeline Banda, madeline.banda@aut.ac.nz , 921 9999 ext 8044.

Whom do I contact for further information about this research?**Researcher Contact Details:**

Jianjing (Kristine) Fu

Tel: 021-136 5363

Email: kristinefj@hotmail.com

Project Supervisor Contact Details:

Professor Deryl Northcott

Tel: 09-917 9999 ext 5850

Email: deryl.northcott@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on 01 April 2010, AUTC Reference number 10/61.

Appendix C

Consent Form



Project title: Capturing the value of flexibility in public sector capital investment projects:
Evidence from New Zealand local government organizations.

Project Supervisor: **Deryl Northcott**

Researcher: **Jianjing (Kristine) Fu**

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 7th April 2010.
- ☐ I understand that I may withdraw myself or any information that I have provided for this project at any time without being disadvantaged in any way.
- ☐ If I withdraw, I understand that all relevant information I have provided will be destroyed.
- ☐ I understand that all data collected for this research will be strictly confidential and accessed only by the research supervisor and the researcher.
- ☐ I agree to take part in this research.
- ☐ I wish to receive a summary report from the research (please tick one): Yes ☐ No ☐
- ☐ I am willing to be contacted to participate in a short follow-up interview, either in person or over the phone (please tick one): Yes ☐ No ☐

Participant's signature:

Participant's name:

Participant's Contact Details (email address preferred):

.....

.....

.....

Date: 7th April 2010

Approved by the Auckland University of Technology Ethics Committee on 1st April 2010

AUTEC Reference number 10/61

Appendix D



FLEXIBILITY IN CAPITAL INVESTMENT PROJECTS

This questionnaire is designed to find out how NZ local government organizations (LGOs) deal with flexibility in their capital investment (CI) projects and to identify what kind of analysis approaches are used. Real options analysis and/or real options ways of thinking are of special interest in this survey (a definition of real options¹ analysis is provided at the bottom of this page).

Your name:

(Please note: your name will remain confidential)

Your job title:

Your email address and phone number:

1. What type of Local Government Organization (LGO) do you work for? (Please tick one box)

Regional council

City council

District council

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

2. What is the current year's capital investment budget for your LGO? (Please circle one)

- a) Under \$1,000,000
- b) \$1,000,001 – \$15,000,000
- c) \$15,000,001 – \$30,000,000
- d) \$30,000,001 – \$45,000,000
- e) Over \$45,000,000

3. On average, how many capital investment projects of the following types does your LGO undertake annually?

Type of Investment	Number
(a) Expansions of existing services or facilities	
(b) Investments aimed at improving efficiency / lowering costs	
(c) Investments aimed at improving environmental outcomes	
(d) Divestments of existing assets or services	
(e) Research and development, or technology improvement	
(f) Merger or partnership with another organization	
(g) Real estate / land purchases	
(h) Others (please specify)	

¹ Real options are manifestations of managerial flexibility that enable management to respond to changing business and economic conditions. Real options can include: options to defer the start of an investment; options to temporarily or permanently cease an existing investment; options to change the scale of an investment in response to changed operating conditions; and many others.

4. Are any of the following appraisal methods used to evaluate capital investment projects? (Please tick a box to indicate your answer for each method.)

Appraisal methods	Never used	Sometimes used	Often used	Always used	Don't know
(a) Net present value					
(b) Return on investment (or accounting rate of return)					
(c) Internal rate of return					
(d) Payback period					
(e) Economic value added					
(f) Other method(s) – please specify below					

If you identified 'other method(s)' above, please describe the method(s) below:

5. When evaluating capital investment projects, how often does your LGO consider the following possibilities for how a project could develop into the future?

(Please assign one of the following scores to each possibility: 0 = Don't know; 1 = Never; 2 = Occasionally; 3 = Quite often; 4 = Most of the time; 5 = Always)

Possibilities

Scores

(a) A project could be implemented in stages	
(b) A project could be expanded later	
(c) A project could be scaled down later	
(d) A project could be delayed	
(e) A project could be abandoned later	
(f) A project could create possibilities for further future growth or development	
(g) Technical changes could be introduced to a project	

6. How important do you think each of these types of flexibility is to the attractiveness of a capital investment opportunity?

(Please assign one of the following scores for each possibility: 0 = Don't know; 1 = Not at all important; 2 = Only slightly important; 3 = Moderately important; 4 = Very important; 5 = Extremely important)

Possibilities

Scores

(a) A project could be implemented in stages	
(b) A project could be expanded later	
(c) A project could be scaled down later	
(d) A project could be delayed	
(e) A project could be abandoned later	
(f) A project could create possibilities for further future growth or development	
(g) Technical changes could be introduced to a project	

7. If your LGO views any other types of flexibility (not listed in question 6) as valuable in capital investment projects, then please describe them below:

8. To what extent do you agree with the following statements? (Please tick one box for each.)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know
(a) The more it costs to exercise project flexibility when it is needed, the less valuable that flexibility is.						
(b) The longer the period for which project flexibility will remain available, the more valuable that flexibility is.						
(c) The greater the uncertainty about future operating conditions, the more valuable project flexibility is.						
(d) The higher current interest rates are, the more valuable project flexibility is.						

