TOLERANCE OF ESCALATING COMMITMENT TO
TROUBLED INFORMATION SYSTEMS PROJECTS

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This research programme investigates the phenomenon known as the escalation of commitment: the tendency to persist with troubled projects despite evidence suggesting that setbacks within the project could lead to its eventual failure. The tendency to escalate commitment to troubled information systems projects by investing greater amounts of time, money and effort than originally anticipated, have been shown to be strong, persistent and contrary to economic rationality.

We postulate that project support, escalation and failure are determined primarily through a decision-maker’s reaction to Zones of Tolerance (ZOTs), defined as the extant set of boundary conditions within which variations from expectations are recognized but carry no significant utility or disutility to the decision-maker. Within a Zone of Tolerance, variations from expectations are considered comparatively small and (importantly) acceptable. We examine how the presence of a Zone of Tolerance affects project managers’ willingness to tolerate budget variances (in both cost and time) and project slippage within information systems developments. This willingness to tolerate resource expenditures in excess of original expectations is dependent upon the qualities of the behavioural, environmental and resource constraints imposed within a project setting.

Experiment 1: Proof of Concept

In the first study, we empirically demonstrate how decision-makers tolerate minor variations from expectations, and how, if these seemingly minor variations are allowed to cascade and compound over time, they create the historically antecedent
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conditions typical of escalation of commitment episodes. Paradoxically, we found that comparatively low budget overruns (which tend to be tolerated) lead to greater total resource commitments than high budget overruns (which tend to be corrected).

Experiment 2: Extension of Concept – Projects Over Time

In this experiment, we investigated the importance of time to a decision-maker’s tolerance. We examined a number of characteristics of a project’s performance that may change over time, namely (1) the effects of the stability of budget variances over time; (2) the magnitude of budget variances over time; and (3) the change in risk preference over time. Confirming our conjectures regarding the effects of ZOTs and Time on the treatment of escalating courses of action we found a significant effect of ZOTs and a main significant effect of time on the evaluation of projects and the continuation decisions made by subjects within the decision task. Contrary to prior escalation studies examining risk preference in loss conditions, this study shows that losses faced within escalation episodes can engender risk aversion, particularly if decision-makers operate under conditions where escalation is the less risky option when controlling project setbacks.

Experiment 3: Project Portfolios

In the final experiment, we hypothesise that ZOTs in hered within the decision context lead to increasingly suboptimal resource allocations between troubled and untroubled projects over time. Applying linear programming, we both theoretically and empirically demonstrated how tolerance for troubled projects draws resources away from well-performing projects within a portfolio. Consistent with our expectations, decision-makers in ZOT conditions permitting absorption of cost
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increases fail to detect early variations from expectations and failed to correct escalating projects. By contrast, subjects in low ZOT conditions tended to be more aware of increasing costs and generally attempted to correct said variations, leading to better resource allocations overall.

This research programme takes a significant step towards understanding how tolerance of seemingly minor setbacks affects future tendencies to persist with challenged courses of action and demonstrates ways in which the structural and organisational constraints on decision-making affect the way in which troubled projects are handled. We hold the micro-decisions of project management practice ‘under the microscope’ and significant questions are posed about the effectiveness of conventional project management tools and techniques in controlling behavioural tendencies that contribute to sub-optimal resource allocation. It is argued that such practices need to be held to account against the realities of human judgement and decision-making behaviour, and it is shown through these empirical studies that manipulating Zones of Tolerance has significant effects of human judgement within the-organisational context and represent, in some cases, stronger controls against escalation of commitment behaviour than conventional project management techniques.
You that would judge me, do not judge alone
This book or that, come to this hallowed place
Where my friends' portraits hang and look thereon;
Ireland's history in their lineaments trace;
Think where man's glory most begins and ends
And say my glory was I had such friends.


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This achievement does not belong to me. It belongs to you.
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--- CHAPTER 1 ---

INTRODUCTION

Tolerance and Persistence in Escalating Projects

On 28 December 2006, CNN interviewed then Chair of the US Homeland Security Council, Fran Townsend and quizzed her on the failure to capture Osama bin Laden. A CNN correspondent asked Townsend, “I know you are saying there [are] successes in the War or Terror, and there have been, but [the failure to capture Osama bin Laden] - that’s a failure.” To which Townsend responded, “I’m not sure that it’s not a success that hasn’t occurred yet.”

At what point do decision-makers exhaust their tolerance and withdraw their support for a course of action that is experiencing persistent, cascading and compounding setbacks? Consider the following cases, and in doing so, consider the extent to which the decision-makers involved remained tolerant of the escalating setbacks that would have contributed to the magnitude of the situation:

British Columbia’s decision to hold a world’s fair, Expo 86, experienced rapidly increasing deficit projections from $6 million in 1978 to over $300 million by 1985, yet the Vancouver provincial government remained steadfast in its commitment to hold the fair (Ross and Staw 1986).
Ross and Stew (1993) detail the development of the Shoreham nuclear power plant which was abandoned after twenty-three years of construction at a loss of US$5 billion despite original estimates of completion within seven years at a cost of US$75 million.

In “one of the major fiascos of business history” the London Stock Exchange abruptly cancelled the £500 million development of ‘Taurus’, an initiative to automate electronic transmission of trade settlements after five years of development, even after it was commissioned and supported by the securities industry and the Bank of England (Dummond 1999).

After 10 years of development and an incalculable amount of spending into the tens of millions of dollars, Keil (1995b) details the case of a configuration management system with a nom du guerre of CONFIG, which was cancelled in 1992 after years of escalating costs with little to no benefit to the organisation.

In 1994 American Airlines was forced to settle a $165 million lawsuit with Rent-A-Car, Marriot Corp and Hilton Hotels after a hotel and car reservation system collapsed and was eventually aborted.

The Channel Tunnel between the UK and France, originally estimated to cost $7 billion was finally opened in 1994 at a final cost of $13 billion. EuroDisney’s costs of development rose from a projected $2.25 billion to a final cost of over $4 billion between 1989 and 1992.
Faced with a failing course of action that is taking place within a complex and multi-faceted decision context, decision-makers are compelled to look beyond the economic side of a decision. Consequences are often not dictated by objectively ‘rational’ economic agents. Fear, regret and aversion to loss are strong psychological forces. The mores of culture and organisations do not, in the main, tend to forgive failure easily. ‘Winning’ managers, sports stars, mountain climbers and people of all ilks are rewarded when their struggle through adversity leads to achievement. Society does not reward those who abandon a challenged course of action, even if all evidence suggests that abandonment is the best way forward.

The Escalation Problem in Context

This research programme investigates the phenomenon known as the escalation of commitment: the tendency to persist with troubled projects despite evidence suggesting that setbacks within the project could lead to its eventual failure. The tendency to escalate commitment to troubled projects by investing greater amounts of time, money and effort than originally anticipated, have been shown to be strong, persistent and contrary to conventional economic prescriptions.

If it becomes evident over time that a course of action is failing, the rational decision-maker is compelled to make the often agonising decision to abandon it (Keil and Montealegre 2000). These decisions are difficult for two reasons. The first is that in real-world situations it is often difficult to ascertain the criteria for success and failure against which a course of action should be judged. Secondly, significant
amounts of resources and reputation may be lost to the decision-maker if a decision to abandon the action is made, particularly if prior decisions to support the venture were public, freely given and irrevocable (Ross and Staw 1986). Often, the reluctance to make such a difficult decision leads people to persevere with courses of action that are demonstrably likely to fail, often spending (and subsequently losing) more than expected in the process.

Within a project management context, commitments to projects are manifest through continuous investments and support throughout the course of their development and implementation. Maintaining the commitment of senior management and the project organization is a necessary component of project success (Sauer 1993; Schmidt et al. 2001; Yetton et al. 1999; Yetton et al. 2000; Sharma and Yetton 2003). However, strong commitment to a project’s development may become aberrant if investments of time, money or effort are doggedly extended for projects that exhibit signs of inevitable failure. ‘Escalation’ occurs when commitment to a project is maintained even though it has begun to exceed time, budget or quality constraints, or fails to become adopted by its intended users. The preponderance of escalation literature has drawn on Cognitive Dissonance theory (Festinger 1957), Prospect Theory (Kahneman and Tversky 1979), Agency Theory (Alchian and Demsetz 1972, Eisenhardt’s 1989, Harrison and Harrell 1993) and Arkes and Blumer’s (1985) sunk cost effect as the descriptive theoretical bases for why decision-makers would cognitively and counter-factually prefer to direct projects towards their inevitable failure than to rationally terminate them before more resources are lost to it.
The Extent of the Problem in Information Systems Projects

Information systems development projects are notoriously prone to failure. It is estimated that just 16% of all information systems (IS) development projects are delivered on time and on budget (Johnson, 1995). Keil, Mann et al. (2000) suggest that between 30% and 40% of IS projects experience some form of escalation. The efficiency with which IS projects meet their time, cost and quality objectives in a project setting has not improved with time, despite the improvements in development technologies such as reusable components and object-oriented design that (at least in theory) should make IS developments and implementation less time consuming and more efficient, customisable and better suited to meeting organisational requirements (Welke 1994). There should therefore be few technical reasons, argue Lyytinen and Robey (1994), for organisations to “experience the backlogs and delays that plagued systems development 20 years ago” (p85).

Yet information systems (IS) research literature abounds in case studies and surveys which detail the endemic and unresolved problem of the failure to develop IS projects within their requisite time and cost budgets (Abdel-Hamid 1988; Drummond 1999; Keil 1995a, 1995b; Keil, Cule et al. 1998; Keil, Mann et al. 2000; Keil et al. 2003; Lyytinen and Robey 1999; Montealegre and Keil 2000; Newman and Sabherwal 1996; Sauer 1993; Schmidt et al. 2001; Zhang et al. 2003). Time and cost overruns during IS project developments have been a persistent and pervasive a problem for as long as the technology industry has existed. Benko and MacFarlan’s (2003) book “Connecting the Dots: Aligning Projects With Objectives in Unpredictable Times” reported estimates that technology spending in the United
States’ was equivalent to around half of all US capital expenditures, with US$2.5 trillion spent on technology in the years 1997-2001 alone. Of this, they estimate that US$1 trillion was invested in underperforming investments over the five years to 2003, a total deduced using a reported estimate that 80% of all IT projects “are conceived and funded in a fragmented manner, with little in the way of overall planning” (Benko and MacFarlan 2003, p2).

**Escalation of Commitment Defined**

Escalation of commitment is defined by Brockner (1992) as the “tendency of decision makers to persist with failing courses of action”. Colloquially, it is often referred to as ‘throwing good money after bad’ (Staw and Ross 1987a). At its simplest level, escalation of commitment is manifest through time and cost overruns in excess of expectations that are embodied in budgets and projects plans. There are, obviously, two definitional aspects of this nomenclature that need explanation: ‘commitment’ and ‘escalation’. Kiesler and Sakumura (1966) view ‘commitment’ as the "pledging or binding of the individual to behavioural acts". Once individuals bind themselves to an action, they argue, “the effect of commitment is to make [that] act less changeable”. Keisler and Sakumura (1966) assert that commitment is often a product of “the explicitness of the act, the importance of the act, the degree of irrevocability of the act, [and] the number of acts performed”. Within an organisational context, commitment to projects is manifest through continuous investment and support throughout the course of their development and implementation. Maintaining commitment to projects from management and project stakeholders is a necessary component of project success (Sauer, 1993). However,
strong commitment to project development may become aberrant if investments of time, money or effort are made to projects once they begin to fail. ‘Escalation’ occurs when commitment to a project is maintained even though it has begun to exceed time, budget or quality constraints, or fails to become adopted by users (Ghosh 1995).

In Brockner’s (1992) widely cited definition of escalation of commitment, the term ‘failing’ is used to denote a project in which negative information has become known that directly affects the viability of the project. Many sources and types of negative information have been employed to denote a project as ‘failing’. Arkes and Blumer (1985) test escalation using a scenario in which a competitor has released a superior product to the one the decision-maker’s organisation is in the process of creating. Ross and Staw (1986; 1993) employ case studies in which disruptions to development, political wrangling and shifting scope and requirements extend the project well outside of its initial cost and time projections. A common finding of many of these investigations is that there may be exogenous shocks to the project – unforeseen occurrences that mar the feasibility of the initial project estimates. Abdel-Hamid (1988) also points to complications arising due to underestimation of cost and time during planning that are only realised well into a project’s development. Responding to these events is difficult, especially when there is extant commitment to the project, often in the form of irrecoverable sunk costs and the personal responsibility of actors whose reputations are bound to the success or failure of the project.
Much of the early literature casts escalation as robustly irrational. Failing projects, this literature argues, should be abandoned without regard to the amount of sunk costs incurred. However, many escalation situations occur because the conditions of the project, and the likelihood of eventual success or failure are ambiguous. This notion finds support with Keil, Mann et al. (2000) who state,

“For a variety of reasons, these [negative performance status projects'] performance problems may or may not be visible to the key decision maker responsible for the decision of whether or not to continue the project” (p634)

This led Keil, Mann et al. (2000) to redefine escalation of commitment as occurring “when troubled projects are continued instead of being abandoned or redirected” (p633, emphasis added) adding that project escalation is seen to occur specifically when there is a negative project status, which is associated with those projects that experience problems and setbacks in cost, schedule, functionality or quality (Keil, Mann et al. 2000). This definition of escalation as commitment to troubled projects will be used within the scope of this research programme.

Ambiguity in the Definition and Clarification

The term ‘escalation of commitment’ has been has been used to define projects that are ‘failing’ (Brockner 1992) or ‘troubled’ (Keil, Mann et al. 2000). These terms are not synonymous. Brockner’s (1992) definition of ‘failing’ describes this state as existing when negative information is available that questions the viability of the project. Keil, Mann et al.’s (2000) definition of ‘troubled’ projects is characterised through negative performance status. In both accounts, escalation of commitment is not necessarily defined through a project’s inevitable failure. ‘Inevitable failure’ is
an amorphous notion and, to date, has not been fully characterised within success and failure literature.

Many projects are continued despite negative project status yet result in what are considered to be successes. Take the example of the Sydney Opera House, which was originally projected to cost A$7 million. Fifteen years and A$107 million later the Sydney Opera House is an iconic piece of architecture and could not, despite its cost and time overruns, be considered a project failure (Lim and Mohamed 1999). However, the Opera House was completed despite ‘negative project status’ evident throughout its construction, as time and cost overruns became apparent and as conflict arose between the architects, government and the community. To this end, assuming negative information connotes failure does not take into account that continued support is the primary determinant of project success (Sauer 1993).

The Working Definition of Escalation Within This Research Programme

Thus we conform to Keil, Mann et al.’s (2000) definition of escalation in this research programme. We see escalation as occurring when projects experience setbacks that require an increase in commitments by stakeholders beyond that which was originally anticipated. When setbacks occur that raise the level of commitments in previously unanticipated ways, they create decision dilemmas in which decision-makers must decide whether continuing their support of a project is worthwhile. In cases such as these decision-makers are left with a number of alternatives: (1) to

1 Prof. Mark Keil, from Georgia State University is the most prolific investigator into the phenomenon of escalation of commitment to information systems projects. Indeed, he is one of the most prolific investigators of the phenomenon within the entirety of escalation of commitment literature. This research programme extensively cites his oeuvre and is heavily influenced by his and his colleagues' findings. It will become evident throughout the course of this thesis, however, that while heavily influenced by his work, this research represents a significant departure from it and from the historical narrative that exists within escalation literature.
fully or partially tolerate setbacks and spend more resources than originally anticipated (i.e. to *escalate* their commitment); (2) address the setback by continuing their commitment at their planned levels (i.e. to *correct* the project); (3) to reduce their commitment to the course of action (i.e. to *de-escalate* the project) (Keil and Robey 1999); or (4) to withdraw their support from the course of action completely (i.e. to *abandon* the project). The objective of this research programme is to investigate how tolerance affects a decision-maker's choice between these alternatives.

**Research Programme: Zones of Tolerance to Escalating Projects**

The basic premise of this research is that decision-makers react to Zones of Tolerance (ZOTs) *in situ* of the decision context and may (at least in the minds of decision-makers) rationalise continuation of troubled projects using the existence of these Zones as evidence that the costs of continuation are less than the cost of correction, de-escalation or abandonment of a project. It will be argued that many of the factors contributing to the continuation of troubled projects that are identified in previous literature are in fact either components of, or manifestations of, Zones of Tolerance, defined as *the extant set of boundary conditions within which the costs to the decision-maker of variations from expectations are immaterial, negligible or zero*. In other words, when ample tolerance for variations from expectations exist within the organisational and structural constraints imposed upon a project's development, decision-makers often feel justified in continuing troubled projects despite significant and repeated setbacks. Further, it is conjectured that correction,
redirection or abandonment of projects may tend to take place only once these ZOTs are breached.

The purpose of this research programme is fourfold:

1. To provide workable definitions of the escalation of commitment phenomenon and associated concepts;
2. To postulate and empirically verify the effect of tolerance to escalating projects that is manifest through the extant organisational and structural constraints present within the decision context,
3. To postulate the effects of some common project setback metrics, such as cost and time overruns, on this tolerance;
4. To investigate the effect of some universal project characteristics (such as alternatives, time, risk and opportunity costs) on the escalation phenomenon and tolerance.

Appendix A xxx lists the overarching research questions, the guiding theoretical propositions, specific hypotheses and results.

This chapter began by advancing a workable definition escalation. It proceeds to define and characterise tolerance and to make some general conjectures about the types and qualities of Zones of Tolerance. The following chapter will go on to examine previous literature and, in doing so, will highlight some of the contradictory findings evident and speculate upon the difference between the intentions versus interpretations of seemingly irrational decisions to continue projects despite setbacks that represent variations from initial project expectations.
Thirty years of literature examining escalation identified a multiplicity of factors that are found to contribute to the phenomenon without much progress towards a definitive solution to the problem (Verner et al. 1999). Case studies, surveys and experiments have ranged in focus from the idiosyncratic features of IS/IT projects that make them more amenable to escalation, examinations of the roles and effects of organisational constraints as well as a broad ranging investigation into the phenomenon from research fields as diverse as information systems research, psychology, organisational behaviour, judgment and decision-making literature.

Examining the extensive and varied perspectives on the escalation phenomenon is an interesting, yet difficult task, particularly since these ranges of perspectives arise from examination of escalation cases and scenarios that are couched within myriad different contexts. The predominant consensus within the literature is that the most significant sources of escalation arise through the sunk cost fallacy and the need for self-justification in the face of negative information. Beyond this, many investigators of escalation case studies employ a classification schema that identifies factors contributing to escalation via project, psychological, social and organisational/structural factors. For the sake of faithful reporting of previous findings, and in keeping with the traditions of investigation into this area, this literature review will maintain those classifications.

What should become clear from review and critical appraisal of prior investigations that follows is that escalation of commitment to troubled projects is a context-laden, ambiguous and multidimensional phenomenon. However, the purpose of this
research will demonstrate how tolerance for setbacks to ventures of this kind predominantly arises through decisions made in reaction to the organisational and structural constraints that undergird all project management decisions within these contexts. Zones of Tolerance, it is argued, represent the extent to which these setbacks from expected outcomes are absorbed by these constraints.

**The Objective of This Research**

The research investigates the extent to which decision-makers tolerate variations from their expectations, and how they behave once their tolerance has been eroded. It postulates that decision-makers take cues from the decision context to determine Zones of Tolerance (ZOTs), the extant set of boundary conditions within which variations from expectations are recognized but carry no significant utility or disutility to the decision-maker. We empirically demonstrate that decision-makers do not correct variations from expectations (such as setbacks to a project) within ZOTs and correct them outside ZOTs.

**The Research Question**

In making decisions to continue, redirect or abandon troubled projects, one is faced with a fundamental question:

*When managing a project facing setbacks, to what extent am I willing to tolerate variations from my prior expectations, and what do I do once my tolerance has been breached?*
Tolerance for variations from expectations, it would seem, is an underlying determinant of a decision to persist with troubled projects, ultimately determining support for the project and its eventual success or failure. The questions posed in this research programme are therefore: How do setbacks erode a decision-maker's tolerance and their willingness to support as project? What influences tolerance? And where do the limits of this tolerance lie?

Over thirty years of escalation of commitment literature have largely assumed that escalating commitment to troubled projects is fundamentally irrational and driven by base impulses of loss aversion and fear of failure. This research sets out to question these assumptions by examining the micro-decisions to tolerate small setbacks which cascade and compound over time to engender large-scale failures, heavy cost overruns and, on the face of it, grossly mismanaged projects. In sum, it is argued that imminently rational decisions to tolerate minor setbacks may become the precursor to imminently irrational decisions to persist once those minor setbacks cascade and compound into larger setbacks that lead to eventual project failure.

Using the context of escalating commitment to troubled projects, this programme of research explores the nature of decisions within failing courses of action. Specifically, it addresses a question that is simple in expression but complex (indeed perhaps unsolvable) in resolution:

When faced with a failing course of action, at what point does one's tolerance for setbacks evaporate, and what happens when it does?
Chapter 1 - Introduction

The Scope and Purpose of This Work

The basic premise of this research is that decision-makers react to conditions within the decision context that contribute to the existence of Zones of Tolerance (ZOTs). These ZOTs in situ of the decision context may (at least in the minds of decision-makers) rationalise continuation of troubled projects using the existence of these Zones as evidence that the costs of continuation are less than the cost of correction, de-escalation or abandonment of a project. It will be argued that many of the factors contributing to the continuation of troubled projects that are identified in previous literature are in fact either components of, or manifestations of, Zones of Tolerance, defined as the extant set of boundary conditions within which the costs to the decision-maker of variations from expectations are immaterial, negligible or zero. In other words, when ample tolerance for variations from expectations exist within the organisational and structural constraints imposed upon a project’s development, decision-makers often feel justified in continuing troubled projects despite significant and repeated setbacks to the project. Further, it is conjectured that correction, redirection or abandonment of projects may tend to take place only once these ZOTs are breached.

An Overview of the Empirical Studies in this Programme

Using three scenario-based simulations, the research investigates numerous determinants of Zones of Tolerance.
Experiment 1: Proof of Concept

In the first study, we investigate whether project support, escalation and failure are determined primarily through the limits of a decision-maker's tolerance (termed here 'Zones of Tolerance', or ZOTs) for variations from expected outcomes. Our conjecture is that decision-makers display certain degrees of tolerance due to manifest ambiguities within the decision context. We demonstrate empirically how decision-makers tolerate minor variations from expectations, and how, if these seemingly minor variations are allowed to cascade and compound over time, they create the historically antecedent conditions typical of escalation of commitment episodes. Paradoxically, we find that comparatively low budget overruns (which tend to be tolerated) lead to greater total resource commitments than high budget overruns (which tend to be corrected). In addition, we find that alternatives to the decision to escalate commitment to troubled projects have no significant effect on the said decision, contrary to prior studies (Arkes and Blumer 1985, Conlon and Garland 1993, Shaubroek and Davis 1994, Keil et al. 1995).