9. In the past 5 years, have the following types of flexibility been necessary for a capital investment project to be approved? (Please answer 'yes', 'no' or 'don't know' for each.)

Y/N/DN

(a) A project could be implemented in stages	
(b) A project could be expanded later	
(c) A project could be scaled down later	
(d) A project could be delayed	
(e) A project could be abandoned later	
(f) A project could create possibilities for further future growth or development	
(g) Technical changes could be introduced to a project	

10. In the past 5 years, did the following types of flexibility exist for any capital investment projects? (Please answer 'yes', 'no' or 'don't know' for each.)

Y/N/DN

(a) A project could be implemented in stages	
(b) A project could be expanded later	
(c) A project could be scaled down later	
(d) A project could be delayed	
(e) A project could be abandoned later	
(f) A project could create possibilities for further future growth or development	
(g) Technical changes could be introduced to a project	

11. In the past 5 years, have the following types of flexibility been taken advantage of in any capital investment projects? (Please answer 'yes', 'no' or 'don't know' for each.)

Y/N/DN

(a) A project could be implemented in stages	
(b) A project could be expanded later	
(c) A project could be scaled down later	
(d) A project could be delayed	
(e) A project could be abandoned later	
(f) A project could create possibilities for further future growth or development	
(g) Technical changes could be introduced to a project	

12. Do you think your LGO is exposed to the sorts of uncertainties that might make project flexibility valuable? (Please tick one box).

Yes ☐ ☐ ☐ **Don't know**

If you answered 'yes', please describe these uncertainties below:

13. Does your LGO have any form of procedure or routine to identify and/or assess different types of flexibility when a capital investment project is being evaluated?

Yes ☐ ☐ ☐ **Don't know**

If you answered yes, please describe the procedure or routine:

14. Does your LGO have a prescribed, quantitative analysis method for valuing the flexibility in a capital investment project?

Yes ☐ ☐ ☐ **Don't know**

If you answered yes, please describe the analysis method:

15. Are the following terms used in your organization when capital investments are being discussed and evaluated?

	Never used	Sometimes used	Often used	Always used	Don't know
(a) Real options					
(b) Growth options					
(c) Operating options					

16. Are any of the following methods used in your LGO for assessing and/or valuing the flexibility of capital investment projects?

	Never used	Sometimes used	Often used	Always used	Don't know
(a) Simulation models					
(b) Sensitivity analysis					
(c) Decision trees					
(d) Real options analysis					
(e) Rules of thumb (i.e. less formal analysis methods developed for easy use)					
(f) Other method(s)					

If you identified 'other method(s)' above, please describe the method(s) below:

17. If you use any of the methods listed in question 16, what challenges have you experienced in using them?

18. Would you like to receive a summary of the survey results?

Yes ☐ ☐ No

Thank you for participating in this survey!

If you are willing to be contacted to participate in a **short follow-up interview** (in person or over the telephone), please tick the box below and ensure your name, organization name and contact details are entered at the start of this questionnaire.

Yes, I am willing to be contacted to be interviewed ☐

Appendix E

Participant Information Sheet



Date Information Sheet Produced

07 April 2010

Project Title

Capturing the value of flexibility in public sector capital investment projects: Evidence from New Zealand local government organizations

An Invitation

You have been selected for invitation to participate in this research. It is sincerely hoped that you will accept this invitation.

My name is Jianjing (Kristine) Fu. I am an AUT student studying for a Masters in Business. This research is for my dissertation as a requirement for my Masters degree.

Your participation in this survey is strictly voluntary and you may withdraw at any time.

What is the purpose of this research?

The purpose of this research is two-fold: to explore how NZ local government decision-makers take account of flexibility in capital appraisal; and to investigate whether they use Real Options Analysis (ROA) approaches in practice. As mentioned above, this research project will help me to complete my Masters degree. The findings of this research may be reported in conference presentations, seminars and/or a publication in an accounting journal.

How was I chosen for this invitation?

You have been contacted because you indicated in your questionnaire responses that you were willing to participate in a follow-up interview. As a financial decision-maker of a local government organization, you are the best source of relevant and appropriate information for this research. Because of the nature and aims of this research, interviewing financial managers from several local government organizations will provide information that may not be apparent from the earlier questionnaire survey (the first stage of this research project). The input of participants such as yourself is expected to provide important and significant data to help answer the research questions for this study.

What will happen in this research?