Experiment 2: Extension of Concept – Projects Over Time

In this study we added the additional constructs of time, variance stability and risk. We found significant influences of time, variance, and ZOTs on the affective states of decision-makers. While budget variances had an effect on decision-making, this effect was largely influenced by the stability of those variances over time.
Experiment 3: Project Portfolios

This study examines the influence of tolerance for setbacks, the extent to which alternative resource allocations are available and the way in which projects change over time. We hypothesize that ZOTs inhered within the decision context lead to increasingly suboptimal resource allocations between troubled and untroubled projects over time. The study compares objectively optimal resource allocation strategies against decision-makers’ actual allocation decisions in a portfolio of two projects.

Consistent with our expectations, decision-makers failing to correct early variations from expectations can be shown to significantly diverge from optimal allocations when ample tolerance exists within the decision context. Conversely, when there is low tolerance for variations within the context, we see earlier detection and correction of variations from budgets and more optimal resource allocation behaviour overall. A second interesting finding is that decision-makers tend to make allocation decisions that are closer to optimality when the organisational constraints manifest low tolerance and, counter-intuitively, when provided with loose, rather than strict, resource constraints. This is possibly due to a belief that loose resource constraints connote the ability to freely move resources between projects.

Philosophical Basis of This Behavioural Research

"Man is a rational animal who always loses his temper when he is called upon to act in accordance with the dictates of reason.” – Oscar Wilde
The phenomenon of escalating commitment to failing courses of action represents a break-down in rational decision-making process. When courses of action are undertaken, they typically begin with imminently rational objectives and strategies. However real-world ambiguity, constraints and risks often cause unintended and unanticipated setbacks, particularly when the course of action is large in scope or complex in nature. When such setbacks occur, they create dilemmas for the decision-maker: should they proceed with the course of action despite its setbacks, escalating their originally anticipated commitment of money, time and effort? Should they change their course of action, by redirecting their efforts, reducing the scope of their objectives or reducing their resource commitments in the face of these unanticipated risks? Should they abandon their commitment entirely, often losing the committed resources spent to date and perhaps jeopardising their reputation, future access to resources, or indeed their jobs?

Rational economic theory offers some advice (Harsanyi 1986), but this advice is not much help to a decision-maker operating in a world where economically sound principles are often trumped by organisational dynamics and cultural mores. Take for instance the theory of sunk costs (Arkes and Blumer 1985), the economic tenet that previously incurred and non-recoverable costs should not be factored into a decision to spend future resources. While objectively rational, this principle bears little authority in real-world decision-making. The case of a failing war, for instance, it would be very difficult to explain to a nation that the lives and treasure already lost to a conflict no longer matter in future decisions.
At its core, the fields of decision theory and behavioural economics explore the often contentious association between behaviour and rationality. Much of the literature cast decision-makers as fickle, emotion-driven creatures varying their tastes, preferences and behaviours in inconsistent (i.e. irrational) ways. Stable preference sets and expected utilities based on known risks and outcomes are the prevailing assumptions that undergird most literature into rational economic behaviour. On the other hand, loss aversion, self justification and incomplete preference sets are among the modus operandi of the irrational decision-maker, their behavioural optimality weakened by these salient, though disruptive, influences on manifest behaviour.

Herbert Simon and his contemporaries, notably James March, Richard Thaler and Gerd Gigerenzer among others, have written in apologia of decision-making that ostensibly deviates from fundamentally 'rational' economic behaviour. The real challenge, they argue, is ambiguity - ubiquitous and insurmountable in the 'real world',

"Rationality implies a complete, and unattainable, knowledge of the exact consequences of each choice. In actuality, the human being never has more than a fragmentary knowledge of the conditions surrounding his action, nor more than a slight insight into the regularities and laws that would permit him to induce future consequences from a knowledge of present circumstances." (Simon 1976, p81)

Rational choice theory can be unworkable under conditions of real-world ambiguity. Specifically, the tripartite challenges posed by time dependence, incomplete
information and a shifting tastes and preferences violate many of the basic assumptions required for many rational choice theories to remain tractable.

Despite the confounding effects of ambiguity on decisions, rational choice theories are the building blocks of optimal choice by first principles. Jon Elster (1993) sums up the importance of rational choice theory thus:

"Rational choice theory is far more than a technical tool for explaining behaviour. It is also, and very importantly, a way of coming to grips with ourselves - not only what we should do, but even what we should be." (Elster 1993, p179)

The escalation of commitment phenomenon – a commonly occurring and pervasive behaviour - is particularly conducive to the examination of the boundary conditions between rationality and irrationality in choice behaviour, since the very nature of the problem allows us to take decision-makers through a series of decisions that begin with an unambiguously orthodox and rational course of action that gradually deteriorates to the point that persisting with the same course of action becomes an unambiguously irrational (Drummond 1998). This decision domain allows us some unique insights the fuzzy boundaries between rational and irrational choice and even the ethical implications of such decisions (Keil and Robey 2001, Street et al. 1997).

Contributions to Theory and Practice

This research programme takes a significant step towards understanding how tolerance of minor setbacks affects future tendencies to persist with challenged courses of action. Using both behavioural decision-making apparatus and by
applying linear programming (in Experiment 3), these studies theoretically and empirically demonstrate how tolerance for troubled projects is extended when variations from expectations manifest within Zones of Tolerance. Furthermore, it demonstrates ways in which the structural and organisational constraints on decision-making affect the way in which decisions are made and troubled projects are handled.

The third study makes another conclusion hitherto never discussed within escalation of commitment literature. It theoretically and empirically demonstrates the ways in which troubled projects draw resources away from well-performing projects within a portfolio. It validates a hitherto unapplied method of measuring the extent to which decision-makers are departing from an objectively optimal decision strategy during escalation of commitment dilemmas.

The practical applications of this research are discussed in the later chapters. In brief, project management practices are held under scrutiny within this research and significant questions are posed about the effectiveness of conventional project management tools and techniques. It is argued that such practices need to be held to account against the realities of human judgement and decision-making behaviour, and it is shown through these empirical studies that manipulating Zones of Tolerance have significant effects of human judgement within the organisational context and represent, in some cases, stronger controls against escalation of commitment behaviour than conventional project management techniques.
Rationality

On its face, escalation of commitment to failing projects appears robustly irrational. It would seem apparent to draw the conclusion (as has been done extensively in prior research) that continuing investments in projects that are failing would represent a departure from rationality – a preponderance of loss aversion, fear and regret on the part of the decision-maker that overwhelms their more rational instincts to cut their losses and reconcile themselves to sunk costs.

For the most part, decisions to invest time, money or effort in a course of action are initiated through real value propositions that are seen to be both realisable and significant. Interpreting the evidence reported in IS case study literature on escalation, it appears evident that small deviations from objectives (such as time and cost budgets) are tolerated rather than redressed, particularly during the early setbacks of a troubled project. In this case, small negative variances from expectations are insufficiently salient indicators of future trouble, and decision-makers would not act to protect or reinstate their asset positions or to challenge their cognitive perceptions of the correctness of their decisions. This tolerance may create the typically antecedent conditions by which decision-makers may become prone to larger variances down the track. Case study literature into the escalation phenomenon (Drummond 1994, 1995, 1997, 1999; Keil 1995b; Montealegre and
Keil 2000; Ross and Staw 1986, 1993) suggests that the greatest contributors to departures from expectations arise both gradually and internally through issues with resource planning, estimation and controls rather than the profound exogenous shocks:

"[T]he typical escalation episode can be seen as beginning with the bright promise of future outcomes through a given course of action. The course of action gradually but progressively becomes a losing proposition [...] as countervailing forces tend to build up over time, making it more difficult to withdraw than would be expected only if economic results were considered."

(Ross and Staw 1993, p. 203, emphasis added)

Why do project managers acquiesce to unfavourable budget variances to the extent that they do? It could well be argued, in many cases, that the costs to the decision-maker of tolerating project slippages are lower than the costs of revising and correcting those slippages. In cases such as these the self-interested or opportunistic decision-maker would be best served by allowing variances up to the point at which the cost of project slippages exceeds the benefits of not correcting them. A decision-maker faced with these circumstances would tolerate slippages to the point where support for these variations from expectations would be violated by constraints on the project, such as management/stakeholder support, or project constraints such as resource limits and deadlines. When variances are compounded to an unreasonable degree, these time and cost overruns lead to entrapment episodes subsequently may compel decision-makers to operate against the economic, social and moral incentives and disincentives available to them.
The pervasive problem of time and cost overruns is compounded by a seemingly cavalier attitude to budget overruns by IS project managers that has been supported in a number of studies (Ewusi-Mensah and Przasnyski 1991; Yetton et al. 2000). Ewusi-Mensah and Przasnyski (1991), in a survey of IS project managers, found that “in most abandonment cases the issue of cost and/or schedule overruns, although a consideration in some cases, is not a major contributor” (p81). Yetton et al. (2000) confirm this in their survey which found that project managers do not actually consider budget variances as critical to project performance.

**Overarching Research Questions**

While tolerance may be extended to setbacks, a decision-maker's willingness to persist with a course of action may be limited by the organisational and structural constraints inherent within the environment. Management support for a project may be negated and effectively vetoed by the tolerance and slack available within the decision context. For instance, management may wish to continue a project, but if no resources exist to pursue the course of action, the project may have to terminate regardless. Ample evidence exists within previous literature to support this conjecture, and this research programme’s objective is to isolate and manipulate the tolerances of both decision-makers and the organisational/structural tolerance of the decision context (as well as the interaction effects between the two). These organisational and structural constraints on escalation decisions are discussed later in this section. For now, however, the critical questions for this programme of research can be stated thus:
RQ1: To what extent are setbacks tolerated by a project's constituents?

RQ2: To what extent can setbacks be absorbed by the environment within which the project is undertaken?

RQ3: Is there an interaction between a decision-makers tolerance of project setbacks and the extant conditions evident in the organisational environment?

It will be argued within the remainder of this chapter that the extent, limits and consequences of tolerance for project setbacks are the key underlying factor in the continuation of troubled projects and the key determinant of project escalation.

Tolerance and Its Limits

What is Tolerance?

To what extent do we tolerate setbacks and where does that limit lie? Consider the following dilemma:

You are sitting in a restaurant waiting to meet a blind date. You realize that she is running ten minutes late. Is it reasonable to castigate her for tardiness if she turns up now, or would you accept there is a margin of tolerance for her arrival time? Unsure of whether she will turn up at all, but knowing that she is arriving by your city's notoriously unpredictable train system, how long would you wait before your tolerance runs out and you decide to go home?
To complicate matters, would you be likely to wait as long if you knew there was a gathering of your friends nearby that you could attend should you choose to abandon the date? In other words, would the availability of an alternative to your date lead you to have less tolerance for his or her tardiness?

The preceding scenario illustrates the basic premises of this research programme. Firstly, we can see that small variations from expectations would not necessarily lead to large manifestations of dissatisfaction with the status quo course of action. We often tolerate small variations from our expectations and consider these variations as an inevitable consequence of an ambiguous decision context with imprecise estimations of investment requirements. Furthermore, if after waiting for half an hour your blind date shows up, is highly appreciative of your patience and the date was worthwhile, then your persistence would be considered rational, indeed rewarded. If your date fails to appear, your support must inevitably be withdrawn at some point. Thus, the rewards and penalties of persistence can often only be known post-hoc. The second part of the scenario exemplifies how the existence of alternatives to challenged courses of action can often complicate the decision-making process, and may reduce our tolerance for variations from our preferred outcomes.

**Tolerance for Project Escalation**

The basic premise of this research is that project support, escalation and failure are determined primarily through a decision-makers reaction to degrees of tolerance
(ostensibly termed here as ‘Zones of Tolerance’, or ZOT's) for variances from expectations that are a product of conditions within the decision context. A ZOT is the margin to which outcomes are allowed to deviate from expectations without a change in support for the course of action. Within a Zone of Tolerance, variations from expectations are considered comparatively small and (importantly) acceptable.

*We therefore posit a Zone of Tolerance (ZOT) as the extant set of boundary conditions within which variations from expectations are recognized but carry no significant utility or disutility to the decision-maker.*

While Zones of Tolerance were originally proposed within the forecasting field (Lawrence and O'Connor 2005), it is contended that ZOTs are phenomena that influence decision-making in a wide and varied number of decision contexts. Specifically, we examine how the presence of a Zone of Tolerance affects project managers' willingness to tolerate budget variances (in both cost and time) and project slippage within IS developments. This willingness to tolerate resource expenditures in excess of initial expectations is dependent upon the qualities of the behavioural, environmental and resource constraints imposed within a project setting.

**Origins and Evidence of the Zone of Tolerance Proposition**

*Loss Functions Containing Zones of Tolerance*

The concept of a Zone of Tolerance represents a specific case of organisational context where the cost to the decision-maker of tolerating variations from
expectations are zero, negligible or relatively less than the costs of correction. The existence of Zones of Tolerance was originally proposed by Lawrence and O’Connor (2005) and couched within the forecasting field. Specifically, ZOTs were examined within the context of forecasting in the presence of symmetric and asymmetric loss functions. They argue that forecasts depart from their expected values when they are influenced by, and face systematic bias from, asymmetric loss functions evident in the decision context. They state that,

"[i]n a less-than-perfect world where errors are inevitable, the ‘cost’ to a forecaster (or a decision maker) of an under-forecast may not be the same as the ‘cost’ of an over-forecast, and if the error falls within the tolerance zone, the cost maybe zero." (Lawrence and O’Connor 2005, p4)

Simple exemplars of the effect of asymmetric loss functions range from the blind date illustration above (where the costs of waiting longer are potentially less than the costs of not waiting long enough) to Lawrence and O’Connor’s (2005) analogy of carrying an umbrella when there is a chance of rain:

"For example, if people consider that they would rather take an umbrella and not use it compared to being caught in the rain without it, it would be beneficial for a weather forecaster to err on the side of forecasting rain, even if the chance was minimal. In this case, the cost of not forecasting rain when it occurs is greater than the cost of forecasting rain when it does not occur. In this example, there is a difference between a forecast error and the ‘cost’ of it to the individual users of the forecasts." (p3)
Within an organisational context Goodwin (2005) offers an illustration of asymmetric loss functions evident in a production environment:

"[I]n decisions on the weekly production levels of a product, the costs incurred though over producing by a given amount, such as extra stockholding costs, may be less than the costs of under producing by this amount." (p386)

Lawrence and O'Connor (2005) empirically demonstrated the effect of these asymmetric loss functions by exposing subjects to both 'kind' and 'unkind' loss functions\(^2\) when asked to perform monthly forecasts on a product's sales with varying levels of loss function symmetry. They found that subjects' forecast errors were significantly higher with the presence of a Zone of Tolerance around their forecast estimates than when it was absent. They also found that decision-makers exhibit adaptive learning behaviour by adjusting their forecast estimates in the direction implied by the loss function and conclude that introducing a forecast error tolerance may reduce judgemental forecast accuracy.

The empirical findings of Lawrence and O'Connor (2005) find corollaries and support with the resource allocation behaviour research of Harvey Langholtz and his colleagues both within and outside an organisational context. Langholtz et al. (1994) conducted an empirical investigation in which two environments of resource constraints were compared. Subjects having to make investment decisions in which resource constraints are known and limited ('harsh environments') became

\(^2\) The 'kind' and 'unkind' manipulation of the ZOT construct used by Lawrence and O'Connor (2005) as well as the 'benign' and 'harsh' manipulations of Langholtz et al. (1994) loosely correspond to the 'high' and 'low' ZOT levels (respectively) used in the experiments within this research programme, albeit with a different problem context and operationalisation.
significantly more conservative in their decision-making strategies from those who made decisions in ‘benign environments’, where “survival was never threatened” (p47). This would suggest that survival reference points do indeed exist where resource exhaustion is a real and salient possibility if the investment does not produce optimal results.

Not all research indicates that asymmetric loss functions contribute to poorer resource allocation decisions. Goodwin (2005) conducted a study into forecast accuracy in a production scheduling task. He found that decision makers who were either unaided or aided by statistical point forecasts made significantly better decisions in the presence of asymmetric loss functions where the costs of shortages were more expensive than the costs surpluses. Lawrence et al. (2006) put these observed differences from the Lawrence and O’Connor (2005) down to the possibility that “minor differences in the task” may have contributed (Lawrence et al. 2006, p498). In sum, the research into asymmetric loss functions seems to suggest that the ecologically rational decision-maker is often compelled to bias their estimates of future outcomes by adapting decisions towards the direction implied by the loss functions present in the decision context, regardless of whether this adaptation is economically rational or not.

Zones of Tolerance in the Presence of Loss Functions

We have earlier defined Zones of Tolerance as the extant set of boundary conditions within which the costs to the decision-maker of variations from expectations are immaterial, negligible or zero. While the findings of forecasting literature are based on explicit loss functions, we can extrapolate this construct to both explicit and
implied 'Zones' inherent within problem space that serve to create an organisational context in which decision-makers are apt to adapt their tolerance. As Lawrence and O'Connor (2005) state "Arguably, the presence or absence of a specified region of acceptability will induce different attention to the accuracy of the forecast and the effort put into such activity" (p6). This would imply that ZOTs are in fact conditions in situ of the decision context, rather than an innate quality of decision-makers themselves. This definition of tolerance departs somewhat from those put forward by Norton (1975) among others who describe tolerance for contextual ambiguity as an innate quality of decision-makers themselves (as well as Fox and Tversky 1995, 1998).

In summary, it is our conjecture that Zones of Tolerance are extant conditions within the decision-context that can be influenced through both explicit and implied gain and loss functions. Within a ZOT, decision-makers find it apt to absorb variations from expectations and correct said variances when inside a ZOT.

How ZOTs Are Relevant to the Escalation Problem

How Is Tolerance Manifest?

Studies of the effects of ZOTs and loss functions on decisions within the forecasting domain have different intrinsic characteristics to those in a project management domain. Goodwin (2005) states that, in forecasting tasks, knowledge of the effects of decisions is presumed ex ante "since, in practice, the losses are often known, or taken as given, [and therefore] the most appropriate role of judgment is to estimate
the probability distribution of demand" (p389). Empirical evidence from forecasting tasks containing asymmetric loss functions have typically comprise of two components known (or knowable) prior to the decision – the probability distribution of future outcomes based on forecasts together with a history of prior forecasts and the losses associated with each production-demand combination.

Within a project management context, as distinct from a forecasting context, both the probability distribution of future outcomes, as well as the losses associated with each outcome are rarely if ever known with any certainty. In other words, future outcomes are characterised by ambiguity (Einhorn and Hogarth 1986a, 1986b). Much of the efforts to ascertain these metrics either quantitatively or qualitatively are hampered due to significant amounts of ambiguity within the decision context. We surmise that given the particular decision context investigated within this research programme (namely project environments where setbacks have occurred) that several conjectures may be made about the nature, scope and salience of Zones of Tolerance that demarcate and distinguish themselves from the conception of Zones of Tolerance as initially defined by Lawrence and O'Connor (2005). In doing so, one can identify three distinguishing factors common to many of the environmental and structural contexts prevalent in escalation of commitment dilemmas, namely:

1. Ambiguity
2. Expectations as reference points
3. Setbacks absorbed within a ZOT and corrected outside a ZOT.
**Ambiguity**

Gingrich and Soli (1984) as well as Busemeyer et al. (1986) investigated resource allocation behaviour in ambiguous and benign environments where survival was never threatened and their findings have direct implications on the nature and scope of this work. Busemeyer et al. (1986) empirically investigated resource allocation behaviour when there were no local optima. In other words, the decision context contained sufficient ambiguity such that no optimal decision was apparent or discoverable. They examined how adaptive learning behaviour influences the allocation of resources with the caveat that, in reality, where situations contain no local optima, “optimal policies cannot be specified without perfect knowledge of the objective function”. They state further for many real life decisions,

> “only imperfect and vague information about the objective function is available [... and] optional allocation rules are often very difficult to calculate, and it seems unreasonable to expect that the typical naïve subject knows the optimal solution a priori” (pp319-320).

In cases such as these “it makes very little sense to test whether or not subjects perform optimally” (p340).

Even with the benefit of 30 years of escalation research, there has not been a single successful model of forecasting escalation prior to its eventuation. Previous research investigating the phenomenon have essentially descriptive cases of escalation or prescriptive models of remedying escalations situations once they occur. Ambiguity prevents decision-makers from discerning optimal strategies for resource allocation a priori, particularly since future outcomes are difficult to ascertain with any certainty, and these outcomes are mutable depending on action. Ambiguity within these cases
is too confounding to the decision-maker to unambiguously denote projects as inevitably failing or certain to succeed.

Ambiguity in Context of Previous Literature

Ambiguity relates to the absence of ex ante knowledge of the extant probability distributions of outcomes and loss functions that manifest within the decision context. Within organisational contexts, ambiguity impedes the decision-maker's capacity to completely access knowledge of future costs and benefits of decisions ex ante. Significant amounts of ambiguity may be present in any predictions of future outcomes that are reliant on human action. Simon (1976) avers that ambiguity about future outcomes and the loss and gain functions that are attendant upon them limits decision-makers in their capacity for rational choice:

"Rationality implies a complete, and unattainable, knowledge of the exact consequences of each choice. In actuality, the human being never has more than a fragmentary knowledge of the conditions surrounding his action, nor more than a slight insight into the regularities and laws that would permit him to induce future consequences from a knowledge of present circumstances." (p81)

Ambiguity is manifest in many ways, but has a prevailing effect on the inability to assess consequences arising in the future. The eventual consequences of present behaviour are often only known post hoc. Decisions about the investment of effort made in previous time periods necessarily limit the available options of future ones. As time passes, investment in one alternative relinquishes the ability to invest in others, ambiguities are reduced and environments altered. Furthermore, temporal ambiguity can often conflict with strategy to the extent that time has a binding effect
on future behaviour and actions by narrowing the availability of alternatives. In other words, there is entropy to strategy over time.

"This time-binding character of strategies deserves the greatest emphasis, for it makes possible at least a modicum of rationality in behaviour, where without it, this would be inconceivable. For example, an individual who has spent seven years of his life preparing to be a physician and ten more years practicing that profession does not ordinarily have to spend any more time deciding whether he should be a physician or not."

"[...Time] narrows appreciably the alternatives that must be considered by the individual at each moment, and is certainly a necessary, though not sufficient, condition of rationality" (Simon 1957, p68)

The confidence in our knowledge of the intrinsic causal models at work within a situation can be characterised by degrees between certainty and ignorance. Ambiguity can be situated somewhere on the continuum between certainty (where causal models are known and future states can be finitely attributed) and ignorance (where no causal models are known and no future states can be ruled out). Daniel Ellsberg’s (1963) seminal work on ambiguity characterises the ambiguity of any situation as dependent on the “amount, type, quality and ‘unanimity’ of information, and giving rise to one’s degree of ‘confidence’ in an estimate of relative likelihoods” of future possible states (p657).

Risk and uncertainty literature is almost totally devoted to the ways in which humans identify and react to varying degrees of knowledge in future states. The comparative effects of certainty, risk and ambiguity on decision-making has been explored widely
within organisational contexts (Langholtz et al 1993; Ho et al. 2002; Einhorn and Hogarth 1985, 1986; Kunreuther et al. 1995). Both implicitly and explicitly, researchers manipulate the amount, type, quality and unanimity of information to elicit the efficiency with which actors delineate ‘possible’ future states as evidenced by the information at hand. In the traditional risk and uncertainty literature, gambles have been the most commonly employed vehicle by which researchers elicit actor behaviours; behaviours which are considered evident through preferences and strategies used within the gamble. The reason for the use of gambles (such as the urn problem of Ellsberg (1963), rolling a die, or tossing a coin for example) finds its roots in history and pragmatism. Historically, most of the risk and uncertainty research has employed these gambles, characterised by defined distributions where one employs a significant number of trials.

Given the inherent complexity of most human action, causal attribution to most preferred consequences of actions can never be determined with absolute epistemic certainty. Ambiguity in real-world decision-making here is characterised by epistemic ambiguity about the appropriate causal attributions of preferred future outcomes. When individuals select their preferred set of outcomes, they must discern which of a range of possible actions would result in those desired outcomes. This is what Simon (1976) defines as strategy. A decision involves the selection of a strategy that most closely follows the preferred set of consequences (Simon, 1976, p67). He adds that decisions become more than just simply factual propositions about current states. Rather, decisions are “descriptive of a future state of affairs” (p46).
Entropy is built into the structure of escalation decision dilemmas, by the use of aspirations, plans, resource limits, deadlines, and penalties and rewards for achievement of goals. Furthermore losses faced on exit from an escalating course of action are not all sunk and not all known – often there are future penalties and costs arising precisely out of the reductions in alternatives that were necessitated at previous decision-points. It is erroneous to assume that prior decisions and investments are sunk and that decisions made at any point in time exist independently of others.

**Expectations as Reference Points and Setbacks as Variations**

**Expectations Defined**

In the absence of known probabilities and outcomes, decision-makers form expectations about future states based on their own plans and intended actions. Expectations manifest from the causal models created by our knowledge of the relationships between current actions and future states. Effective decisions require knowledge of the problem space in order to “determine which consequences follow upon which of the alternative strategies” (Simon, 1976, p68). The more we know about the causal mechanisms at work in the problem space, the better we will become at predicting the future states that evolve out of our decisions to undertake actions in the present. Simon (1976) acknowledges that we can never know precisely all of the consequences that arise out of our present behaviours. Rather, we form “expectations of future consequences, these expectations being based upon known empirical relationships, and upon information about the existing situation” (p68, emphasis in text).
Within ambiguous decision contexts (such as escalation situations), expectations about project outcomes and expected resource allocations serve as reference points by which project team members benchmark project performance. Reference points have a number of characteristics:

1. They represent intended outcomes;
2. They are sourced from either the individual, group or the organisation;
3. They are often determined through history or force of precedent; and
4. They are often socially constructed and negotiable.

One set of reference points examined in previous literature and relevant to the current inquiry were those of hurdle rates. Cheng, Schultz et al. (2003, p65) investigated how the strength of the "psychological contract" created by a personally set hurdle rate affected the strength and salience of that hurdle rate in the face of an under-performing project. The strength of a hurdle rate set by the individual themselves, they argue, should create enough of a cognitive attentional load to "increase the salience of the dissonant feedback" (Cheng, Schultz et al., 2003, p69). Employing a laboratory study, they used both organisation-set hurdle rates and self-set hurdle rates and predicted that these hurdle rates acted as a control to deescalate or terminate failing projects (that is, the IRR not meeting the required IRR set by the hurdle rate). While Cheng, Schultz et al. (2003) could not find support for their hypothesis that organization-set hurdle rates significantly reduced the tendency to escalate commitment; they did find that self-set hurdle rates were a significant factor in reducing the tendency to escalate.
Cost, Time and Effort Budgets - More Art Than Science

The social construction of project expectations create two issues that have historically proved significant and often debilitating to the project development process. Firstly, those responsible for planning projects often (either wilfully or accidentally) tend to significantly underestimate time, cost and effort investments required for the smooth development of a project. The underestimation of these investment requirements stem from two sources. If accidental, they are often due to the widely prevalent problem known as the 'planning fallacy'. The planning fallacy was postulated by Beuhler et al. (1994) and relates to the empirically verified phenomenon that people systematically underestimate the time it takes them to complete tasks due to the use of 'plan-based' scenarios, rather than the use of their own past experiences to inform future expectations of required effort. Schmidt et al. (2001) confirm the planning fallacies effect on information systems project developments in a Delphi study of IS project managers in which poor estimation, insufficient staffing and inadequate planning were all identified as being among the top risks that projects face. Another interesting explanation of under-budgeting is discussed by Lovallo and Kahneman (2003) who suggest that people display systematic 'optimism bias' for future consequences of planned action that induces them to underestimate the likelihood of negative consequences and overestimate the likelihood of positive consequences of their actions.

Budgets may also be wilfully or deliberately understated. These budgets often suffer the limitation that they are agreed upon and committed to at the outset of a venture. This may become problematic if these budgets are deliberately understated in order to 'sell' the project to an organisation or client, either by overstatement of the
expected outcomes of the development or by understatement of the realistic resource requirements (Smithson and Hirschheim 1998). This understatement is often used as a selling tool for project managers especially when they are in competition with others for contracts from clients, or for funding within the organisation. Selling project in this way is often believed to be a necessary pretext for project inception and funding.

Expectations within Projects

Expectations arise in two basic forms within project management in information systems contexts:

1. Expectations about the *project outcomes*;

2. Expectations about the *resource investments* required to attain these outcomes.

Expectations about Project Outcomes and Deliverables

Project outcome expectations relate to the goals for undertaking a project and can be traced to the goals, scope and strategic value of the project. Project deliverable expectations relate to the sub-goals representing progress towards the intended outcome, such as project milestones and stage gates. These are typically codified within a project plan, most commonly in a project specification document and the project plan. Within information systems project developments, Fitzgerald (1998) identifies two broad categories of project outcomes from systems development projects. He identifies a broad class of ‘efficiency’ projects, those that aim to reduce the costs of a process by introducing information technology. Secondly he identifies ‘effectiveness’ projects which “better achieve the required results, leading to
increased revenues, better service or whatever” (Fitzgerald 1998, p18). Butler Cox (1990) identifies three additional types of project outcomes: mandatory investments (due to legal requirements, enforced monitoring et cetera), infrastructure investments (such as technology platforms, communications systems or other enablers of systems and services), and research investments (increase future potentials of technology), the latter of which is a special case where the ultimate objectives or expected values of such investments may often be unclear.

Each of these five general classes of projects will exhibit differing metrics with regards to their expected outcomes. The point made here is that these projects are initiated with certain expectations of intended outcomes from project sponsors, development teams, user groups and other external stakeholders. The expectations are often codified within project plans and benchmarks, and most of the prominent information systems development textbooks and literatures advocate the establishment and agreement of these expectations among the various interest groups as the first activity to be undertaken during the planning process (Project Management Institute 2000).

**Expectations about Resource Investments**

Expectations about resource investments relate to the anticipated requirements, most commonly in terms of investments of money, time and effort. These expectations are usually codified within cost budgets, time plans and activity schedules. Yetton et al. (2000) use budgets and budget variances as the key measure that captures the effectiveness with which a project is undertaken. Variances from resource expectations are operationalised through budget variances. Johnson (1995), Hallows
(1998) and Yetton et al. (2000) identify time and cost variances as a key measure of a project manager’s effectiveness.

The importance of variations from expectations is critical to the investigations undertaken within this research programme as these will be shown to be absorbed and tolerated within ZOTs and corrected outside ZOTs. These corrections are manifest by actions ranging in severity from cost corrections (budget tightening) through to de-escalation and project abandonment.

Two Expectation Reference Points: Aspiration Level and Survival

“What he [the decision-maker] does is to form expectations of future consequences, these expectations being based upon known empirical relationships, and upon information about the existing situation.” (Simon 1957, p68)

Reference points, particularly aspiration-level reference points, are “central to theories of individual and organisational choice” (March and Shapira 1992, p172). Aspirational reference points refer a specific and significant value metric relevant to the measurement of an expected outcome. Examples of aspiration-level reference points are budget figures, schedule deadlines, usage and deliverables metrics. March and Shapira (1992, p173) extended the notion of reference points given a few more real-world constraints on the decision-maker. They assert that decisions change with respect to not only status quo, but also with “the amount of current resources and the history of reaching that amount”. Aspiration-level reference points were employed
by Kahneman and Tversky's (1979) as a status quo expectation that adapts with experience and expected returns.

Unlike Kahneman and Tversky's (1979) prospect theory model, March and Shapira (1992) postulate a second 'survival reference point' which represents the point at which resources are exhausted. Risky decisions, then, are predicated on which of the two reference points the decision-maker is attending to. They explain that:

"aggregate risk-taking behaviour in a population is attributable partly to the way the process affects the accumulation of resources, partly to the way it distributes risk takers to success and failure (in terms of their own aspiration levels), and partly to the way it allocates attention between the two reference points" (p174).

Bright Lines and Mutable Reference Points

Budget amounts, deadlines, usage metrics, quality requirements et cetera can either be mutable or immutable depending on the context and qualities of the expectation in question. Immutable reference points have been referred to by Schelling (1960) (and commonly within law) as 'bright lines', especially salient outcomes where deviations are markedly noticeable and significant. An example of a bright line survival reference point could be a budget spending limit, the points at which there are no longer any resources to spend, regardless of whether or not a decision-maker still wished to continue spending.

Reference points are usually a little less transparent within a project management context. This is especially so if reference points are situated in a cardinal space (e.g.
in terms of money or time). These mutable reference points adapt to the changing circumstances of the organisation and the project and have the potential to be influenced by the actors involved in the decision-making process.

**Tolerance for Variations**

Budget overruns compounded to an unreasonable degree lead to entrapment episodes that may compel decision-makers to operate against the economic, social and moral incentives and disincentives available to them. Case study research by Keil (1995b) suggests that, in some circumstances, escalation is due to the project manager's allowance of budget variances in a tenacious attempt to salvage a project from failure. Prior escalation studies (such as Arkes and Blumer 1985) have examined escalation by giving decision-makers the binary decision to either allocate the entire remaining budget to complete the project or to abandon the project immediately. However, negative information does not often lead to considerations of project abandonment. Project teams may attempt to resolve problems that arise during development so that the project may stay viable. Therefore, in order to ascertain the veracity of ambiguous cues, project managers may decide to continue investment in projects with a view to addressing some of the sources of potential project failure. Similarly, project managers may adopt a 'wait and see' approach by delaying the decision in order to better understand the likelihood of success or failure of the project. This approach to addressing ambiguity in information systems development environments effectively involves 'paying a premium' for ambiguity reduction by delaying the abandonment decision until such time as the ambiguities surrounding the likelihood of success are better understood. Ironically, tentatively continuing an
investment to reduce ambiguity may be seen to be compounding the likelihood of failure by causing the very escalating commitment it seeks to avoid.

Ambiguity is the major reason for the encoding of tolerance within project plans. Within the context of project management, expectations about project outcomes and expectations of resource investments required to generate those outcomes represent the majority of all measurable reference points available to a decision-maker. Resource investments, the main object of inquiry within this research programme, relate to cost, time and quality budgets for projects. Of all project management tools available to decision-makers in projects there are few if any commonly accepted project management techniques that advocate the imposition of bright line budget limits, of which a breach would represent serious correction or stoppage of the project. Rather, budget overruns are usually dealt with on an ad hoc basis – and decisions to approve resource expenditures in excess of budget expectations depend greatly on the level of tolerance for these overruns expressed either by decision-makers or through the environments in which they operate. The standard project management technique of incorporating resource slack into project plans is evidence of this phenomenon.

Why do project managers acquiesce to budget variances to the extent that they do? To what extent does ambiguity drive the decision-making process? It could well be argued, in many cases, that the costs to the decision-maker of tolerating project slippages are lower than the costs of revising and correcting those slippages. This would suggest an asymmetric value function that implies that tolerance is more advantageous than correction. In cases such as these the self-interested or
opportunistic decision-maker would be best served by allowing variances to up to the point at which the cost of project slippages exceeds the benefits of not correcting them. A decision-maker faced with these circumstances would tolerate slippages to the point where support for these variations from expectations would be violated by constraints on the project, such as management / stakeholder support, or project constraints such as resource limits and deadlines. Furthermore, if a decision-maker knew a priori where these points of tolerance exhaustion lay and the magnitude of budget variance experienced by a project could be considered to be ‘absorbed’ by this tolerance, then there would appear to be few disincentives to overspending.

Ultimately, the problem of allowing such budget overruns within a Zone of Tolerance is that overruns tend to have the effect of cascading and compounding over time. Making continuous small investments in the hope of a large eventual pay-off has been termed by Brockner (1992) as ‘entrapment’. Brockner and Rubin (1985) exemplifies entrapment in a situation where one has waited 30 minutes for a bus and is considering catching a taxi. By waiting a little longer, one can hope to ‘salvage’ wasted time by continuing to wait for the bus to arrive, or one can catch the taxi at the expense of time lost and a costly taxi fare.

Tentative Conjectures: Variances, Tolerance, Ambiguity and Uncertainty

Tolerance for Ambiguity is Contextual, Not Innate

The very structure of the escalation of commitment problem seems to imply an interaction between variances from expectations and acknowledgement of ambiguity
in the decision context. The interplay between the two may lead decision-makers to reasonably concede that project setbacks are an inevitable consequence of ambiguity or uncertainty. Tolerance therefore, becomes a crucial part of the decision-making process. Tolerance may be extended by the decision-maker, but as will be seen later in this section, this tolerance is dictated by the organisational and structural context within which an escalating project is being developed.

Ambiguity can be situated somewhere on the continuum between certainty (where causal models are known and future states can be finitely attributed) and ignorance (where no causal models are known and no future states can be ruled out). Daniel Ellsberg’s (1963) seminal work on ambiguity characterises the ambiguity of any situation as dependent on the “amount, type, quality and ‘unanimity’ of information, and giving rise to one’s degree of ‘confidence’ in an estimate of relative likelihoods” of future possible states (p657).

Tolerance for ambiguity has been a widely investigated construct in decision-making processes (Norton et al. 1975, Staw and Ross 1978, Teger 1980, Bowen 1987, Ghosh 1994, among others). Within escalation literature neither Teger (1980) nor Staw and Ross (1978) found an effect of tolerance for ambiguity on the propensity to escalate. It is contended here that the reason for no discovery of an effect of tolerance for ambiguity in these decisions is that ambiguity has historically been investigated as internal to the decision-maker and exogenous to the decision context. By contrast, this research sees tolerance as inhered within the decision context and a product of the organisational and structural characteristics within which a decision-maker is
compelled to operate. This ambiguity is either promoted or constrained by the types and qualities of expectations and survival limits that are present within this context.

**Proposition 1: Treatment of Variances Within Zones of Tolerance**

As conceptualised by Lawrence and O’Connor (2005) Zones of Tolerance are created when a gap exists between reference points. Specifically, when a variance between expectations and outcomes is evident, decision-makers are compelled to examine the costs and benefits of maintaining the status quo and correcting problems (either by budget correction, project redirection or abandonment). If the outcome exists at a point where the costs of correction exceed that of maintaining the status quo, decision-makers may find it apt and appropriate to tolerance the variance, rather than incur these costs. This leads to the following proposition:

*Proposition 1: Decision-makers’ reactions to variations from expectations associated with a project (overruns, errors, setbacks and other problems) depend upon Zones of Tolerance inherent within the project context.*

Represented graphically, we may infer a relationship between a expected outcome metric’s (such as a budget) and tolerance overlayed in the following way (Figure 2.1):
Zones of tolerance therefore, are a product of the distance between reference points. Rather than tolerance being viewed as inherent to the decision-maker, it makes ecological sense to surmise that this tolerance is a product of the context of the decision and the proximity of outcomes to these reference points.

**Situating Zones of Tolerance within Extant Literature**

The examination of Zones of Tolerance within escalation of commitment decisions has hitherto never been applied. Indeed, the nature of this research programme represents a broad departure from the extant literature base and necessitated a comprehensive examination of the tolerance phenomenon. It is, however, necessary to give due investigation to the extant literature base that inspired the current research programme.

The determinants of escalation discovered from 30 years of literature are diverse and complex. What follows is an in-depth investigation into the pre-existing literature.
and the identification of the key determinants and factors that have been seen to contribute to escalation. These factors were discovered by numerous investigators through numerous research methods, most commonly case study, survey and experiment. Investigators from the fields of information systems, organisational behaviour, decision sciences and management have all applied insights from their fields to the problem. This is a testament to both the prevalence of the problem, its complexity and the multiperspectival character of its determinants.

Three determinants of escalation have received much attention: management support, sunk costs, the completion effect. Within organisational behaviour literature, significant attention is allocated to the notion of sunk costs (Arkes and Blumer 1985, Garland 1990, Garland, Sandfeur and Rogers 1990, Arkes and Ayton 1999, Arkes and Hutzel 2000, Keil, Mann et al. 2000) and completion (Garland and Newport 1991, Conlon and Garland 1993, Keil 1995a, Boehne and Paese 2000, Humphrey et al. 2004) as fundamental determinants of escalation. Management support, driven by self justification and cognitive dissonance, has received attention predominantly within information systems and psychology literature. What follows is a discussion of the sunk cost fallacy and completion effect. Subsequent to this discussion, we then employ a commonly accepted taxonomy of escalation factors: project, psychological, social and organisational/structural (Ross and Staw 1986 and 1993, Drummond 1994, Keil 1995b, Newman and Sabherwal 1996). This taxonomy has been used repeatedly throughout the escalation research and this literature review remains faithful to that classification.
The primary purpose of the remainder of this section is to put forward the argument that most escalation determinants are in fact manifestations of, or antecedent to, the factors identified within the organisational and structural determinants of escalation - technical side bets (Becker 1960), strong advocacy by key decision-makers and the nature of management controls, among others. These structural factors, impregnated into the organisational context writ large, act as scaffolding upon which decision-makers determine their own tolerance for projects, and find constraints situated within the organisational context. These organisational/structural factors can be seen to be the most significant (albeit not the only) determinants of Zones of Tolerance. These organisational/structural factors encode tolerance into the decision context and it is postulated within this research programme that decision-makers react to these encoded conditions. Previous literature (particularly Drummond 1994) strongly suggests that the reference points that demarcate and delimit these ZOTs are most often found within these organisational/structural factors.

When projects exist in isolation of the organisational context they can be seen to be influenced by very different determinants of escalation. In cases such as these, characterised by a lack of technical side bets (Becker 1960) and decision-making responsibility found within one individual (as opposed to a group), one could argue that the psychological determinants of irrational support may be more relevant.

It is important to acknowledge Drummond's (1994) insight that most organisation-driven projects (in particular information systems projects) are not ad hoc. Projects situated within organisations, however, face many more constraints and influences. Projects are embedded within organisations, and project constituencies can be
diverse and conflicting (such as the project Steering Committee, the project manager, users, customers, suppliers and other stakeholders). In these situations, the overarching organisational and structural constraints are more important and more salient to the decision processes that occur when a project faces escalation.

Thus it will be argued that, in the main, Zones of Tolerance are constituted by these organisational and structural factors. This is not to say that other determinants will impinge upon this process. For the purposes of this research programme (largely a preliminary and limited investigation into the phenomenon of Zones of Tolerance), these organisational and structural factors will constitute the predominant metrics used by decision-makers to determine their course of action when faced with escalating projects.

A Detailed Look at Extant Literature

From Ambiguity to Its Manifestations

A rich body of literature has developed around information systems project escalation. Within the context of information systems, escalation literature has typically focussed on causes due to project management failures during development. Time and cost overruns of IS development projects are attributed to mismanagement during the development cycle, obstruction by stakeholders and the inability to accept uncompensated losses by abandoning failing projects (Abdel-Hamid, 1988; Keil 1995b; Keil et al. 1995, Newman & Sabherwal, 1996). An IS project manager facing the decision to escalate commitment to a failing system’s development must evaluate whether it is more reasonable to abandon the project or
to complete it in an attempt to recoup as much of the investment as possible. In making this decision, these project managers are faced with high degrees of ambiguity. Ambiguity may be induced by conflicting information arriving from several sources whose authenticity and impact on the project needs to be assessed. There may be outcome-based ambiguity about a project’s future costs, the value of the completed project and process-based ambiguity concerning whether the technologies to be implemented will work as planned.

Abdel-Hamid (1988) suggests that IS projects are hampered by poor estimation of progress due to the inherent intangibility of the product under development and unreliability in information used to forecast time and cost budgets. In software development there are “no visible milestones to measure progress and quality like a physical product” (Abdel-Hamid et al., 1993, p604). It is very difficult to manage software development, he argues, since it is difficult to measure development costs, schedules and project development rates (Abdel-Hamid et al., 1993; Sengupta & Abdel-Hamid, 1996, Moores and Edwards 1992). He found that a common problem within IS development is the phenomenon of the ‘90% syndrome’, where project completion status increases uniformly to around 90% and tends to plateau until the project is completed (Abdel-Hamid, 1998).

**Loss Aversion as an Escalation Determinant**

The fundamental decision problem inherent to escalation of commitment is whether to abandon or continue a project when information becomes known that reduces its likelihood of success. The compulsion to finish a project may be extremely strong despite knowledge of its possible failure. The project abandonment decision will
require that some amount of previously invested costs, termed sunk costs, will be irrecoverable. This may be manifest as investments of time, cost, effort or even the reputation of the managers that have supported the system’s development.

This phenomenon can often be explained through Prospect Theoretic evidence that suggests that losses are significantly more salient and keenly felt than equivalent gains (Kahneman and Tversky 1979). The findings from this literature confirm March and Shapira’s (1992) conjectures that decision-makers focus their attention on salient indicators of loss functions, such as the proximity of an outcome to the aspiration reference points (i.e. goals) as well as to the survival points (i.e. resource exhaustion). In sum, decision-makers are influenced by the presence or threat of punitive losses of variations of outcomes from their expectations. Decision tasks in which survival is not threatened or losses will not occur create antecedent conditions for generally more ‘lazy’, self-interested or opportunistic resource allocation decisions.