Your participation in this research will involve a telephone interview, where you will answer questions put to you by the researcher. The interview questions will focus on how you deal with the flexibility of capital investment projects based on your answers to the questionnaire. The interview will be tape-recorded (unless you object, which you are free to do), and the researcher will also take notes. You can withdraw from the interview at any time, should you so wish.

What are the discomforts and risks?

The interview process is not expected to cause any discomfort or risk to you or your organization, other than you will be revealing to the researcher:

- d) Your identity as a financial decision-maker (CEO, CFO or Financial Manager) in your organization
- e) The identity of your local government organization
- f) Some organizational information that you may consider to be confidential.

How will these discomforts and risks be alleviated?

All data collected for this research will be strictly confidential and accessed only by the research supervisor and the researcher. All data will be stored in password protected computer files in the research supervisor's office.

In the event of any publication resulting from this research, your name and the identity of your organization will not be disclosed. Also, steps will be taken to ensure that no information presented in any publication will reveal your identity or that of your organization. Further, the researcher will send you a copy of any interview material selected for inclusion in any report/publication, so that you can check it to ensure confidentiality is preserved to your satisfaction.

What are the benefits?

For you as a participant: This will be the first study to examine how New Zealand local government financial decision-makers take account of flexibility when assessing capital investment projects. The findings will, therefore, be useful to you in reflecting on how you value flexibility when assessing your own organization's capital investment projects.

For the researcher: the main benefit is the completion of a Masters degree. Also, findings from this research may provide the basis for further research within other areas of the New Zealand public sector.

How will my privacy be protected?

In addition to what has been said above, any publication of the research data will **NOT** identify your name or the identity of your organization.

What are the costs of participating in this research?

No more than 30 minutes of your time will be required to complete the interview.

What opportunity do I have to consider this invitation?

The interviews are planned for April and May 2010. The researcher will email you soon to confirm your willingness to participate and set up an interview time that is convenient for you.

How do I agree to participate in this research?

You agree to participate by replying to the researcher's email and completing the attached consent form.

Will I receive feedback on the results of this research?

During the interview, the researcher will ask you whether you would like to receive a summary of the findings from these research interviews. A summary will be sent to you if requested.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Professor Deryl Northcott, Deryl.northcott@aut.ac.nz, 921 9999 ext 5850.

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTECH, Madeline Banda, madeline.banda@aut.ac.nz, 921 9999 ext 8044.

Whom do I contact for further information about this research?

Researcher Contact Details:

Jianjing (Kristine) Fu

Tel: 021-136 5363

Email: kristinefj@hotmail.com

Project Supervisor Contact Details:

Professor Deryl Northcott

Tel: 09-917 9999 ext 5850

Email: deryl.northcott@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on 01 April 2010, AUTEK Reference number 10/61.

Appendix F

Consent Form



Project title: Capturing the value of flexibility in public sector capital investment projects: Evidence from New Zealand local government organizations.

Project Supervisor: **Deryl Northcott**

Researcher: **Jianjing (Kristine) Fu**

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 9th February 2010.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed (please delete any parts not agreed to).
- ☐ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ☐ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ☐ I agree to take part in this research.
- ☐ I wish to receive a copy of the report from the research (please tick one): Yes ☐ No ☐

Participant's signature:

Participant's name:

Participant's Contact Details (if appropriate):

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.....
.....
.....

Date: 7th April 2010

Approved by the Auckland University of Technology Ethics Committee on 1st April 2010

AUTEC Reference number 10/61

Appendix G

Project Title

Capturing the value of flexibility in public sector capital investment projects:
Evidence from New Zealand local government organizations

Applicants

Professor Deryl Northcott

Jianjing (Kristine) Fu (Masters student)

Attachment: QUESTIONS FOR FOLLOW-UP INTERVIEWS

1. Can you give an example of a capital investment project undertaken by your organization that had elements of flexibility in it? (Probe for details of the project)
2. How do you deal with the sorts of capital investment project where flexibility might be important and valuable? (Probe for details)
3. Can you give an example of a capital investment project in the last five years where the ability to change the project was of value when circumstances changed or new information came to hand? (Probe for details)
4. Does your LGO have any form of procedure or routine for assessing project flexibility when launching a capital investment project? (Probe for details)
5. Does your organization employ any type of technique for assessing project flexibility when evaluating a potential capital investment project? (Probe for details)
6. Have you had any experience with using real options analysis in your organization? (If yes, then go to question 7 / If no, then go to question 8)
7. What difficulties have you encountered when trying to apply real options analysis to capital investment projects?
8. Do you think real options analysis is a useful technique in practice? Why, or why not?
9. Do you think there is need for an appropriate method to assess project flexibility, and what challenges do you think would be met by using the method?
10. Would you like to receive a summary of the findings from these research interviews?