**The Sunk Cost Effect**

The biggest effect of loss aversion within an escalation context is seen as manifest through the ‘sunk cost effect’. The ‘sunk cost effect’ biases decision-makers to become impelled to continue a course of action due to their inability to reconcile with their losses. Classical economic theory considers sunk cost concerns as irrational. Extant theory asserts that sunk costs should not be factored into future investment decisions, since they cannot be altered by the decision variables (Arkes and Blumer 1985; Arkes and Ayton 1999; Arkes and Hutzel 2000). However, Kahneman and Tversky (1979) empirically prove that while the sunk cost effect may
be irrational, “a person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise” (p287). Contrary to the dictates of expected utility theory, their descriptive account of risk preference, known as prospect theory, maintains that loss aversion, rather than risk aversion, is the stronger motivator behind choices involving risky prospects. The theory states that a decision to accept risk is not invariant across all domains; rather, it is reference dependent and contingent upon the possibility of making a gain or a loss relative to the status quo. The prospect of abandoning a project and incurring a loss with certainty “increases the aversiveness to losses as well as the desirability of gains” (Kahneman and Tversky 1979, p269). They find that when faced with the option of a certain loss (abandonment of development) or the risky possibility of recouping losses with an attendant increase in investment (escalation of commitment), decision-makers tend to prefer to take their chances.

Arkes and Blumer’s (1985) examination into escalation of commitment regards the sunk cost effect as a “robust judgement error” (p139) which is “irrational, no matter how compelling [the argument] may seem” (p126) and “promotes lingering until the bitter end” (p126). In a series of experiments, they investigate how the presence of sunk costs affects peoples’ decisions to escalate commitment to chosen courses of action. These experiments included organisational decisions on troubled projects such as the highly replicated airplane experiment (see Figure 2.2) as well as personal decisions (such as where to go on holiday after paying for two trips for the same weekend). They found that individuals tended to want to complete projects when presented with sunk cost information (expressed as a percentage of the total budget). Thus, Arkes and Blumer (1985) show that the ‘sunk cost fallacy’ impacts upon
decisions and becomes salient in the decision to abandon projects. The Arkes and Blumer (1985) experiments, particularly the airplane investment problem (Figure 2.2) have been replicated a number of times in several studies into the sunk cost phenomenon (for example, Garland 1990, Conlon and Garland 1993 and Keil et al. 1995).

As the president of an airline company, you have invested 10 million dollars of the company’s money into a research project. The purpose was to build a plane that would not be detected by conventional radar, in other words, a radar-blank plane. When the project is 90% completed, another firm begins marketing a plane that cannot be detected by radar. Also, it is apparent that their plane is much faster and far more economical than the plane your company is building. The question is: should you invest the last 10% of the research funds to finish your radar-blank plane?

Yes 41 / No 7

Conlon and Garland (1993) postulate a ‘completion effect’, based on prospect theory (Kahneman & Tversky, 1979), which describes the increasing tendency to escalate
commitment to a failing project as it draws nearer to completion. The completion effect conforms more closely to prospect theory than the sunk cost effect (Whyte, 1986). As Kahneman and Tversky (1979) explain, prospect theory concludes that sensitivity to gains or losses are not evaluated in terms of total wealth, but by relative gains and losses from a reference point, such as a total budget or an expected return. Prospect theory's value function is hypothesised as concave for gains and convex for losses (see Figure 1). In this case, gains and losses are determined in relation to a reference point that represents an initial asset position. From this reference point, the relative magnitude of gain or loss from this reference point is the main carrier of value, rather than the absolute amount of that change.

Kahneman and Tversky (1979) exemplify this relativity by showing how individuals tended to value the difference between $100 and $200 much more than the difference between $1100 and $1200, even though there is no difference between the two in absolute terms. Furthermore, the value function is steeper for losses than for gains, since "losses loom larger than gains. The aggravation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount" (Kahneman & Tversky, 1979).

Figure 2.3: The Prospect Theory Value Function (Kahneman & Tversky, 1979)
Garland and Newport (1991) question the construct validity of Arkes and Blumer’s (1985) treatment of sunk costs suggesting instead that “relative sunk cost” (later termed the ‘completion effect’), rather than the absolute amount of the prior investment, significantly affected decisions to escalate. Garland and Newport (1991) aver “individuals should be more likely to persist in a chosen course of action when these dollars represent a higher proportion of their anticipated budget” (p58). This hypothesis finds empirical support within prospect theory and IS escalation research (Keil, Mann et al., 2000). They see sunk costs as being confounded with the completion effect in Arkes and Blumer (1985) by the expression of sunk costs as a proportion of the overall budget. Garland and Newport (1991) find that 67% of their respondents tended to escalate commitment in conditions of high proportional sunk cost, as opposed to 28% within the context of a proportionally low sunk cost, regardless of its absolute dollar value. On the other hand, the tendency to escalate appeared invariant when subjects were presented with absolute sunk costs without reference to a total budget. Conlon and Garland (1993) empirically validate that sunk cost and project completion represent two theoretically different constructs. Varying the levels of sunk cost and percentage completion independently, Conlon and Garland (1993) find that the completion effect positively correlated with the tendency to escalate and found no significant effect from the absolute level of sunk cost incurred. Garland and Conlon’s (1998) replication of the previous completion effect studies using various demographic samples also found strong support for this

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3 Practically, however, they would most likely be highly related. As one gets closer to completion, one is likely to have spent more of the budget. However, the point of Conlon and Garland’s (1993) argument is that the relative, rather than absolute, amount of spending is more important to decision-makers.
finding. Within the IS context, Keil and Mann. (1997) finds strong support for the completion effect in a survey of IS auditors.

Garland and Conlon (1998) hypothesise that “[a]s a project completion increases, subjects’ willingness to continue investment in the project will increase.” This implies that the completion effect is correlated with the proportion of the project completion. However, in their operationalisation of the completion effect phenomenon, the study employs a limited set of completion rates; 20% and 80% in the first experiment, 10% and 90% in the second and third. Similarly, Conlon and Garland (1993) examine the completion effect using project completion rates of 10%, 50% and 90%. Studies of the completion effect have consistently used high rates of completion (80% and over) in the operationalisation of the completion effect (see Table 2.1). Although Garland (1990) reports a linear correlation using completion rates of 10%, 30%, 50%, 70% and 90%, the study suffers from common method variance. Bias is induced into the research instrument as the response mode has the same scale as the level of completion reported in the scenario proposed. In Garland’s results, there is quite a clear similarity between the completion effect (expressed as a percentage) and the respondents’ likelihood of contributing more funds (also expressed as a percentage). This criticism is given further cogency by the study’s non-significant results when correlating completion effect with the respondents’ belief that the project will be profitable. That is to say, the belief in the profitability of the project is empirically proven not to correlate with the level of completion. Despite claims by these studies that the completion effect has a monotonic association with the tendency to escalate, this linearity has never been conclusively established.
Table 2.1: Completion Levels Employed When Examining Completion Effect

<table>
<thead>
<tr>
<th>Completion Rates</th>
<th>Low</th>
<th>Intermediate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garland (1990)</td>
<td>10%, 30%</td>
<td>50%</td>
<td>70%, 90%</td>
</tr>
<tr>
<td>Garland &amp; Newport (1991)</td>
<td>10%, 15%, 20%</td>
<td></td>
<td>90%, 85%, 80%</td>
</tr>
<tr>
<td>Conlon &amp; Garland (1993)</td>
<td>10%</td>
<td>50%</td>
<td>90%</td>
</tr>
<tr>
<td>Garland &amp; Conlon (1998)</td>
<td>10%</td>
<td></td>
<td>90%</td>
</tr>
</tbody>
</table>

The effects of completion may be better understood by examining its causal source. While providing a robust descriptive account of changing risk preference, prospect theory does not attempt to address the cause of the phenomena. The causal source of the completion effect is not adequately addressed even within escalation literature itself, although Garland and Conlon (1998) provide a tentative explanation of the completion effect in terms of Lewin's (1935) theories of goal satisficing. Lewin postulates that proximity to a goal, even if it is unattainable, creates an independent incentive to complete that goal. In situations where the primary goal is unattainable, the "attainment of a substitute goal, a consolation, or an encouragement is, for a child, to a rather considerable degree the equivalent of a genuine success." However Garland and Conlon (1998) fail to report that Lewin's (1935) examination of this hypothesis comprised of experiments conducted by testing infants with tasks of varying difficulty. Whether these findings can be extrapolated to information systems projects is a matter for conjecture.

Ambiguity and the Completion Effect

As a project draws nearer to completion, ambiguity usually diminishes that relates to whether the technology works and what the final costs will be. At completion, the
only significant ambiguity remaining is the value of the project itself. This ambiguity reduction in the final stages of the project may be the real reason for the completion effect. Garland and Newport (1991) and Conlon and Garland (1993) replicated the Arkes and Blumer (1985) instrument in their studies with the additional construct of project completion.

**Self-Justification and Management Support**

"I could not love thee, dear, so much, lov'd I not honour more."

Richard Lovelace

Strong, public and continued support for troubled projects by key decision-makers such as a project's management team deserves significant attention as it has been robustly identified as one of the most significant predictors of commitment to troubled projects (Schmidt et al. 2001). The hypothesised effects arising from management support and personal responsibility within escalation theory has borrowed heavily from Festinger's (1957, 1964) 'theory of cognitive dissonance'. The founding idea within the theory of cognitive dissonance is that individuals strive toward consistency within themselves (Festinger, 1957). Once decisions are made, individuals tend to innately conduct cognitive processes of self-justification in order to 'freeze' and rationalise the decision in their own minds. Challenging this rationalising process by providing negative or disconfirming information will induce the decision-maker to actively and deliberately avoid situations and information which would likely increase dissonance between their perceptions and actions (Festinger, 1957). These challenges may arise from logical inconsistencies in information, adherence to cultural mores and decisions based on past experience.
Cognitive dissonance is said to occur when decision-makers actively suppress or reframe negative information pertaining to the project, rather than adjusting their previously-held beliefs about the likelihood of project failure.

Keil (1995) found that strong management support is coupled with high degrees of personal responsibility felt by senior members of project teams are one of the most consistent and significant predictors of escalating commitment to troubled projects. This is especially so if managers tie the success of the project to their own standing within organisations or if it is likely to affect their future job prospects. Negative information about a project’s status is seen to be actively ignored since it goes against a manager’s own conceptions of the viability of projects and creates cognitive dissonance in the mind of a decision maker. This may be often compounded by their emotional, financial or otherwise personal investment in the project’s outcomes.

Support from management is not the only source of support necessary to prop up troubled projects. While senior management, in the form of a Steering Committee or a project management team, are most often the key decision-makers in funding and continuation decisions, support from users, suppliers, customers and other external stakeholders is also critical to the eventual success or failure of a project. A lack of support from any of these constituencies may lead to an erosion of overall support that would necessitate a project’s eventual termination.

In the case of Vancouver’s world fair the Expo 86 (Ross and Staw 1986), a strong determinant of the escalation of the project was the exigencies associated with the re-
election of the public officials that provided their support. The need to justify prior investments is especially strong when "prior expenditures are irrevocable, public, freely chosen and repeated" (Keil 1995b). The effect of personal responsibility and justification, according to Keil et al. (2000) may be both a phenomenon in the social sense (justifying actions to peers) as well as the personal (decision-makers convincing themselves of the efficacy of their decision). Ross and Staw (1986; 1993) also found that management support was often extended in order to justify the project to peers within the organisation or the public.

Staw (1976) applies the theory of cognitive dissonance to escalation by proposing 'self-justification theory'. Cognitively, individuals strive for consonance in decisions post hoc. This behaviour may become aberrant when they "go beyond the passive distortion of adverse consequences in an effort to rationalise a behavioural error" (Staw and Fox, 1977, p432). This theory states that individuals are most likely to invest additional resources to failing projects in order to justify their previous investment decisions. In such situations, suppressing negative information may become a causal source for escalating commitment to a failing project. Staw and Fox (1977) find that investment decisions under conditions of high personal responsibility are more unstable than under conditions of low personal responsibility, however did not find self-justification persisting over time.

Not only can these impressions occur within an individual, such as the project manager or project sponsor, self-efficacy arising out of prior success may also occur within an entire project team. Festinger's (1957) theory is enrolled to explaining the effects on escalation by management's history of past success. Keil (1995b) finds
that “a prior success may inhibit a decision-makers’s willingness to re-examine the current course of action, thus promoting escalation”. He reports one interviewee within the case organisation suggesting that the project managers’ success with a recently completed project led to the belief that he could “hit that home run again” (Keil, 1995b). Festinger (1957) specifically mentions ‘past experience’ as a conduit for impressions of self-efficacy.

Based on the theory of cognitive dissonance, Staw’s (1976) self-justification theory asserts that negative information is suppressed by decision-makers post hoc, leading to bias in future decisions. However, Festinger (1957) is more moderate in his description of the individual’s receptivity to negative information, stating that decisions may be made with due acknowledgment of negative information that may impact the decision. This is especially prevalent when two negative options are placed in direct opposition (such as the decision to escalate or abandon a project). He states,

"The mere presence of two negative alternatives does not put the person in a decision situation unless there are some other factors that force him to choose between them. If this occurs, the same consequences concerning dissonance will exist after the choice has been made. There will be some cognitive elements favouring the choice of the other alternative. No matter which is chosen, there will then be a number of cognitive elements dissonant with the cognition about the action" (Festinger 1975, p36, emphasis added).
Festinger (1957), in apologia of decision-makers, acknowledges that “very few situations are clear-cut enough that opinions and behaviours are not to some extent a mixture of contradictions” (p5). In other words, decision-makers need not necessarily actively ignore negative information when deciding to escalate commitment to a project. In fact, Festinger (1957) asserts that most decisions one must make will be in direct opposition to certain information that refutes the appeal of the option chosen.

**Questioning Management Support**

While strong management support for projects appears both intuitively and empirically supported as a key determinant of escalation, it is important not to neglect certain qualifiers to this argument. Research by Sharma and Yetton (2003) finds that management support is also significantly correlated with project success. That is to say, strong management support is necessary for any IS project to be successful, both to maintain interest in the project at an organisational level and to encourage usage of the systems implemented. Employing surveys, Yetton et al. (1999) find empirically that “[s]enior management support, as measured by resource commitment, clarity of objectives and communication of objectives, increases the likelihood that the project is completed and not redefined or abandoned” (p277). While this study does not exclusively examine escalated projects, it does give insight into the relative importance of strong management commitment in any project venture. Indeed, Sauer (1993, p27) conjectures that the absence of management support itself is a sign of project failure, stating that failure “finally and irreversibly occurs when the level of dissatisfaction with a system is such that there is no longer enough support to sustain it” (although this is questioned by Boehm (2000) who sees
project termination as an inevitable aspect of software development). While Keil (1995b) finds empirical validation of management support as a determinant of escalation, Keil et al. (1998) empirically validate the opposite conclusion. In a survey of project managers in three countries found that the most significant risk during project development was the potential for “lack of top management commitment to the project” (rated by Likert scale for relative importance against twelve potential project risks).

Management support appears to be necessary, therefore, for all projects regardless of whether they are escalated or not. Contrary to some escalation theories, strong management support is not just a determinant of projects that are likely to go over time and over budget. Rather, it is a determinant of all projects that do not experience early termination. Aristotelians would label the empirical validation of management support construct in escalation literature a fallacy of secundum quid, the failure to acknowledge qualifiers to an argument proposed. Strong management support, therefore, is lauded when projects are successful and blamed when they are not. Regardless of the motive behind the support, poor decisions leading to escalation of commitment cannot logically be solely ascribed to continued support for a project.

Management Support Really Represents Tolerance

It is reasonable to assert that, in reality, information systems projects, indeed projects and ventures in toto, rarely if ever progress precisely as planned during the course of its development. Unanticipated events (negative or positive) may affect either the
eventual outcomes that a project can reasonably achieve, or the resources required to achieve them. When unanticipated setbacks occur they force a project’s stakeholders to evaluate whether or not they will continue their support for the course of action, whether it should be re-directed or whether it should be abandoned. For a project to withstand setbacks without redirection or termination, project stakeholders must be willing to tolerate these setbacks as a ‘necessary evil’.

Management support, therefore, is too imprecise a term for a decision-maker’s attitudinal stance when assessing their reactions to unanticipated setbacks. Decision-makers deciding to absorb setbacks on the path towards an implementation goal tolerate setbacks (rather than support them). Thus management tolerance is perhaps a term more specific and germane to the failure question.

Project, Psychological, Social and Organisational/Structural Factors

A little over thirty years of escalation research has provided a litany of causal contributors to escalation in addition to the sunk cost, completion and management support constructs discussed previously. These determinants have been ascertained and investigated through a range of research methods, most commonly through case study, survey and experiment. The list of causes is extensive and indeed contradictory in some cases (such as for management support). Nevertheless, many within the catalogue of determinants have been found consistently across a range of case studies and found significant within experimental research.
Much of the research into escalation of commitment in project management has been conducted using a case study or survey research design. Such examples are Ross and Staw’s (1993) investigation into the Shoreham nuclear power plant, Ross and Staw’s (1986) investigation of the 1986 Expo, Keil’s (1995b) study into the CONFIG development and Drummond’s (1999) case study of TAURUS. These projects represent large-scale, highly escalated failures receiving wide public attention during development. Case study research into the escalation phenomenon has the ostensible aim of theory building and is deemed significant in absence of research into the escalation phenomenon within organisational settings. The authors of these case studies argue that the laboratory experiments of Garland and Newport (1991) Garland and Conlon (1998), Arkes and Blumer (1985) and Kahneman and Tversky (1979), among others, do not capture the organisational dynamics of the phenomenon of escalating commitment, perhaps explaining some of their contradictory results and implications.

Ross and Staw (1986) investigated the world fair “Expo 86” hosted and managed by the government of British Columbia. This project was originally estimated to cost $78 million, although the final cost of the escalated venture exceeded $1.5 billion. Ross and Staw (1993) presents a study of the Shoreham nuclear power plant development, initially estimated to cost between US$65-$75 million and abandoned after outlays of more than US$5.5 billion. Keil (1995b) examined a software development project named CONFIG as an example of escalation. The organisation internally funded this development project for over a decade although its failure to be adopted by end users ultimately lead to its termination.

Note that Expo 86 was an escalated project (in terms extremely high time and cost overruns) rather than a ‘failed’ project since the project maintained enough support to be seen through to execution.
What is clear, particularly through case study research, is that no single determinant is common to all cases of escalation. Much of the escalation literature has divided the contributory determinants of escalation into four classes: project, psychological, social and organisational/structural determinants as originally classified by Ross and Staw (1986, 1989), borrowed from Brockner and Rubin (1985). Project determinants are those factors that are "variables relating to the objective utility of one's course of action" and include investment returns, opportunity costs, salvage value and the general economic structuring of the project (Ross and Staw, 1986). Psychological determinants include self-justification mechanisms, personal values and preferences, as well as heuristics and biases in information processing (Ross and Staw, 1986). Social determinants include the need to 'save face' or credibility with others and social norms, and structural determinants relate to how the organisation has structured the project, in terms of political support, and economic and technical side-bets (Ross and Staw, 1986). Technical side-bets refer to measures that have been undertaken to support and supplement the project "such that withdrawal from a course of action involves many changes in an organisation beyond the ending of the project itself" (Ross and Staw, 1986). For example, such side-bets could include opening new plants, hiring new staff and development of distribution channels (Ross and Staw, 1986). Ross and Staw (1986) employed the same framework for case study research into escalation that was used by Ross and Staw (1993) and Keil et al. (1995b).

\[^5\] It should that the term "structural factors" is used in Staw and Ross (1986) which they later renamed to "organisational factors" in Ross and Staw (1993). Other papers, such as Drummond (1994) retain the use of the term "structural factors" and these are used interchangeably here.
Table 2.2a: Project Factor Determinants of Escalation of Commitment

<table>
<thead>
<tr>
<th>Escalation Determinant</th>
<th>Promotes EOC</th>
<th>Controls EOC</th>
<th>No Effect</th>
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</thead>
<tbody>
<tr>
<td><strong>Project Factors</strong></td>
<td></td>
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</tr>
<tr>
<td>Large Payoff / Terminal Value</td>
<td>Keil, Mixon et al. (1994), Case &amp; Shane (1988)</td>
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<td></td>
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<tr>
<td>Large Closing Costs</td>
<td>Ross and Staw (1993)</td>
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<td>Low Salvage Value</td>
<td>Ross and Staw (1986, 1993)</td>
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<tr>
<td>Infeasibility of Alternatives</td>
<td>Keil, Mixon et al. (1994)</td>
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<tr>
<td>Setbacks Seen as Temporary</td>
<td>Keil, Mixon et al. (1994)</td>
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<tr>
<td>Feedback</td>
<td></td>
<td>Ghosh (1997), Hollar et al. (2000)</td>
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<tr>
<td>Risk</td>
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<tr>
<td>Time</td>
<td>Staw and Fox (1977), Staw and Barside (1997)</td>
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<td>Budgets</td>
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### Table 2.2b: Psychological Factor Determinants of Escalation of Commitment

<table>
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<tr>
<td><strong>Justification</strong></td>
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<tr>
<td><strong>Entrapment</strong></td>
<td>Brockner &amp; Rubin (1985), Brockner &amp; Houser et al. (1986), Brockner, Nathanson et al. (1984)</td>
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<tr>
<td><strong>Completion Effects</strong></td>
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### Table 2.2b: Psychological Factor Determinants of Escalation of Commitment (Continued)

<table>
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<th>Promotes EOC</th>
<th>Controls EOC</th>
<th>No Effect</th>
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</thead>
<tbody>
<tr>
<td>Inaction, Status Quo Bias</td>
<td>Thaler, Tversky et al. (1997), Kahneman and Tversky (1979), Whyte (1986)</td>
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<td></td>
</tr>
<tr>
<td>Loss Aversion / Prospect Theory</td>
<td>Fox and Staw (1979)</td>
<td>Karlsson et al. (2002)</td>
<td></td>
</tr>
<tr>
<td>Goal Setting / Hurdle Rates</td>
<td>Fischer et al. (2000), Tversky and Shafir (1992a, 1992b), Tversky et al. (1990), Redelmeier and Tversky (1992)</td>
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<tr>
<td>Information Asymmetry</td>
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<td>Framing</td>
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<tr>
<td>Attribute Conflict</td>
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Table 2.2c: Social Factor Determinants of Escalation of Commitment

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</thead>
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<td>Responsibility for Failure</td>
<td>Caldwell and O'Reilly (2003), Kirby and Davis (1998), Leatherwood and Conlon (1987)</td>
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<tr>
<td>Competitive / Political Rivalry</td>
<td>Rubin et al. (1980), Haunschild et al. (1994), Keil (1995b)</td>
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<tr>
<td>Successful Models of Persistence</td>
<td>Staw and Ross (1980), Brockner et al. (1984), Ross and Staw (1993)</td>
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<tr>
<td>Norms of Consistency</td>
<td>Ross and Staw (1993), Keil (1995b)</td>
<td></td>
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<tr>
<td>Emotional Attachment</td>
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<tr>
<td>Prior Resistance Encountered</td>
<td>Ross and Staw (1993)</td>
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<tr>
<td>Cultural Impacts</td>
<td>Keil, Tan et al. (2000), Sharp and Salter (1997)</td>
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<tr>
<td>Separating Champion from Sponsor</td>
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<tr>
<td>Policy Resistance</td>
<td>Fox and Staw (1979)</td>
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</table>
# Table 2.2d: Structural / Organisational Factor Determinants of Escalation of Commitment

<table>
<thead>
<tr>
<th>Escalation Determinant</th>
<th>Promotes EOC</th>
<th>Controls EOC</th>
<th>No Effect</th>
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<tr>
<td><strong>Structural Factors</strong></td>
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<tr>
<td><em>Economic and Technical Side Bets</em></td>
<td>Becker (1960), Ross and Staw (1993)</td>
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<tr>
<td><em>Portfolio Effects</em></td>
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<tr>
<td><em>Alternatives / Opportunity Costs</em></td>
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Keil, Truex et al (1995),
Northcraft and Neale (1986)
Escalation as a Multi-Dimensional Construct

Multidimensionality – A Detailed Look at Factors Promoting Escalation

The following section details the more influential factors promoting escalation (i.e. the most commonly discussed within literature) that have been found to contribute to escalation within projects, both within information systems and projects in general. These factors are divided into four broad categories of project factors, psychological factors, social factors and structural/organisational factors. This taxonomy has been used extensively throughout case study research into the phenomenon (most notably, Brockner and Rubin 1985, Heemstra and Kusters 1989, Ross and Staw 1986, Staw and Ross 1987b, Drummond 1994, Keil 1995b and Sabherwal et al. 2003). Drummond (1994) and Sabherwal et al. (2003) further suggest that their case studies saw evidence of a changing prominence of the four classes of determinants over time. As a general taxonomy, this list is useful as a categorisation mechanism when dealing with escalation of commitment causes and prescribing remedies for their avoidance (refer to Table 2.2).

A certain conflict is evident upon review of the factors promoting escalation. Many of the factors (such as management support discussed previously) would appear to be determinants of both success and failure, i.e. that many of these attributes cannot be solely factors evident in escalating and failing projects only. Many of these factors are evident in information systems project development writ large and stem mostly from the high levels of ambiguity present when assessing a project’s required investments (Abdel-Hamid 1998), future payoffs and anticipated support from the project community.
Nevertheless, while all of these factors appear to be present within the escalating project cases, surveys and experiments investigated here, it will be argued that many of these factors are manifestations of underlying organisational/structural constraints (or the lack thereof). These organisational/structural factors are the key contributors to Zones of Tolerance. Furthermore, it will also be argued that many of these factors require as an antecedent condition, organisational and structural constraints that allow them to become problems during a project's development.

**Project Factors**

Project factors relate to the objective features of the project itself and typically centre around the payoff structures and expected returns specifically associated to the project in question. Projects most conducive to escalation have been found display some combination of characteristics that indicate that they are long-term investments, have long-term payoffs, large eventual payoffs, high closing costs and low salvage values or beliefs that setbacks are temporary in nature (Newman and Sabherwal 1996, Keil 1995b).

**Salvage Value, Terminal Value and Closing Costs**

An often discussed element relevant to this is the salvage versus terminal value of the project (Keil and Mixon 1994, Case and Shane 1988, Ross and Staw 1986, 1993). Put simply, when forced to evaluate the relative costs and of project abandonment, decision-makers are forced to consider closing costs (Ross and Staw 1986), salvage values (Keil 1995b) and terminal values (Case and Shane 1998). The nature of IT projects is often such that payoffs have the potential to be much larger
than the commensurate investments. Keil’s (1995b) ‘CONFIG’ case study reports that economic analyses conducted on the (eventually) failed project on three separate occasions all reported that the high payoff anticipated from the project strongly encouraged continuation despite its rapidly rising costs.

Ambiguities in Payoff Value, Payoff Structure and Net Present Value

One of the most conventional and widespread assessment tools available to project managers is the calculation of the net present value of a project in order to determine whether future cash flows arising from the project’s development are sufficient to cover the current and future cost outlays. A project’s terminal value, therefore, is a key estimate necessary to determine whether or not a project is worthwhile. Determining future costs and benefits may be difficult, and Case and Shane (1998) report that measuring terminal values are often difficult (or even impossible) to quantify “because it depended on the value of the qualitative factors such as organisational learning, inter-departmental relationships of communication channels, competency building, and hypothesis testing” (p773). Furthermore, the ambiguity surrounding these future benefits may confound efforts to assess them, as found by Ross and Staw (1986) who report that during “much of [Expo 86’s] early planning stages, the deteriorating financial situation was neither universally accepted or verifiable” (p288). The study found a pattern over time, whereby the project “stated out as a beneficial project, then entered a period of contested projections, and finally became a clear-cut financial loser. Yet the decision to stage Expo [the project] remained unchanged” (p289).
Ross and Staw (1986) suggest that the assessment of project structure and value are insufficient in themselves to promote or inhibit escalation: "[w]e might therefore conclude that project variables alone are insufficient to explain commitment to Expo; other variables are necessary to explain why the decision to hold Expo was repeatedly affirmed despite the growth in project losses" (p289).

**Psychological Factors**

**Self-Justification and Management Support**

As discussed previously, management support has consistently been identified as one of the most significant determinants of escalation. Yet the contention with this conclusion remains that management support is a key in both continuation of escalating projects resulting in failure, and continuation of projects resulting in success.

**Social Factors**

Social factors are determinants of escalation that arise from group decision-making or involvement by stakeholder groups that restrain a decision-maker into continuing projects despite an individual's personal beliefs about the project (Brocker and Rubin 1985, Newman and Sabherwal 1996). Some of the more common determinants of escalation that have been identified within this group of factors pertain to competitive rivalry between competing stakeholders, the need for external justification and norms of consistency (Rubin et al 1980, Ross and Staw 1993, Keil 1995, Haunschild et al 1994, Brockner et al 1994).
Competitive Rivalry Among Stakeholders

In a study investigating over-commitment to acquisitions, Haunschild et al. (1994) empirically validate that competition between rival stakeholders creates an inordinate commitment to a venture that extends beyond the venture itself and cites two reasons for this phenomenon:

"First, competition indicates that others are interested in the target, and participants may be reluctant to "lose" the target to others. Second, competition may provide a signal to participants that the target is valuable."

(p538)

The contention is that project managers that are competing for resources with other stakeholders within and outside the organisation are often compelled into commitments for reasons beyond the economic viability of a particular project and perhaps may view commitment to particular underperforming projects from a strategic perspective.

Persistence is Synonymous With Strength

One of the more folkloric aspects of management in general is that commitment to projects despite setbacks is often considered a sign of strength and resolve. Staw and Ross (1987b) point out that managers "who can turn things around or convert a losing project into a winner" are often rewarded, through promotion or recognition (Staw and Ross 1987b, p58). Keil (1995b) speculates that

"there may be a kind of "hero effect" in which society reserves special praise and admiration for leaders who "stick to their guns" and are able to turn things around even when there is a low likelihood of success” (p434).
The paradox inherent within this popular logic is clear: persistence with eventual payoff is rewarded, whereas persistence without eventual reward is reviled, regardless of the likelihood of success. Indeed, one may go so far as to conjecture social rewards for success may even increase upon payoff as the probability of success decreases.

External Justification

The two factors discussed above, competitive rivalry and norms of consistency, are interlinked with the need for external justification as an escalation determinant. IT projects are particularly prone to this when customers, industry and other external stakeholders look to public and high profile systems implementations as models for implementations success. The contemporary phenomenon of the commoditisation of software may create strong incentives for project managers to successfully implement benchmark industry applications simply to keep up with competition, independent of the value of these implementations to the business itself (Carr 2004).

Group Decision-Making

Paradoxically, the effect of group decision-making has been found to be both a contributor and an inhibitor to escalation. Rutledge (1995) and Whyte (1993) both found group decision-making as a contributory factor in escalation situations, whereas Whyte (1995) found that group decision-making contexts can actually act as check and balance that mitigate the effect of an individual’s personal attachment on the decision-making process. The social or group decision-making elements of escalation situations are highly germane to any investigation into the escalation phenomenon as most projects are initiated, continued and implemented by groups. It
is rare for any IT project to be championed, sponsored and developed by any one individual except under circumstances where the project is small or of low value. The very definition of escalation as arising from a decision that is public (Ross and Staw 1986) presupposes that many, if not most organisational escalation situations arise through the decision-making of large constituencies of diverse stakeholders.

**Sponsors and Champions**

One of the remedial actions against escalation touted by Barton et al. (1989) is to use the group decision-making process in order to benefit oversight on a project. In an experimental scenario involving technology managers as subjects, Barton et al. (1989) tested whether decoupling responsibility for initial decision to commence a project from the subsequent decisions to continue investment and found conditional support. They found an interrelationship within the data to suggest that decision-makers with initial responsibility for commencing a project were more inclined to escalate projects than decision-makers who were not responsible for the decision upon receiving positive feedback. Counter-intuitively and contrary to their expectations, they found the opposite result when decision-makers were given with negative (rather than positive) feedback about a project.

**Structural / Organisational Factors**

Structural factors pertain to the extant contextual conditions surrounding the project. Staw and Ross (1987b) initially used the term ‘structural’ to which they later rename ‘organisational’ in Ross and Staw (1993). Ross and Staw (1987b, 1993) refer to three particular phenomena: technical side bets (Becker 1960), political support and institutionalisation.
Technical and Economic Side-Bets

Technical and economic side-bets were postulated by Becker (1960), but interestingly have received little attention in commitment and escalation literature. Side bets refer to the linking of extraneous interests with a consistent line of activity (Becker 1960). Becker puts forward a number of ways in which side bets may be manifest within the decision context. Generalised cultural expectations may provide penalties for those who violate them, for instance within a culture or a context in which consistent behaviour is expected and deviations from this are considered erratic or unstable. Impersonal bureaucratic arrangements may provide disincentives to change courses of actions, if extraneous financial side-bets (such as other development projects) may be threatened by change. An example of this could be found if some development projects that are troubled may be continued for the purpose of building or retaining the same development teams on future projects. Individual adjustment to social positions may be dictated by the social and cultural mores within the institution or society. And finally, face to face interactions suggest undergirding social mechanisms that are relevant and significant outside the venture in question and these interactions within one domain (such as a troubled project) may negatively impact these interactions in other projects.

Keil (1995b) added three more determinants from his case study investigation, namely:

- Strong advocates who provided continued funding and protection;
- Slack resources and loose management controls;
Empire building (where divisional managers seek to bolster their departments through conspicuous and highly supported projects)

It will be argued that these structural and organisational factors represent the most significant factors that either promote or inhibit escalation. The factors are examined in more detail in the following section.

**Significance, Temporal Precedence and Interrelationships – Where Do They Exist?**

A significant limitation with case study research is that results often give no indication of the strength of the relationships between the determinants identified and the resultant escalation behaviour. Furthermore, many of the case studies and surveys used to analyse escalated projects rely on self-report on behalf of the decision-makers involved in the project itself. This opens up significant scope for self-report bias, where a decision-maker may consciously or subconsciously skew their assessment of past actions towards justification of why they chose to take that action, or to assign blame to external parties. Significant doubt persists within this research as to which of the four sets of determinants actually contributes most to escalation behaviour, where interactions exist and what remedial policies would best prevent this behaviour in the future.

Interaction effects seem to be quite evident, yet remain unreported in much of the case study-based escalation literature. For instance, there would appear to be prima facie evidence to suggest that Keil’s (1995b) identification of project factors relating to high personal responsibility and emotional attachment to a project would seem to
be associated with the organisational/structural factors relating to the presence of strong advocates providing funding and protection. However, in the model suggested in his results, these three factors appear independent (see Figure 2.3). It could even be argued that many of the project factors impacting upon decisions to persist despite the repeated and significant setbacks to the project could have all been prevented had there not been an environment of slack resources and loose management controls (an organisational/structural factor in Keil’s (1995b) model).

![Figure 2.4: Summary Model of Factors that Promoted Escalation](Keil 1995b, p436)

Not only are the individual factors insufficient as independent explanations of escalation behaviour, but the temporal precedence of these factors (and by
association, their interdependencies) are not clear. Sabherwal et al. (2003) suggest that these four factors appear to have differing effects at different stages of a development process. They find, for instance, that project factors such as the size and timing of payoffs (project factors) have greater importance at the beginning of a project and decline in importance near the end of a project.

While case studies cannot be seen as prototypical examples of escalation due to selection bias, several findings are common. These projects are all reported to have experienced strong management support, often due to prior management successes and the need for external justification. It was also found that decisions relating to the project were prone to errors in information processing and negative effects arising from the project’s sheer size and complexity (Ross and Staw, 1986; Ross and Staw, 1993; Keil, 1995, Newman and Sabherwal, 1996, Wallace et al. 2004). These findings must be moderated by the lack of predictive ability and external validity. Hoyle et al. (2002) explain that case study research examines situational characteristics of phenomena, such as the environmental characteristics and the situational constraints, however the researcher’s control over these environments is limited. As a result, researchers must often limit their claims to external validity. Ross and Staw (1986; 1993) and Keil (1995b) are only able to identify each escalation determinant inter alia, and are not able isolate these determinants to ascertain their relative effect on the overall scenario. Despite this, it is worth examining these findings within the context of escalation research and within the context of project management.
Chapter 2 – Literature Review

It’s Basically All Structural

“The sea itself is one thing, the foam another;
Neglect the foam and regard the sea with your eyes.”

Rumi, from The Elephant in a Dark Room

Drummond (1994) offers some insights into the problems of significance, temporal precedence and interdependencies in her case study of a failing city council project:

“IT was suggested that escalation would be successively structural, project, psychological and then once again structural. Escalation is basically cyclical but the pattern of micro-variables is different from that predicted, that is, the pressures are mainly structural and social” (Drummond 1994, pp602-3.).

“The pressures to escalate in established decisions are indeed different from those experienced in ad hoc ventures. It is a speculative point, but the data here suggest that escalation in established situations is basically structural, overlain by project, psychological and social pressures” (Drummond 1994, p064, emphasis in text).

This distinction between ‘ad hoc situations’ and ‘established situations’ is one that has received only scant attention in previous studies. She suggests that the Ross and Staw (1986) case of Expo 86 was in fact a project that had very few interdependencies with the surround organisational context, suggesting that as an ad hoc venture if it “were not cancelled, the fair would have been held and that would have been the end of the matter” (p591) suggesting further that “[m]any
organisational predicaments are not nearly as dramatic or self-resolving” (p591). Rather, she suggests that projects are often essentially ‘muddled through’, constantly playing to the mores of the extant decision context as dictated by the environment.

Organisational/Structural Factors as the Foundation of Escalation Behaviour

In this program of research it is argued that the escalation of commitment dilemmas finds their foundations and naissance within the extant organisational environment within which a project is undertaken. Ewusi-Mensah and Przasnyski (1991) provides survey data to confirm this conjecture. They found that organisational factors are dominant, albeit not to the exclusion of economic and technical considerations. They cite some of the main sources of project failure as arising through management and organisational politics, with only 13% of respondents reported that organisational politics did not influence a project failure.

The organisational and structural factors, therefore, are the undergirding structure above which the economic, social and moral incentives and disincentives within the organisation are based. These factors can either promote or inhibit escalation and are posited to be of fundamental importance to projects that are (as in reality) situated among a portfolio of differing activities with interdependencies and common constituencies.

Proposition 2: ZOTs as Organisational and Structural Constraints

The purpose of this research programme is not to investigate the individual effects of these factors. Rather, it is hypothesised that these factors combine to structure the decision environment and inhere ZOTs into the decision context. Similar to
Langholtz et al.’s (1993) conceptualisation of ‘harsh’ and ‘benign’ resource constraints, and Lawrence and O’Connor’s treatment of ‘kind’ and ‘unkind’ loss functions, these constraints combine to either extend or contract the Zones of Tolerance within which decision-makers find it ecologically rational to skew their decisions towards erring on the side of continuing projects despite setbacks.

Proposition 2: It is therefore proposed Zones of Tolerance are constructed through the interplay of organisational and structural factors within the decision context that define the economic, social and moral incentives and disincentives for continuing with projects experiencing setbacks.

These Zones of Tolerance may be so broad as to never threaten a project’s survival despite repeated setbacks or as strict as to threaten a project’s survival with even minor deviations from expectations. Revisiting the organisational/structural factors detailed previously, three major factors stand out as germane to the ecology of organisations within which projects are developed:

Economic and technical side bets situate the project within the overarching culture and context of the organisation. The nature of the organisation’s work, the industry within which it operates and the management culture present combine and manifest within the organisation in many ways. Activities that are undertaken in parallel to the project may compete for funding and attention from key decision-makers The parameters on a project’s scope, impact and return on investment are also situated in reference to other activities. They are either complementary to the work on the
project, or may represent its opportunity cost, and the nature of these side bets can be hypothesised to be important to garnering tolerance for a project’s setbacks.

**Advocacy by top management**, particularly those who control the funding decisions of the organisation and can mandate a project’s implementation, are critical to the continuation of projects. Tolerance for setbacks from these key stakeholders are crucial for maintaining funding and interest in the project, as well as garnering additional resources in excess of initial expectations in order to combat its problems and setbacks.

**Resource slack and management controls** can either encourage or deter decision-makers (particularly those who are strongly invested in the project) to continue projects despite setbacks to a project’s development. Given sufficiently loose resource constraints and management controls, the irrational decision-maker may escalate projects even despite its lack of any prospect of success. When management controls and oversight are strict, however, they can mitigate or completely nullify the effects of self-justification, irrational persistence and uncontrolled spending.

This programme of research, therefore, will use these organisational and structural constraints as points of reference to decision-makers. It will empirically validate how these constraints, when operating in ambiguous decision contexts, serve to create Zones of Tolerance that decision-makers reference in order to determine their chosen course of action when faced with a troubled project.
Experiment 1: Proof of Concept

The first experiment detailed in this dissertation will serve as a ‘proof of concept’ for the basic propositions for this research programme. The manipulation of these constructs (Zone of Tolerance and Budget Variance) is discussed in more detail in Chapter 5. These two constructs are present in all three experimental investigations detailed within this dissertation and represent the core contribution of the research programme. We therefore make the following propositions to inform the first experiment:

**Proposition 1:** Decision-makers’ reactions to variations from expectations associated with a project (overruns, errors, setbacks and other problems) depend upon Zones of Tolerance inherent within the project context.

**Proposition 2:** Zones of Tolerance are constructed through the interplay of organisational and structural factors within the decision context that define the economic, social and moral incentives and disincentives for continuing with projects experiencing setbacks.

As a secondary hypothesis, this study examines the effect of the availability of alternatives on both the decision to escalate a current project and as a factor in the diminution of ZOT’s. Alternatives become important particularly when a challenged course of action requires decision-makers to conduct search of other possible avenues of progress (Janis and Mann 1977). Keil, Truex & Mixon (1995) and Schaubroeck & Davis (1994) found that the availability of alternatives had a moderating effect on escalation tendencies.

**Proposition 3:** The availability of alternatives has a negative effect on the tolerance for variances outside a ZOT.
Concluding Remarks

This chapter outlined the basic premise of the research programme and put forward some basic propositions relating to the escalation of commitment phenomenon (especially within information systems projects). Escalation is defined as occurring when projects experience setbacks that require an increase in commitments by stakeholders beyond that which was originally anticipated. When setbacks occur that raise the level of commitments in previously unanticipated ways, they create decision dilemmas in which decision-makers must decide whether continuing their support of a project is worthwhile. Our guiding research question can be stated as a question to the decision-maker: when managing a project facing setbacks, to what extent are you willing to tolerate variations from your prior expectations, and how do you react once this tolerance has been breached?

The objective of this research programme is to investigate how tolerance for variations from expectations affects a decision-maker's choice in escalation situations. Our fundamental proposition is that Zones of Tolerance have a foundational impact upon the way decisions are made within escalation situations. These Zones of Tolerance are encoded within projects primarily through the organisational and structural factors which situate economic, social and moral incentives and disincentives within the decision context. These factors can either promote or inhibit escalation and are posited to be of fundamental importance to projects that are (as in reality) situated among a portfolio of differing activities with interdependencies and common constituencies.
We therefore posit two propositions that inform the three experiments detailed within this research programme:

**Proposition 1:** Decision-makers' reactions to variations from expectations associated with a project (overruns, errors, setbacks and other problems) depend upon Zones of Tolerance inherent within the project context.

**Proposition 2:** Zones of Tolerance are constructed through the interplay of organisational and structural factors within the decision context that define the economic, social and moral incentives and disincentives for continuing with projects experiencing setbacks.

We also made mention of a third proposition that will be tested within the first experiment, namely that the availability of alternatives are important to escalation decisions. This proposition will be discussed in the first experiment chapter.

**Proposition 3:** The availability of alternatives has a negative effect on the tolerance for variances outside a ZOT.

This research programme contains three experiments in which the main and interaction effects of Zones of Tolerance and Budget Variances will be tested, as well as testing other constructs germane to escalation situations (namely alternatives, time, risk, variance stability and resource slack). The following chapter details the methodological and procedural approaches used within these experiments as well as a discussion of some of important considerations that were taken into account when executing and analysing them.
Introduction

The purpose of this section is to outline the research methods and analysis techniques used in three studies comprising this programme of research. This chapter discusses how this research has been characterised as both universalistic and basic and how this characterisation strongly influences the design of the research and the way in which the inevitable challenges of data collection and analysis were managed. By characterising the research in this way, the underlying considerations of research scope and interpretation of findings allow us to reconcile some of the conflicting demands on experimentation and establishes a relative importance of the demands of internal validity over external validity when designing and conducting the experimental tasks.

Furthermore, this chapter outlines the design of the experiments, the way in which they were conducted and the statistical techniques used to analyse the findings. It describes the common laboratory settings through these experiments, the experimental particulars, construct manipulations and dependent variables used across all three experiments in this research programme. In summary, the chapter discusses the following key elements of the research design, implementation and analysis:
Sample Selection: The sample selection strategy and procedures are discussed with particular examination of the caveats associated with recruitment of student subjects on response homogeneity and generalisability.

Sample Description: The number and qualities of the samples used in the experiments are detailed with reference to previous experiments as benchmarks of appropriateness.

External Validity: It is argued within this section that due to the scope and purpose of the experimental design, internal validity considerations were deemed to be of greater significance to the findings than external validity considerations when making tradeoffs between the two.

Experimental Design: The key elements of the experimental designs for the three experiments in this dissertation are outlined and the rationale for the selection of these designs is addressed.

Experimental Procedures: The recruitment procedures, laboratory settings and participant interactions are discussed in detail.

Measures: The key dependent measures used across the three studies are discussed with particular attention to the use of multiple
measures and the subtle differences between them as the experiments refined and improved over time.

**Validity threats:** The potential for validity threats associated due to individual differences, non-probabilistic samples due to self-selection as well as the difficulties associated with generalising the findings are all discussed in detail.

**Universalistic and Basic Research**

As it is characterised in this research programme, a Zone of Tolerance is an abstract construct that has the potential to be universally applied to any number of decision contexts and situations. When testing such hypotheses, particularly in proof of concept-stage experiments, the basic question we must ask is ‘can the existence of such a construct be demonstrated at all?’ To this end, particulars regarding the setting, population and other idiosyncrasies of the experiment are less important than the ability to prove the existence of ZOTs. In other words, the demands of internal validity exceed those of external validity.

This research can be described as both universalistic and basic. “Universalistic research is intended to investigate theoretically predicted associations between abstractly specified constructs” (Hoyle et al. 2002). In light of this, a laboratory setting is an appropriate method to manipulate certain variables that may or may not be able to be controlled in a real-world setting. Specifically, laboratory research allows us to control and manipulate variables associated with failing projects that may not be controllable or manipulable in any practical or ethical way in a real-
world context. Some examples of variables that are more amenable to manipulation in experimental tasks, rather than real-world settings, include varying the level of management support, sunk costs, budget variance and availability of alternatives (as in Experiment 1).

Basic research is conducted to "develop and refine new knowledge" (Hoyle et al. 2002). The examination of Zones of Tolerance as an independent construct in escalation of commitment research constitutes basic research that has hitherto never been posited or tested. The uses of escalation of commitment dilemmas as the decision context are simply pragmatic foundations within which these construct may be saliently exemplified. These experiments constitute what amounts mostly to a 'proof of concept', whereby the ZOT is examined against some of the more basic constraints in IS project management contexts.

This being said, the characterisation of Zones of Tolerance as both universalistic and basic create a unique set of circumstances surrounding the objectives and scope of the experimental tasks performed to test hypotheses. Simply put, the greater demands on the experiment relate more to the appropriate definition of the ZOT construct and the convergent and discriminant validity of the variables used to measure it. Therefore, in a practical sense, some amount of compromise must be exerted against the demands for generalisability (thus external validity). The following research designs and analysis methods reflect the greater need for internal validity and also acknowledge some of the challenges to external validity necessary when only three relatively small experiments are performed.
Sample Selection

Sampling Procedures Specifications

In all three studies conducted for this research programme, the unit of analysis was the decision-maker's resource allocation decision. Both business trained students and professionals participated in experimental tasks (see Table 3.1). Participation in the experimental tasks was voluntary in all three studies conducted. Voluntary participation in experiments essentially connotes that participants are self-selected, and this was due to the ethical constraints imposed upon the research process as well as practical considerations when recruiting from the population of interest. It can be argued that self-selection essentially makes a sample non-probabilistic, thus controls and manipulation checks need to be implemented in order to ascertain the potential for systematic Type I or Type II errors from this potential bias.

Sample Description

Table 3.1: Sample Profiles of Experiments

| Experiment 1 | Masters students enrolled in a postgraduate Business Information Systems course at the University of Sydney. Components of this course include Systems Development methodologies and project management, included in the criteria for PMI accreditation. In addition, the course provides an exploration of the Information Systems industry as a whole, its core characteristics and strategic position in the value chain. |
Experiment 2  Final Year auditing undergraduate students as well as PhD students enrolled at the University of Sydney. Topics taught in the Accounting course include risk management, assurance and controls.

Experiment 3  Final year undergraduate students enrolled in an Information Systems Project Management course at the University of New South Wales. Topics taught include all areas of the Project Management Institute (PMI) accreditation criteria and assessments include the creation of project requirements, plans and risk management procedures.

**Determining Sample Size**

In all three experiments, sample sizes were based on sufficient samples for statistical significance for each level of the between-subjects factors in a randomised experiment. This was decided in order to minimise the likelihood that variations between groups were simply a product of chance. This does not include those responses that were removed by virtue of being either incomplete or significantly anomalous to suggest the task was misunderstood. Anticipating this requirement for redundancy in the sample, typically more than 25 participants were recruited per factor group\(^6\).

It is practically impossible to determine or estimate the global population of IS project managers against which we could calculate the requisite sample size for

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\(^6\) Experiments 1 and 2 contained a minimum of 25 subjects per treatment group. In experiment 3, fifteen subjects were used for each between-subjects group and this was based on studies upon which that experiment was based (e.g. Langholtz et al. 1994) which used comparable sample sizes.
adequate statistical power and confidence intervals. In the absence of such metrics, it may be useful to benchmark the sample sizes used in these experiments with the sample sizes used in previous experiments into the field of escalation of commitment.

*External Validity Considerations - University Students as Experiment Subjects*

The key consideration for external validity implied here is how representative the responses of this sample are of the aforementioned total population of interest (i.e., IS project managers). Students were recruited from within both Information Systems and Accounting postgraduate and undergraduate courses, since it is believed that they are familiar with the Information Systems industry and have had at least some experience in an industry setting.

A long-standing issue within the fields of experimental and behavioural economics is the use of students as subjects for experiments. Many argue that students represent a viable sample base replacement when selected from among a student population that is studying economics, business or in other fields related to the research in question. There is a long history of student participation in experiments, not limited to smaller experiments, but even in some of the most widely cited papers in the field, such as the seminal Prospect Theory paper by Kahneman and Tversky (1979), Conlon and Garland's (1993) proposal of the completion effect, Kahneman, Knetsch and Thaler's (1990) experimental investigation into the Endowment Effect, Arkes and Blumer's (1985) exploration into the Sunk Cost Fallacy, Tversky and Kahneman's (1974) widely cited paper into heuristics and biases even used high school students to explore anchoring and adjustment heuristics.
Remus' (1986) empirical study testing for differences between line managers and postgraduate students with no managerial experience found no significant difference between the responses of both groups in production scheduling decisions. He concluded that “research on decision-making should not be discounted simply because graduate business students were used as subjects” (Remus 1986, p24). Chang and Ho (2004), on the other hand, found that students tended to display less escalation tendencies than equivalent managers. Research into the use of students as subjects generally urges caution, without ever going so far as to categorically rule out their use. Truth be told, students represent a pragmatic surrogate to industry professionals since they are readily accessible to academics and are, in effect, a convenient subject market. One of the more compelling criticisms of using students is that age and education have been proved to be powerful demographic variables in the capacity and comprehension of decision-making tasks in organisational settings. Sears (1986) criticises such a narrow methodological base of life experience, suggesting that student subjects may have internal biases relating to “demand characteristics, experimenter bias, and, evaluation apprehension” (p516) referring to the ability of experimenters to exert comparatively stronger pressure on younger, less experienced subjects through unequal power relationships that are inherited from the classroom. Indeed, some of the more controversial incentives for participation include tying participation to course credit, non-anonymity of respondents and using results of experiments as an assessable component of a course.

Conducting experimental research often involves compromises. In the same way that one must give sufficient consideration to the trade-off between experimental realism
and parsimony, so too must there be compromises in the execution of the experiment. Indeed it would be time- and cost-prohibitive to seek out a high number of industry professionals and to adequately reimburse them for at least an hour of their time to undertake an experiment. In addition, it is much harder to find said professionals in sufficient numbers to be conducive to a sufficient sample for appropriate statistical power. Professionals generally have greater demands on their time than do students and are not as willing to accept a token reimbursement of $20 or $30 for their foregone time as would a student.

Caveats to Consider – Response Homogeneity and Generalisations

Thus while the use of students are appealing from time, cost and scale perspectives, an experimenter must consider certain caveats to any findings they may make. In particular, experimenters must look with a critical eye upon the homogeneity of responses and the ability to generalise their findings to the overall population. Importantly, an experimenter needs to be aware of systematic differences between the responses of students and the potential responses of the population as a whole.

Perhaps one of the most comprehensive investigations into the issue within a Social Science context was conducted by Peterson (2001) in The Journal of Consumer Research. In that study, he conducted four meta-analyses into response homogeneity (with an approximate n=650,000) as well as thirty meta-analyses into effect sizes of sixty-five behavioural and psychological relationships (approximate n=350,000). In these studies he compared the responses of college students to non-student (adult) samples and found the responses of students to be slightly more homogenous than those of the non-student samples. In Peterson’s (2001) words, students “displayed
less variation within a scale (smaller standard deviations) and more consistency across scales (higher correlations) than did non-students" (p454). But while this may be the case, the study showed that this does not necessarily relate to higher more powerful hypothesis tests or larger effect sizes. He states,

"Although greater homogeneity implies less noise or extraneous variability in data, it may also reduce the magnitude of differences or minimise relationships that do exist among variables" (ibid, p458).

Peterson (2001) concluded that while these results suggested some difference, there are no systematic patterns of differences between students and non-students. From a research point of view, the corresponding conclusion to be drawn from this is that, while students can still be used, prudence must be exerted when making claims to the generalisability of findings. The remedy, of course, is to replicate experiments outside of the student population.

The Use of Subject for IS-Related Experimental Tasks

Høst, Regnell and Wohlin (2000) report a study of subjective indicators of the lead time of projects to compare the performance of Masters students and professional software developers. The study employed 26 final year Masters students from the Computer Science and Engineering, and the Electrical Engineering programmes at Lund University; as well as 18 professional software developers with a mean industry experience of 11 years. The study found "only minor differences between the conception [of the experimental task] of students and professionals" (p212) and "no significant difference between the correctness [of the conceptions of the task between] students and professionals" (p212). The consistency ratios found by the
study are presented in Figure 3.1, which shows a close similarity between professionals ("prof") and students ("stud") and seems to confirm Peterson's (2001) suggestion that students sample sets display greater homogeneity of variance.

Figure 3.1: Box plots of the consistency ratios for each group of subjects reported by Höst, Regnell and Wohlin (2000).

At this point, it is important to declare that all pilot studies that for the following experiments were conducted with Information Systems industry professionals, and post-test interviews for these pilots were conducted with a view to strengthening face validity (that the presentation of the case accurately abstracted real projects), concurrent validity (that budget measures resembled real project metrics) and external validity (that project managers and IS professionals would make similar decisions to that of the student subject sample).
Experimental Design

**Mixed Factorial Designs**

These experiments were conducted using a research design unique and hitherto untested within escalation research. They employed combinations of both within- and between-subjects factors, each with slightly different matrices of constructs and construct levels. These mixed designs presented both new opportunities and challenges.

In all the within-subjects factors tested throughout these experiments, the integrity of the randomised experimental design is maintained by randomising the order in which each combination of within-subjects factors is presented to the subject. The use of a within-subjects design also allows us to control the number of subjects required for each experiment while still investigating an appropriate number of levels for each factor. For instance, Experiment I contains nine within-subjects factor combinations (3 X ZOT and 3 X Variance). A within-subjects design allows us to examine all of these factors efficiently by reducing the need for participants to a number that satisfies the requirements for statistical power for the between-subjects factors.

**Experiment 1**

Experiment 1, the Proof of Concept experiment, employs a randomised mixed design; a 2 X (3 X 3) factorial design in which the Availability of Alternatives was the between-subjects factor. Zone of Tolerance and Variance were the two within-subjects factors, each with three levels: none (control), low and high. Subjects were randomly assigned to each of the two between-subjects groups in an effort to
maximise internal validity by minimising any effects from individual differences
between participants creating a systematic imbalance between treatment groups.

In this experiment, the interaction effect between ZOTs and Variance is a primary
hypothesis. In order to empirically test this hypothesis, it is useful to be able to
examine the interaction of these two constructs within the same subject. An
advantage of employing a between-subjects design in this case is that it allows us to
use each participant as a comparison against themselves. Specifically, we can see the
threshold of tolerance within an individual when faced with multiple levels of the
Variance. Furthermore, we can also see how the same individual responds to
differing levels of tolerance within the environment. ZOT posited as a product of the
external environment (as opposed to casting it as a source of individual difference) is
important here, as individual differences cannot be used as a within-subjects factor
(Hoyle et al. 2002).

Availability of Alternatives consisted of two levels: ‘Alternatives Available’ and ‘No
Alternatives Available’. It was operationalised as the option (or lack thereof) to
reallocate unspent resources from an abandoned project to other projects under the
decision-maker’s control. In the ‘No Alternatives’ condition, participants were told
that cancelling a project would connote that the remaining unspent funds would be
lost to the decision-maker and subsumed into the company budget, outside the
control of the project manager.

The Availability of Alternatives construct was selected as a between-subjects factor
in order to preserve face validity. It would not be ecologically valid, nor intuitively
tractable that project managers would have options of how to use unspent funds that changed between decisions. It would appear more credible that the conditions of use of unspent funds be set at as a budgeting rule at a higher organisational level, and not subject to change between two projects under control by the same project manager in the same organisation.

**Comparisons to the Research Designs of Prior Escalation Research**

This research design was selected because it allows us to examine the tolerance towards different levels of variance within the same participant. Previous escalation research has often suffered from the problem that participants were presented with a simple one-shot decision task (see Table 3.2). Typically, these decisions were framed around a project that was unambiguously failing, or unambiguously not failing. In Arkes and Blumer's (1985) seminal investigation of sunk costs, every experiment consisted of one-shot decision tasks involving two, or in some cases three, alternatives. The organisational decision-making tasks consisted to yes/no responses to the option of whether or not one would continue investment in a troubled project.

The standard between-subjects factorial designs in previous research have not adequately explored the transition in decision-making between points where a project is not in trouble, is beginning to get in trouble and is finally unambiguously failing. This new and hitherto unapplied research design will be continued through the research programme discussed in this dissertation and represents one of the key contributions of this research programme.
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<tr>
<th>Study</th>
<th>Research Design</th>
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<tbody>
<tr>
<td>Arkes &amp; Blumer (1985)</td>
<td>1 Factor (2 levels) Between-Subjects</td>
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<td>Cheng &amp; Schultz (2003)</td>
<td>1 Factor (3 levels) Between-Subjects</td>
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<td>Conlon &amp; Leatherwood (1989)</td>
<td>1 Factor (8 levels) Between-Subjects</td>
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<td>Garland (1990)</td>
<td>1 Factor (5 levels) Between-Subjects</td>
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<td>Garland and Newport (1991)</td>
<td>4 X 4 X 4 Latin Squares</td>
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<td>Garland et al. (1990)</td>
<td>1 Factor (4 levels) Between-Subjects</td>
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<td>Keil et al. (1995)</td>
<td>2 X 4 Between-Subjects</td>
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<td>Conlon &amp; Garland (1993)</td>
<td>2 X 4 X 4 Between-Subjects</td>
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<td>Schaubroek &amp; Davis (1994)</td>
<td>2 X 2 Between-Subjects</td>
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<td>Schaubroek &amp; Williams (1993)</td>
<td>1 Factor (2 levels) Between-Subjects</td>
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<td>Schoorman &amp; Halohan (1996)</td>
<td>3 X 2 Between-Subjects</td>
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<td>Schmidt &amp; Calantone (2002)</td>
<td>2 X 2 X 2 Between-Subjects</td>
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<td>X 3 Within-Subjects (Time)</td>
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<td>Schultz &amp; Cheng (2002)</td>
<td>2 X 2 Between-Subjects</td>
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**Experimental Procedures**

**Setting**

The laboratory setting in which a subject participant participates may influence his or her behaviours. Perhaps the most important aspect of this is the contribution of the setting to any unwanted experimenter expectancy effects. Expectancy effects arise when participants wish to ‘please’ the experimenter by second-guessing the answers.
that they believe the experimenter wishes to see. Care was taken not to overstep ethical lines and introduce internal bias into the subject responses due to any overt or perceived coercion on the part of the experimenter. In particular, recruitment was conducted with the following constraints:

The recruitment procedure was approved under the conditions set out by the Human Research Ethics Committee (HREC) at the University of Sydney, For each of the three experiments, the researcher attended the lectures or tutorials of the potential participants. The potential participants were told only that they were invited to participate in an experiment relating to resource allocation in project management to test their judgement and decision-making skills. Further, subjects were told that there was no preparation necessary, it was non-assessable, voluntary, anonymous and paid. If one had instead told students that the experiments specifically examined decision-making within the context of project failure, a subject may have reasonably induced that they would be expected to treat projects with suspicion or be encouraged to abandon projects. Since such a statement would induce a high possibility of experimenter expectancy, such information was not given to students until the debriefing.

Participation was voluntary and anonymous
In accordance with the ethical guidelines set out by the University of Sydney, subjects were reminded that all participation was voluntary and that no personally identifying information would be collected. Consequently, there were some limitations induced since no demographic information with regard to age, gender, race or educational background was collected, even though these demographic
variables have been investigated within the context of escalation of commitment dilemmas in previous research.

While recruitment was conducted within the lectures and tutorials within which the potential subject pool were studying, a number of measures were undertaken to ensure that recruitment could not be seen as a product of coercion in order to ‘please’ the lecturer approving the advertisement of these experiments. Specifically, participants did not sign up within the lecture itself. Rather, they were able to sign up with the experimenter outside the classroom after the lecture or tutorial had taken place. The potential subjects were made assured by the experimenter that the lecturer or tutor of their class would not be aware of who chose and did not choose to participate in the experiment.

**Participants Were Reimbursed For Their Time**

Subjects were paid either $20 or $30 for their time depending on the experiment in which they participated. Reimbursement was not tied to performance in the experiment for the first two experiments. In the third experiment a $200 prize was given to the participant who performed closest to optimal behaviour. Reimbursement serves two important functions in experiments. Primarily, it acts as an inducement for the potential subject pool to participate. Secondly, it also allows both participant and experimenter to complete a ‘contract’ that facilitates the efficient and effective running of the experiment. It induces the participant to apply themselves to the experiment and create an environment in which they are more likely to spend time and consideration on the task at hand.
Measures

The Particular Need for Multiple Measures in Escalation Research

This research programme employs a number of dependent variable measures of tolerance to assess escalation behaviour as test of both convergent and discriminant validity. Escalation of commitment decision dilemmas are vastly different from the gambling tasks from which 'revealed preference' experiment designs have arisen. Critically, one often cannot make the same assumptions about the rationality or irrationality of behaviour because probability estimates and payoffs are either incomplete or non-existent. Most of the experimental escalation literature has utilised some degree of ambiguity in future outcomes in order to preserve the face validity of the task.

Furthermore escalation decisions are often made with high degrees of conflict within the decision-maker when making a choice between what they feel is the economically rational decision to make and avoiding the 'blow-back' from other stakeholders who still perceive the project to be worthwhile in continuing. Much of the case study research indicates that projects often reach a point where both continuation and abandonment of a course of action contain equally dire results.

Dependent Measures: Experiment 1

The notion of tolerance in resource allocation decisions requires at least two measures: (1) the decision-maker's resource allocation decision, and (2) their evaluation of how 'happy' they are with said allocation. In order to operationalise this within an escalation of commitment context, the fundamental goal of these
dependent measures is to determine how much of a departure from their budgets or expectations that the decision-maker is willing to tolerate. In the first two experiments, the independent variable for budget variance is operationalised through a ‘team request’ for additional funding for the coming period in excess of the original budget. Approving part or the entire additional request for additional resources would constitute some degree of escalation, whereas allocating only the budget amount could be seen as an effort to control spending. Resource allocations below the budget could be construed as manifest de-escalation behaviour and allocating no resources to the project can be considered abandonment behaviour.

In addition to the actual resource allocation decision, a second measure is required to determine how the decision-maker evaluates their own decision to make said allocations. In other words, in the presence of a resource allocation in excess of original expectations, we also need to determine how ‘worried’ they are about the decision that they make. Little or no conflict about allocating resources in excess of original expectations would seem to constitute tolerance, and it is interesting to observe the interaction between how much a decision-maker invests and the level of tolerance to that investment.

Resource Allocation Decision: Recommendation / Request Ratio (R/R Ratio)
The first dependent variable was computed by dividing subjects’ recommendations for spending for the next period by the allocation requested by the Project Team for that period. The rationale for using the ratio was to ‘wash out’ the effects of project size to aid comparability between recommendations within and across subjects and projects. Thus, if a subject allocated the amount requested by the project team the
R/R Ratio would be 1.0. If the subject allocated the original budget amount, the mean R/R Ratio would be 0.930 for the Low Variance condition (a mean requested budget variance of 7.5%) and 0.816 for the High Variance condition (a mean requested budget variance of 22.5%). In the Low and High Variance conditions, an R/R Ratio of 1.0 would indicate the subject’s willingness to escalate the project to the budget overrun requested by the Project Team. Similarly, an R/R Ratio at or below the budget indicates that the subject elected to control or de-escalate the project by recommending a reduction to next period’s allocation below the original budget. Project abandonment decisions (R/R Ratios of 0) were excluded from the univariate ANOVA to maintain the normal distribution of the results and were considered in separate analysis.

**Project Status**

The dependent measure of the ‘worry’ or concern about the variances experienced in the project is operationalised through a simple nominal scale rating of the project manager’s assessment of the significance of the variances that the project is experiencing. Specifically, participants were required to suggest a ‘project status’ to the Steering Committee to whom they report.

In experiment I, this project status changed depending on the treatment of whether alternative investments were available or not. In this way, one can tease apart decisions to continue that were made because the decision-maker was happy to tolerate the variances experienced and those that were reluctantly made. The project status options are illustrated in Figure 3.2.
Figure 3.2: Experiment 1 Project Status

Participants were asked to select one of the following options for each of the projects under their control.

'Alternatives Available' Condition:

□ On Track: Continue Without Change

□ Some Concerns: Continue With Closer Monitoring

□ In Trouble: Continue But Seek Ways To Minimise Loss

- OR -

Suspend Project: Project Should Be Suspended Immediately

□ And Use Remaining Funds to Commence a Project Awaiting Funding

□ And Use Remaining Funds to Deposit in Corporate Bank

'No Alternatives Available' Condition

□ On Track: Continue Without Change

□ Some Concerns: Continue With Closer Monitoring

□ In Trouble: Continue But Seek Ways To Minimise Loss

□ Suspend Project: Project Should Be Suspended Immediately

Dependent Measures: Experiment 2

In Experiment 2, the 'Alternatives' condition was not manipulated, thus the Project Status measure needed to slightly change. These are illustrated in Figure 3.3.
Experiment 2 was designed in a slightly more complex fashion than Experiment 1 given the introduction of time as a 10 factor-level within-subjects measure. To that end, the measure of a subject's 'worry' was combined with their resource allocation decision. If subjects chose a project status stating that they were either satisfied with the project or that they needed to remain vigilant of budget overruns, then the project's funding continued uncorrected. Subjects chose one of the following options in order for the project to continue uncorrected:

1. The project is progressing on or close to track;
2. Variations are occurring but no action needs to be taken at this stage;
3. Variations are occurring and we need to be careful about future spending.

If, however, the subject chose the option that 'serious budget and scope cuts are needed for this project', the project's funding reduced by 10%. A graphical simulation depicted the effect of this project status prior to a subject confirming this option. Finally, subjects choosing the option 'the project should be suspended immediately' withdrew all funding from the project.
A caveat must be noted at this point: while there is a certain amount of valid criticism that the selection of these measures and associated actions do not conform well to face validity considerations, the choice of manipulating the project in this way was to make way for measurement of an additional construct Project Risk, in which subjects were required to decide upon their treatment of how certain setbacks experienced by the project were to be handled. In truth, the decision to tie decision-makers' selected project status with funding continuation was borne of pragmatism—a need to simplify the number of choices a subject made within each of the ten time periods in order to ensure the experiment was completed in under an hour, given additional complexities in the task. As it stood, the experiment required 30 decisions by the subject. Retaining the bi-partite feedback structure of the first experiment would have required subjects to have made 50 decisions in under an hour.

**Dependent Measures: Experiment 3**

Experiment 3 included a measure asking subjects to determine the percentage *project completion* (a formula determined by both time and cost inputs) they decided to undertake on two projects per period (one escalating and one non-escalating). This measure, expressed as a percentage of total project completion, was compared against a linear programming optimal.

---

7 Ideally, common dependent measures across all three experiments would improve the comparability between experiments and allowed for cross-analysis to enhance the richness of the findings. It would be worthwhile to retest these experiments with two common dependent variables (the resource allocation decision and the project status) measured in exactly the same way, however time and cost constraints did not allow for this to occur prior to the completion of this dissertation. Rather, appropriate care was taken when analysing these results and when making generalisations from the findings. Both the changes to the dependent measures and the reasoning behind them are discussed throughout this chapter and within the chapters detailing each experiment.
Experiment 3 returned to a Project Status measure independent of the investment decision (Figure 3.4). The wording of the Project Status options were very similar to Experiment 2. The reason for retention of Experiment 2’s wording was due to the absence of Alternatives as a construct.

<table>
<thead>
<tr>
<th>Figure 3.4: Experiment 3 Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ The project is progressing on or close to track</td>
</tr>
<tr>
<td>□ Acceptable variations are occurring</td>
</tr>
<tr>
<td>□ Unacceptable variations are occurring</td>
</tr>
<tr>
<td>□ Serious budget and scope cuts are needed</td>
</tr>
<tr>
<td>□ The project should be suspended immediately</td>
</tr>
</tbody>
</table>

**Interpreting the Dependent Variables**

It cannot be assumed that continuing a project simply implies complete support for it despite variations from expectations. The notion of tolerance to such variances recognises that there are in fact two major elements to any decision of this kind: the attitude or ‘utility’ experienced by the decision-maker over the variations from his or her expectations, and the manifest behaviour that it engenders. Continuing a project despite budget variances may in fact have a number of possible interpretations. The decision-maker could be untroubled by the idea of tolerating the variations and thus happily invest more than they originally expected, or they may decide to continue the project, yet carry some degree of worry or reluctance about the variances that are occurring. Thus, the same investment in the project could be due to a number of possible attitudes and vice versa. Similarly, there may be a number of possible
interpretations to a project manager's decision to reduce spending on a project in which budget variances are occurring. Conlon and Leatherwood (1989) suggest that some of these reasons may be “as a punishment, as an attempt to constrain or control future spending, as a desire to extend a project's completion horizon, or as a mistrust of the cost projections” (p840).

Multiple Dependent Variable Measures – Avoiding Errors of Assumption from Revealed Preference Techniques

With any number of interpretations of manifest behaviour possible, Conlon and Leatherwood (1989, p840) conclude, “[r]esults that converged on more than one measure would be more likely to represent commitment effects than would an effect on a single dependent variable.” Multiple measures were employed specifically to see the interaction between the 'disutility' of variations from expectations, the risk preferences they engendered as well as manifest behaviour in order to see if and where anomalies and aberrant behaviours lie. Employing multiple dependent measures in any experimental research design also has many benefits, such as the ability to draw stronger conclusions from our research findings by providing multiple metrics to establish the motivations and manifestations of extant decisions and behaviours. Furthermore, it allows us some degree of insurance against the possibility that the responses from one dependent measure are not simply a product of chance, variable error or invalidity.

Many behavioural studies rely on manifest behaviour to interpret the mindset of decision-makers when performing decision tasks in an experimental process known as ‘revealed preference’. Revealed preference is based on the assumption that
manifest behaviour reflects the internalised attitude or motivation of the decision-maker. Such an approach has been recognised in the past as problematic, as it relies almost exclusively on the assumptions that the researcher makes regarding how a manifest behaviour is to be interpreted. Sen (1971) critiques these assumptions, particularly through the lens of theoretically posited axioms of rational behaviour. To that end, he raises the question “[a]re the rationality axioms to be used only after establishing them to be true?” (p312) and observes that “a primitive concept like the coincidence of different interpretations of revealed preference can be taken to be a complete criterion of rationality of choice is of some interest in understanding this problematic concept” (p311). Sen (1971) hits upon a fundamental problem with revealed preference – that a lack of criteria for complete rationality complicates the assumptions we can make about the rationality or irrationality of manifest behaviour, particularly when decision-makers are provided with as little information as they have in previous escalation of commitment tasks. For instance, in Arkes and Blumer’s (1985) investigation into sunk costs, the questions leading to the binary dependent variable (yes / no response) is stated thus:

- Experiment 8 A/B: “[S]hould you invest the last million dollars of your research funds to build the radar blank plane?” (Arkes & Blumer 1985, p133)

In the case of these experiment tasks, there could be many explanations for why decision-makers would decide to invest in the project, despite the researchers’ insistence that such a choice would be irrational. Perhaps they have a belief that the competitor threat could be tolerated (since competitor threats seldom if ever disrupt production so significantly that a product offering is abandoned). Alternatively, in the absence of disconfirming information, the decision-maker may surmise that there
is sufficient salvage value if the project is seen to completion, or that the project could be re-focussed to another segment of the market. Essentially, given a decision task that contains neither future projections of income, nor quantitative assessment of the competitor threat, the decision-maker is forced to make a binary escalate/abandon decision with incomplete information and no recourse to justify their decision.

Validity Threats

Individual Differences

It could be argued that Zones of Tolerance are, in part, a product of individual differences between decision-makers. For instance, Zones of Tolerance can be a product of individual’s tolerance for ambiguity, risk tolerance, gender or some other demographic variable. However, in this research programme takes as its foundational premise that tolerance is (at least in the main) determined through the organisational and structural components of the decision-context. Due to constraints within the laboratory settings it was not possible to record demographic variables due to the constraints of time, costs and requirements for anonymity of the participants. The main focus of the study is to examine the effects of experimental variables (i.e. properties that an experimenter can manipulate) as opposed to the effects of individual variables. Examining the effects of all possible individual variables is not possible within the confines of this laboratory setting.

The most common method of mitigating the effects of individual differences is through randomisation. Randomised research designs and random assignment of
participants to treatment groups assures that every participant has an equal likelihood of being exposed to each of the experimental conditions. By doing so we can maximise our assurance that, given a sufficiently large sample size, that all treatment groups are essentially similar and contain no systematic differences. Hoyle et al. (2002) state that “random assignment and randomised experimental research designs control for all possible individual differences”.

The second approach to addressing the possible effects of individual differences are by recruiting a sample set in which participants are relatively homogenous. Perhaps more through the practical limitations on the recruitment process than by design, the participants for these experiments were relatively homogenous. The use of postgraduate and final year undergraduate students resulted in a certain degree of homogeneity with respect to age, business experience and knowledge of project management tools and techniques. Homogeneity of the sample set allows us to assume (to a degree) that significant differences discovered through experimentation are most likely a product of the tested constructs themselves, rather than through extraneous experimental artefacts.

There are two major limitations to consider when using relatively homogenous sample sets: homogeneity of responses and lack of generalisability. As discussed earlier, the use of students as experiment participants has been empirically proven to result in commensurately more homogenous responses. That is, it is shown in earlier studies that the responses of students compared to business professionals tend to contain less variance (Figure 3.1). However, the differences between professionals and students are not deemed to be significant enough to preclude the use of students
as surrogates for professionals, and there are no other empirically verified significant systematic differences between these two experiment groups. The second threat, a lack of generalisability, is discussed below under ‘External Validity’.

Non-Probabilistic Samples Due to Self-Selection

What would be a systematic difference between the self-selected recruits and the non-participating elements from the population? Possibly, the ability to be induced through the (small) reimbursement could be one differentiating factor. Time-poor or wealthier students may not be able to be induced to participate though a token remuneration. Arguably, a postgraduate subject that is not induced through a $20 or $30 reimbursement may not have the time available or does not feel the reward sufficient for the time spent. Such subjects are perhaps more likely to be otherwise employed and a part-time university student (as is the case with many postgraduate students). Perhaps therefore, the subjects choosing not to participate may have more industry experience. This is obviously an unprovable conjecture under our constraints of voluntary participation. Once again, the potential effects of using a non-probabilistic sample were mitigated through the use of a relatively homogenous sample and random assignment to treatment groups.

External Validity

Real-world escalation dilemmas are very difficult to analyse, since they are a product of numerous context-specific and history-laden influences. Previous research identifies a litany of psychological and organisational factors that contribute to each decision point. Every escalation of commitment dilemma is a product of the history of the decisions that led to the dilemma, as well as the ambiguities inherent when
making any forecasts of potential future outcomes from current decisions. One may argue that all escalation of commitment dilemmas can only be viewed through the lens of history, and that experiments by design, do not provide sufficient historical context nor psychological affect to truly replicate what are often very difficult decisions with significant and negative consequences.

While significant pre-testing was conducted to maximise the face validity of the experiments, the artificiality of the decision setting does not fully represent the natural processes associated with decision-making of this type. For instance, participants knowing that their decisions have no real impact on themselves, others or on a ‘real’ project are less likely to completely experience the levels of anxiety, frustration and fear arising from a real-world responsibility for a project that is facing significant setbacks. Nor would they experience the levels of conflict between stakeholders that attend such decision dilemmas.

Experimental designs are more efficient, albeit somewhat more passive, than attempting to manipulate factor levels in the midst of a real-world setting (Levitt and List 2006). In truth, experimental settings may actually as beneficial (or indeed more beneficial) to understanding the unique problems associated with escalation of commitment dilemmas since it can allay these extraneous factors in order to single out particular influences on the decision process. It would be impossible for all practical purposes to ‘experiment’ on real-world situations by adjusting the dynamics of the natural decision processes mid-stream. For instance, it would be unconscionable to experiment various management strategies when faced with a failing war, since lives and national assets may be lost in the process. Similarly, in an
organisational setting, it would be difficult to manipulate organisational conditions when scarce organisational resources, not to mention the reputations and jobs of the stakeholders involved, are at stake.

These experiments have been designed with a primary goal of maximising internal validity. The experiment design is intended to rule out alternative explanations of the findings through individual differences through randomisation and the use of homogenous sample sets, particularly during the proof of concept stages of experimentation. However, as is the case with most experimental research, the obvious trade-offs of maximising internal validity is a commensurate loss of external validity. It is not possible to draw too many conclusions about the generalisability of the findings until such time as these ZOT experiments are applied to different samples of the population and in different contexts of decision-making. Future studies could include manipulation checks on constructs under investigation to add empirical veracity to the variables used to test them. In addition, external validity of these findings could be supported by the use of IT Professionals as experimental subjects, instead of students as surrogates for IT managers.

In conclusion, while the artificiality of the experimental settings used for this body of research do not fully capture the historical and psychological influences on real-world escalation of commitment dilemmas, they are necessary in order to single out and examine the effects of tolerance. Addressing external validity in such experiments is only truly possible by replicating them (or experiments of this ilk) in a number of different settings with a number of different samples from the population. Time and cost constraints to attempt such efforts are outside the purview
of this dissertation. The abstract and innocuous nature of Zones of Tolerance would be very difficult to isolate and examine within, say, a case studies of escalated projects, since decision-makers often forget or fail to address the incremental effects of small variations in expectations.

Analysis

The Research Design Informs the Analysis

As has been mentioned earlier, this research programme employs a unique research design that has hitherto rarely been used within escalation of commitment research. The use of mixed factorial models that incorporate both within- and between-subjects designs create exigencies associated with the method of analysis. The main purpose of analysis in this case is to examine whether decision-makers change their resource allocation decisions depending on the Zones of Tolerance associated with the project context. To that end, using Repeated Measures Analysis of Variance (ANOVA) provides the best and most robust methods with which to compare means across multiple factor treatments.

ANOVA's are used to compare means from a number of populations of interest. It takes as its null hypothesis that the means of all independent treatment groups are equal. The alternative hypothesis, that there are differences in the means of the treatment groups (such as low vs high ZOTs), suggests a rejection of the null hypothesis that are not attributable to the natural variability among sample means (Norušis 2002).
ANOVAAs are useful in analysing fixed effect models – where multiple treatments of the same construct are applied to subjects within a number of treatment groups. The use of *t*-tests are insufficient given (in some of the experiments) a larger number of groups (such as in the time conditions of Experiments 2 and 3 – where 10 levels of time are measured). Rather, the *F* ratio obtainable within ANOVAs is a simpler and more effective measure of determining the strength of a construct's effect on the overall model. ANOVAs require a number of assumptions (Norusis 2002):

1. Populations are normally distributed;
2. Equality of variances (i.e. population variances are equal); and
3. Independent random samples are taken from each population.

**Normal Distributions**

The normality assumption states that each group be normally distributed. This can be verified by normality distribution plots or histograms. While ANOVAs are not heavily dependent upon this assumption, one must be cautious when applying the technique to small sample sizes in which outliers may skew the distribution of responses. In the case of this research programme, responses that were significantly aberrant were removed from the analysis, since they are believed to represent naïve responses or an indication that the task was not sufficiently understood.

**Equality of Variance**

The equality of variances assumption is not of critical concern to ANOVAs if the number of cases in each group is similar (as in the case of the experiments within this programme of research). In order to ensure that variances are equal between
groups, one may employ Levene’s test for equality of variance and, if necessary, apply a Boneferroni correction to the model.

**Independence**

The independence assumption requires that observations between groups, and observations in the same group, are not related to one another. In Experiment 1, a singular challenge to the analysis was that a project abandonment decision was represented a $0 budget allocation. A $0 allocation to a project provides a significant skew of the distribution of responses and, as such, it was deemed necessary to remove them from the data set and analyse these cases separately. If one were to treat all project decisions by the same subject as related, a $0 response from a subject within a group of ‘related’ other project decisions would be treated by an ANOVA as a ‘missing value’ and the entire subject’s response would be removed from the analysis. Missing values introduce imbalance into the sum of squares model resulting in non-orthogonal design matrix (Golub and Nash 1982). Thus, ANOVAs remove all observations containing missing values. Since one cannot remove individual observations from an ANOVA without removing the entirety of the subject’s response, it was deemed necessary to treat projects as independent observations, removing only those observations that related to an abandoned project.

Within the scope of this research programme, a critical question therefore arises: can observations from the same individual independent? If (as in Experiment 1) one were to treat each project as independent (even though each subject made decisions on nine projects), then randomisation of tasks becomes crucial to the analysis. Through randomisation one washes out order effects and expectancy effects. While not
perfect, the analysis of these projects as independent was important to our analysis, as will be discussed further in the Experiment 1 chapter.

**Statistical Software**

Both SPSS 11.5 and SPSS 15.0 were used to analyse the results. SPSS is a commonly used and robust statistical software application. Most of the statistical and graphical outputs of the analysis were generated through this application. The software was licenced through the Faculty of Economics and Business at the University of Sydney.

**Concluding Remarks**

We have established that this research is both universalistic and basic. The characterisation of Zones of Tolerance as such create a unique set of circumstances surrounding the objectives and scope of the experimental tasks, placing the greater priority on the construct, convergent and discriminant validity of the variables used to measure it. The experiments that follow were conducted using a research design unique and hitherto untested within escalation research, employing combinations of both within- and between-subjects factors, each with slightly different matrices of constructs and construct levels. These mixed designs presented both new opportunities and challenges and these were discussed above.

Thus, the research design and analysis methods reflect the greater need for internal validity and also acknowledge some of the trade-offs against external validity that were necessary in this new experimental programme.
Experimental 1: Proof of Concept

Abstract

This study is a preliminary investigation whose objective is to determine how the presence and function of ZOT’s affects resource allocation decisions. This proof of concept experiment seeks to establish the relationships between the key constructs and variables used in this research programme. In particular, we aim to test the effects of Zones of Tolerance and Budget Variances on the tendency to escalate commitment to information systems projects. We postulate that the structural and organisational conditions that surround a project create boundaries within which budget variances (and, more generally, variations from expectations) are tolerated. As a secondary hypothesis, we examined the effects of Availability of Alternatives on the decision to escalate. Furthermore, we seek to establish the veracity of the research design (hitherto not used within escalation research), subject selection and data collection methods for use in subsequent studies.

We found that Zones of Tolerance and Variance are statistically significant contributors to the continuation of courses of action. Contrary to prior studies (and our expectations) we could find no significant effect of Alternatives on either the continue/abandon decision or as an interaction effect with either Zones of Tolerance or Variance. Decision-makers’ sensitivity to ZOT’s are intuitively and empirically
valid phenomena and have been shown to be a key contributor to resource allocation decisions in general and escalation of commitment decisions in particular.

**Proof of Concept and Parsimony**

"Entia non sunt multiplicanda praeter necessitatem."
("Entities should not be multiplied beyond necessity.")
– William of Occam

**Overarching Objectives of Proof of Concept Experiments**

Proof of concept experiments serve a number of purposes, and their main objective is to clarify and defined the nature of the problem under investigation. They establish the existence of constructs and make some tentative conclusions about their effects on the population of interest. Furthermore, proof of concept experiments are used predominantly to test the veracity of the key constructs, particularly if those constructs a new and hitherto untested. These experiments also establish the relationships between key constructs and variables and this is particularly important if these have not as yet been operationalised in previous research. Furthermore, the use of proof of concept-style research using experimentation establishes the veracity and validity of the research method. In particular, it seeks to establish the veracity of the research design, subject selection and data collection methods.

The two major constructs to be examined in this proof of concept experiment are Budget Variance (VARIANCE) and Zone of Tolerance (ZOT). An important consideration during the conduct of proof of concept experiments is that the number
of constructs under investigation and their operationalisations remain as parsimonious as possible. In the Popperian tradition, simplicity in applying inductive reasoning, particularly for new interpretations of manifest phenomena, is requisite to the falsifiability criterion (Popper 1992). This is critical to avoid possible confounds in findings and to establish the effect of core constructs on observed behaviours. Furthermore, it allows for stronger tests of reliability during empirical testing. For these reasons, the first experiment conducted here establishes conceptual and empirical proof of the core constructs manipulated within this research program, namely Zones of Tolerance and budget variance. Zones of Tolerance situate an escalation dilemma within the structural and organisational context within which decisions to escalate are made, as well as within the constraints imposed therein. Budget variance is manipulated as an overt manifestation of project escalation, objective evidence that the project is not going according to plan.

Important Considerations and Challenges in Research Design

Possible Confounds From Individual Differences

Both of these constructs present some unique challenges that stem largely from the fact that they are relativistic depending upon the impression made upon the decision-maker. This impression may be made through risk preference, past experience and subjective framing. The main threat to validity, therefore, derives from individual differences between participating subjects. Individual differences would introduce complications to the model due to random error in empirical results, possibly confounding its findings. Argawal and Prasad (1999) posit a reference model for individual differences in information technology acceptance by suggesting individual
differences arising from an individual’s role within IT, tenure in the workforce, education, prior experience and training. They state:

“A radical suggestion then, if these results are further confirmed in subsequent work, might be that researchers construct simpler models that exclude individual differences altogether.” (Argawal and Prasad 1999, p383).

Their justification for this is that beliefs and cognitions about information technology acceptance and innovation are not invariant across technologies, and the effect of individual beliefs need to be negated or controlled in order to develop parsimonious models of technology use. In the case of this research, Zones of Tolerance, while represented by manifest conditions within the organisational environment, may be perceived differently depending on a subject’s prior knowledge or experience of these constraints.

Eliminating Individual Differences Through Within-Subjects Design

One method of controlling for individual differences, particularly while investigating relativistic independent constructs, is through the research design itself. One of the more potent means of addressing the validity threats present in such research is through the use of within-subjects research designs. Used in conjunction with random assignment of subjects to treatments, within-subjects designs serve to reduce the error variance between treatment groups since subjects experience all treatments, thus aiding the comparability of observations.

Within-subjects designs also aid the objectives of the research itself. To wit, it allows one to investigate the relative (not absolute) changes in behaviour between ‘low’ (or harsher) ZOTs as compared to ‘high’ (or more lenient) ZOTs without
presupposing all the possible permutations of conditions by which these Zones arise. Since the responses to a ZOT are essentially evaluator-relative, observing differences over a number of conditions (enabled by a within-subjects design) allows us to evaluate these observations in relation to each treatment group. In other words, this research programme is less concerned about the specific components of Zones of Tolerance and instead focuses on the behaviour manifest by the general condition.

One of the common issues associated with within-subjects design are 'carry over effects' - that providing subjects with multiple treatments available to their memory may create false positives through subject reactions to the perceived differences between treatment groups. Any experimentation that runs the risk of experiencing this validity threat requires careful testing, with the inclusion of random assignment and random ordering of treatments. Given sufficient sample size and due care to random assignment, these effects can be negated or controlled.

Objectives of Experiment 1

Establishing the Core Causal Model

The purpose of this proof of concept experiment is to set some broad and unequivocal manipulations of both the Variance and Zone of Tolerance constructs in order to observe both the main and interaction effects between the two. As a secondary hypothesis we will examine the effect of alternatives on the decision to tolerate variances from expectations, as the effect of this as a foundational aspect of decision theory is germane to the question of tolerance.
It is possible to construct a simple causal model using a Bayesian net, constructed using a directed acyclic graph whose arcs represent the both the main and interaction effects between the three independent constructs investigated within this experiment (Figure 4.1).

![Diagram of hypothesised causal model]

**Figure 4.1: Hypothesised Causal Model**

To reiterate from the previous chapter, there are three core assumptions to this research that each relate to a foundational aspect of the theoretical model and its attendant constructs. These elements are postulated to be common to most escalation episodes. These core assumptions are important to keep in mind as we explore the constructs examined within this experiment, and their manipulations, more deeply. Namely:

1. **Temporal ambiguity**: manifest through the structural and organisational context;

2. **Expectations as reference points and setbacks as variations**: manifest in a project context through budget variances;
3. *Project setbacks are absorbed within Zones of Tolerance and corrected outside them:* a behavioural outcome manifest through a decision-maker's willingness to tolerate budget variances

The Core Causal Model – Zones of Tolerance and Budget Variance

Zones of Tolerance

As stated in the previous chapter, Zones of Tolerance are defined as *the extant set of boundary conditions within which variations from expectations are recognised but carry no significant utility or disutility to the decision-maker.* In other words, the costs to the decision-maker of tolerating variations from expectations within ZOTs are zero, negligible or relatively less than the costs of correction.

Specifically, we postulate that the structural and organisational conditions that surround a project create boundaries within which budget variances (and, more generally, variations from expectations) are tolerated. The extent to which the environment dictates tolerance for variations from expectations is determined predominantly through the loss functions inhered within that context by said constraints on decisions and actions. For instance, an organisational context within which rivalry between competitors is fierce may have the effect of making decision-makers more cost-conscious than, say, a research and development division where it is understood that many of the experimental projects under development may never be implemented.
An important distinction between this research and the previous literature examining the escalation of commitment phenomenon is that this research is less interested with the specific components of the project context that contribute to escalation and more interested in the incentives or disincentives to escalate that are manifest through the boundary conditions of tolerance that they create. The aforementioned project management constructs are considered antecedent to the creation of a Zone of Tolerance and are excluded from manipulation in this programme of research. As has been discussed previously, escalation is a multi-dimensional construct within which many factors combine to contribute to the phenomenon in various ways and with varying magnitudes. In this investigation, Zones of Tolerance are, in effect, a gestalt look at the project environment that incorporates such factors as the nature of the project, its interdependencies with other activities within the organisation, the ambiguities inherent within the environment and the significant actors that participate in the decision-making process. It represents a departure from the traditional approach of investigating the more literal aspects of conventional project management constructs and organisational contexts.

Formally, we hypothesise a main effect of Zones of Tolerance:

\[ H1: \] There is a main effect of Zones of Tolerance on the willingness of a decision-maker to tolerate escalating commitment to troubled projects.

Within this experiment, Zones of Tolerance will be manipulated by using three variables that are common to all IS project management contexts: the nature of the project itself, the nature of the organisation/industry and management support.
These variables are germane to the research question, empirically supported as relevant by previous research and parsimonious in nature.

The Nature of the Project

The purpose of the project and its overarching objectives affect the assessment of its strategic importance to the organisation, its contribution in terms of economic and strategic value to the organisation’s activities, and the interdependencies between it and other activities. This variable relates loosely to the 'project factors' postulated by Ross and Staw (1986) and employed as a category of escalation constructs within the literature review. Some of the facets of the nature of the project could include its:

- Strategic focus;
- Payoff structure (Keil and Mixon 1994, Case and Shane 1988);
- Terminal value (Sabherwal et al. 2003)
- Closing costs and salvage values (Ross and Staw 1993)
- Ambiguity or equivocality of objectives (Bowen 1987, Bragger et al. 1998, Bragger et al. 2003, Drummond 1997, Lindblom 1959);
- Probability of success (Arkes and Hutzel 2000); and
- Riskiness (Kirby and Davis 1998).

For the purposes of this investigation, manipulations using the nature of the project as a component of a Zone of Tolerance will focus mainly on (1) the strategic focus of the project, (2) its payoff structure and (3) its likelihood of success, and these three factors will be used concurrently with each other to create organisational conditions that generally indicate high or low tolerance conditions (Table 4.1).

Table 4.1: Boundary Conditions Contributing to Zones of Tolerance Employed Within Experiment 1

<table>
<thead>
<tr>
<th>Nature of Project</th>
<th>HIGH ZOTs</th>
<th>LOW ZOTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Value to Organisation</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Economic Value to Organisation</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Ambiguity</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Probability of Success</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of Organisation / Industry</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Rivalry</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Stability / Maturity of Technology</td>
<td>Unstable</td>
<td>Stable</td>
</tr>
<tr>
<td>Implementation Rates of Project Within</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Portfolio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature of Consumer Demand</td>
<td>Strong</td>
<td>Weak</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Management Support</th>
<th></th>
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<tbody>
<tr>
<td>Steering Committee Tolerance of Budget</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Overruns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 149 -
The Nature of the Organisation / Industry

The nature of the organisation within which a project is being developed has not as yet been formally investigated in escalation literature. Within this research, while not directly addressing the components of the organisational context, applies some basic elements of an industry context that would seem to have an effect on Zones of Tolerance writ large within organisation:

- The nature of competitive rivalry within the industry; including both the number and intensity of competition between rival organisations as well as the nature of the product offering as competing on price or quality;
- The stability and maturity of technologies used within the organisation that would have a direct effect upon the risk associated with the implementation;
- The success and failure rates of implementation, and,
- The nature of consumer demand for the products under offer.

Management Support

Management support has been found to be one of the strongest determinants of escalation (Schmidt et al. 2001, Keil 1995b among others). Support for a project from a project’s key decision-makers creates conditions in which projects may be doggedly supported despite deteriorating project performance in order to self-justify prior decisions, in line with cognitive dissonance theory (Festinger 1957). However, as discussed within the literature review, research by Sharma and Yetton (2003) among others finds that management support is also significantly correlated with project success. That is to say, strong management support is necessary for any IS
project to be successful, both to maintain interest in the project at an organisational level and to encourage usage of the systems implemented.

Rather than focusing on management support for overall project success, this research situates management support for budget variances as a key determinant of Zones of Tolerance. If a decision-maker is cognizant that they are likely to be reproached or punished for budget overruns by senior management, they are likely to adjust their own tolerance for budget variances accordingly. The point at which senior management (or indeed other project stakeholders) are likely to rebuke a decision to tolerate budget overruns creates a boundary condition beyond which there will be costs associated with the overrun, either through disapproval by management or by more punitive action, such as withdrawal of support. Implicit to this is that tolerance is predicated not only on a decision-maker’s tolerance to overruns, but also by those other key decision-makers who can affect the eventual success of a project through a threat of withdrawal of their support.

**Budget Variances**

Budget overruns (particularly time and cost overruns) are a critical measure of a project manager’s performance with regards to delivering a project in a timely and efficient manner (Johnson 1995, Hallows 1998). Budget variances refer to the differences between a project’s actual spending versus its originally planned spending as expressed in a cost budget. In this study, budget variations are used as an objective indicator that a project is experiencing setbacks or troubles that were not originally expected, hence representing a salient and objectively verifiable variation from expectations.
Yetton et al. (2000) employ budget variances as a dependent variable to encapsulate the efficiency with which a project is meeting its expectations. They cite Lyytinen and Hirschheim (1987), Sauer (1993) and Ewusi-Mensah and Przanyski (1991) in their caveat that management support is the primary determinant of project influence on whether a project is completed, they make the conceptual distinction between said project support and the efficiency with which business benefits are delivered, stating

"[b]udget performance is generally the primary concern of the project manager, rather than the business investment appraisal team [or Steering Committee]. The project manager’s focus is on project efficiency"

(Yetton et al. 2000, p265).

While ZOTs are postulated as being critical to tolerance of budget variances, we hypothesise that the relative magnitude of budget variances (as a proportion of the overall spend) have a main effect on the willingness to continue with a project. Specifically, we hypothesise that small budget variances are likely to be tolerated while larger budget variances are likely to be corrected. Formally,

**H2:** The magnitude of budget variance has a negative effect on the willingness of a decision-maker to tolerate said variances.

Furthermore, we hypothesise that the magnitude of budget variance that is indeed tolerated by a project manager is determined in part by the Zones of Tolerance. Budget variances occurring where Zones of Tolerance are high (i.e. benign
constraints) are much more likely to be tolerated, and to a greater extent, than the same budget variances occurring in the presence of low ZOTs (i.e. strict constraints).

Formally,

**H3:** There is an interaction effect between the magnitude of budget variance and Zones of Tolerance on a decision-maker's willingness to accept said variances.

*Availability of Alternatives*

As a secondary hypothesis, this study examines the effect of the availability of alternatives on both the decision to escalate a current project and as a factor in the diminution of ZOT's. Referring back to the blind date scenario, it would appear that a salient alternative to the chosen course of action could complicate the decision process. Alternatives have been thoroughly examined within decision literature, notably by Simon (1976) who placed central importance on the presence of alternatives as central to strategy selection, and the key ingredient in choice behaviour. Alternatives become important particularly when a challenged course of action requires decision-makers to conduct search of other possible avenues of progress (Janis and Mann 1977). Keil, Truex & Mixon (1995) and Schaubroeck & Davis (1994) found that the availability of alternatives had a moderating effect on escalation tendencies.

The availability of alternatives was selected as an important and interesting additional construct within this investigation as it provides an ecologically valid extenuating circumstance to most organisations: namely, that when projects are situated within
established (rather than ad hoc) organisational contexts, they are constantly competing for attention, support and funding from key stakeholders. Rarely if ever are information systems projects developed outside of such a portfolio of projects.

In this study, we examine the effect of alternatives on Zones of Tolerance as well its main effects on the continue/abandon decision in escalation situations (see Figure 4.3 for manipulation). We hypothesise that decision-makers are more likely to take alternatives under conditions where 'unkind' ZOT's exist in the environment or decision task, and are less likely to accept alternative courses of action to the trouble project when ZOT's are accommodated in the environment. Formally,

\( H_4: \) Decision-makers are more likely to escalate commitment to a course of action when there are no alternatives to the investment.

\( H_5: \) There is an interaction effect between alternatives and Zones of Tolerance on a decision to escalate commitment to a course of action.

---

**Section C: Summary of Requirements**

You must make a recommendation for the funding amount you wish to allocate to this project in the next period. This recommendation can be the same or different from the Project Team's request and/or budget.

Senior management can choose to accept or reject your recommendation based on whether they believe you have allocated too much or too little. Your reputation with them depends on your ability to make good recommendations.

**Should you choose to suspend a project, the remaining funds CAN be used to EITHER fund the commencement of other projects awaiting funding, OR deposit it in the corporate bank with an low-interest yield equivalent to government bonds.**

**N.B. You cannot reallocate funds from suspended projects to projects that are already under development.**

---

Figure 4.3: Alternatives Manipulation

---

*8 The decision-making behaviour of project managers when faced with a portfolio of multiple projects is empirically investigated in Experiment 3.*
Additional Considerations and Experimental Controls

The following experiment is a relatively simple decision-making task. However, it is predicated on the application of a unique research design that needs to be tested before being applied to more complex decision tasks in later studies. Therefore, there are a number of constraints imposed upon research method that need to be taken into account. We can control some unintended effects from the idiosyncrasies of a decision-makers personality or background by use of a homogenous sample. Using homogenous sample can mitigate random effects from demographic, socio-graphic and psychographic influences.

Secondly, it is important to appreciate the contribution of both pilots and post testing when conducting the experiment. Both pilot testing and post testing allow for us to get a greater insight into the face for Lydia the case, the internal validity as well as the discriminating and convergent validity of goal constructed manipulations.

Methodological Foci of Proof of Concept Experiments

When conducting proof of concept experiments it is important to acknowledge that the outcomes of these experiments do not offer conclusive evidence of the hypotheses being investigated. Neither, therefore, does it immediately suggest remedial options for escalation of commitment dilemmas under these constraints. For this reason this experiment is one of a number of experiments investigating this phenomena, and as a result will be focused on the main independent variables that will be examined repeatedly throughout this multi-study dissertation. Later studies will further retest and expand upon the hypotheses within the present study and
further explore related and possibly interdependent factors, such as tolerance's effects over time, its effects on risk-taking, how it is affected by the stability of variances and how tolerance exhibited in one project can affect a project portfolio.

Research Method

Sample Selection

Overview of Subject Selection

A total of fifty-four subjects participated in the experiment. This experiment was conducted with 27 subjects for each of the two Alternatives levels ('No Alternative Available' and 'Alternative Available'). The decision on the sample size was made due to the presence of two between-subjects levels of the Alternatives factor and a minimum of 25 subjects per treatment group. Subjects were recruited from postgraduate students enrolled in a Business Information Systems course at the University of Sydney in 2006.

Subjects voluntarily participated in the task and were reimbursed for their time at a flat rate of $30 in cash, paid upon completion. Reimbursement was not tied with their performance of the decision task.

Selection Procedure

The researcher attended two lectures for a Business Information Systems course attended by students of the Masters of Business degree at the University of Sydney. The prospective subjects were presented with a brief announcement at the beginning of the class that the experiment was to be conducted (see Figure 4.4 for slides). In
this announcement they were told that the experiment related to a resource allocation task within a project management context that would test their judgement and decision-making skills. They were instructed that the experiment was to be conducted in the following week and would take up to one hour of their time. Further, they were told that there was no pre-requisite of prior knowledge of the task domain, no preparation necessary and completely voluntary. To stress the anonymity of their participation, they were assured that the lecturer-in-charge of the course in which they were enrolled would not know who participated or their proficiency at the task and that the task was non-assessable.

Following the announcement, an Expression of Interest form was passed throughout the class and subjects were asked to arrange a time to attend following the completion of the lecture (See Figure 4.5). The Expression of Interest form requested subjects’ contact details (email and phone) and their preferred time to attend. The form also contained key information relating to human research ethics requirements mandated by the University of Sydney.

Once prospective subjects completed the form they were booked into one of the available time slots for attendance. The following day, they were emailed confirmation of their attendance as well as the time and location of the session for which they requested to attend.

A couple of important points must be mentioned relating to subject recruitment. All procedures relating to subject recruitment were approved by, and conformed to, the requirements of the Human Research Ethics Committee (HREC) at the University of
Sydney. These are stringent controls imposed upon University researchers by the University in which all recruitment procedures, participation incentives (i.e. payments to participants), data collection instruments and analysis techniques must be approved by the HREC prior to the commencement of the research. A second important point to be declared is that potential participants were told that they would be audio-recorded for the purposes of the experimental task. The initial reasoning behind this was to collect some verbal protocol information for subsequent analysis. This requirement was later removed, since the initial recordings contained little value to the final analysis. Less than ten subjects were audio recorded for the experiment.

Figure 4.4: Recruitment Slides

Participants Wanted

- Resource Allocation in Project Management
- Experiment to test your judgement and decision-making skills
- Chief Investigator is a Professor of Business Information Systems at University of Sydney

The Experiment

- One hour next week - at a time that suits you
- You will be paid
- No Preparation Necessary
  - No pre-requisite knowledge
  - Non-assessable
  - No personal information collected
- You will be audio-recorded

Please fill out the Expression of Interest form if you would like to participate.

Then see me during the break to organise a time to attend that suits you.
Chapter 4 – Proof of Concept Experiment

Figure 4.5: Expression of Interest Form

-- Obverse Page --

Yes, I would like to register my interest to participate in this Resource Allocation in Project Management experiment.

Name: 
Email: 
Daytime Phone: 

YOUR EXPERIMENT SESSION IS: 

Please see reverse side for important information about this experiment.

You will receive information about the location of the experiment via email.

Please contact Jonathan Paul (j.paul@econ.usyd.edu.au) if you are unable to attend at this time.

-- Reverse Page --

Some important points to note:

1. You will be required for one hour and you will be paid $30 upon completion of the experiment.
2. The experiment will be conducted on the University of Sydney (Camperdown campus) at a location to be confirmed.
3. Your participation is completely voluntary and you will be audio recorded for the purposes of the experiment.
4. No personally identifying information about you will be collected, used or revealed during the experiment.
5. You can withdraw from the study at any time, without affecting your relationship with the researchers now or in the future.

Project Title: Tolerance, Alternatives, Escalation and Exit Decisions.
HREC Approval Ref: 02-2006/1/8793
Chief Researchers: Jonathan Paul (j.paul@econ.usyd.edu.au)
Prof. Marcus O’Connor (m.oconnor@econ.usyd.edu.au).

Any person with concerns or complaints about the conduct of a research study can contact the Manager, Ethics Administration, University of Sydney on (02) 9351 4811.
Sampling Method and External Validity Considerations

Postgraduate students were chosen as an acceptable surrogate for Information Systems project managers. The advantages and disadvantages of selecting students for experimental tasks are examined in detail in the Research Methods section. Briefly, several studies on the effects of student samples on observed results have found little or no evidence of systematic differences between observed responses when compared to industry professionals (Peterson 2001, and Host et al. 2000 among others). It must be reiterated, however, that it would not be possible to make broad generalisations based on any empirical findings based on this research. However, external validity through generalisability are not the objective of this proof of concept experiment.

By retaining students from the same class as the entirety of the sample, while posing significant challenges to external validity, actually serves to assist the research design. By selecting subjects from a relatively homogenous sector of the population of interest, the possibility of random error due to individual differences reduces as a validity threat. Random allocation of subjects to tasks can largely reduce and control for this validity threat.

Special Sampling Procedures for Student Samples

We employed a number of the suggestions from Carver, Jaccheri et al. (2003) on the use of students in IS-related experimental tasks.

1. The goals, measures and analysis method were not revealed prior to executing the experiment. Other than stating that they were to complete a
project management task, subjects were not given details of the task, viz. that the purpose of the experiment was to examine their tolerance variances during troubled projects.

2. Subjects were given an opportunity for feedback to justify their decisions. By means of an open-ended question, students were able to explain the rationale for their decisions if they so chose. It also served as a tacit reminder as to the requirement for recommendations that would be approved by senior management. The question asked the subjects to “[s]tate the reasons for your recommendation and why you think senior management should approve it”.

3. Subjects (if they so requested) were given the chance to receive feedback on their performance in the task. Upon completion of the experiment, subjects that requested feedback on the task were told that the experiment tested their willingness to tolerate budget variances under differing project conditions.

4. Subjects were given a realistic time estimate of one hour to complete the task. While told the experiment would take up to an hour to complete. On average, subjects took between 45 minutes to one hour to complete the paper-based task, including reviewing the cover material, making their project recommendations and completing the post-test questionnaire.

5. Finally, students were allowed to choose from a range of possible times to attend so as to avoid conflicts with their lesson schedules. Multiple session times were held over a two week period in which students could choose their
preferred time for attendance. These times were chosen so as not to clash with their classes.

Design and Procedures

Experimental Design

A 3 (Zone of Tolerance) X 3 (Variance) within-subjects and an additional X 2 (Availability of Alternatives) factorial design was employed to test both the independent and interaction effects between the Zone of Tolerance and Variance. In all, each subject made decisions on nine projects in all three ‘Zone of Tolerance’ and ‘Variance’ conditions, in either the ‘Alternatives Available’ or ‘No Alternatives Available’ treatment group.

Three levels of the variance factor were used to manipulate a control condition of No variance (0% difference between budget and actual), a low variance condition of between 5% and 10% (which was expected to be tolerated) and the high variance condition of between 20% and 25% (which was expected to be corrected). The first hypothesis pertaining to the main effects of the variance factor predicted that there
will be no significant difference between the control and low variance conditions. In other words, there will be little or no impetus on behalf of the decision maker to correct minor variances from expectations. On the other hand, we should see some significant difference in the reaction to high variances from expectations.

It would be disingenuous to assert that there are clear boundary conditions between what the decision maker would deem to be a variance worth correcting and one that can be tolerated in the absence of additional information. As a result, the choice of low and high variance conditions were used as extreme, yet realistic, quantities of budget variance.

This research design is a considerable departure from prior escalation studies in that it tests within-subject behaviour over a variety of escalation situations and over a variety of magnitudes of variance from budget (including one control group where no budget variance is displayed). While the investment recommendation is still a single-shot decision (one decision required per project), the purpose of making decisions on three projects each with a different budget variance within the same Zone of Tolerance condition is an attempt to make each decision independent while testing a variety of magnitudes of budget variance. Most prior studies have not been able to test investment behaviour under numerous conditions within similar decision contexts due to their between-subjects, single-decision designs.

Neither does this study make a priori judgements of the conditions of a ‘failed’ project. Rather, it allows the decision-maker to assess the amount of tolerance they can display for budget variations depending on the decision context. For example,
while a 20% budget variance may be rationally judged to be acceptable under a ‘High Tolerance’ condition (such as for an R&D project), it is anticipated that a similar variance may not be tolerated under a ‘Low ZOT’ or ‘No ZOT’ condition.

**Dependent Variables: R/R Ratio and Project Status**

**Recommendation / Request Ratio (R/R Ratio)**

The dependent variable was computed by dividing the subjects’ recommendation for spending in the next period by the allocation requested by the Project Team for that period. This project team request was the manipulation of the VARIANCE condition, as the team would request funding at No (0%), Low (5-10%) or High (20-25%) variance from the original budget for that period.

\[
\text{Recommendation / Request Ratio} = \frac{\text{Subject's Allocation Decision}}{\text{Project Team Request}}
\]

The rationale for using the ratio was to ‘wash-out’ the effects of project size (which varied from $500,000 to $700,000) in order to aid comparability between recommendations within and across subjects and projects. Thus, the R/R Ratio would be 1.0 if the subject allocated the amount requested by the project team in any of the Variance conditions.
The following budget information represents one of the High Variance treatments a subject could have been presented with during the experiment. The High Variance condition presented subjects with budget variances randomly varying between 20-25% above the original budget estimate. In this example, the original budget for the coming period is $60,500 and the project team is requesting $74,839 (23.7% above the original budget estimates).

<table>
<thead>
<tr>
<th>Cost</th>
<th>Budget ($)</th>
<th>Actual ($)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Final Costs</td>
<td>605,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spent to Date</td>
<td>503,705</td>
<td>623,083</td>
<td>23.7%</td>
</tr>
<tr>
<td>Request From Project Team For Next Period</td>
<td>60,500</td>
<td>74,839</td>
<td>23.7%</td>
</tr>
</tbody>
</table>

If the participating subject decided to allocate the budget amount only (i.e. $60,500) for the following period, the RIR Ratio would be calculated thus:

\[
\text{Recommendation / Request Ratio} = \frac{\text{Subject's Allocation Decision}}{\text{Project Team Request}}
\]

\[
\text{Recommendation / Request Ratio} = \frac{60,500}{74,839} = 0.808
\]
In the Low and High Variance conditions, an R/R Ratio of 1.0 would indicate the subject’s willingness to escalate the project equal to the amount requested by the Project Team. If the subject allocated the original budget amount (deciding to ignore the Project Team’s request for additional resources), the mean R/R Ratio would be 0.930 for the Low Variance condition (a mean budget variance of 7.5%) and 0.816 for the High Variance condition (a mean budget variance of 22.5%). An R/R Ratio below these benchmarks indicates that the subject has elected to de-escalate the project by recommending a reduction to next period’s allocation below the original budget. Project abandonment decisions (R/R Ratios of 0.0) were excluded from the univariate ANOVA to maintain the normal distribution of the results and are considered in separate analysis.

**Project Status**

In addition to the investment decision, subjects were asked to select an option which best described the status with which the project should be reported. This measure was introduced to allow some comparison between the stated investment decision and the ‘feelings’ subjects had about the project. By including such a measure, one would be able to gain some insights into the potential for cognitive dissonance in investment strategies. By that, we intend to see if subjects were providing their ‘true’ opinion regarding the status of the project and to see how that tracks to the investment decision.

In experiment 1, this project status changed depending on the treatment of whether alternative investments were available or not. In this way, one can tease apart decisions to continue that were made because the decision-maker was happy to
tolerate the variances experienced and those that were reluctantly made. The project status options are illustrated in Figure 4.8.

<table>
<thead>
<tr>
<th>Figure 4.8: Experiment 1 Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants were asked to select one of the following options for each of the projects under their control.</td>
</tr>
</tbody>
</table>

*Alternatives Available' Condition:

- **On Track**: Continue Without Change
- **Some Concerns**: Continue With Closer Monitoring
- **In Trouble**: Continue But Seek Ways To Minimise Loss
  - OR -
- **Suspend Project**: Project Should Be Suspended Immediately
  - □ And Use Remaining Funds to Commence a Project Awaiting Funding
  - □ And Use Remaining Funds to Deposit in Corporate Bank

*No Alternatives Available’ Condition

- **On Track**: Continue Without Change
- **Some Concerns**: Continue With Closer Monitoring
- **In Trouble**: Continue But Seek Ways To Minimise Loss
- **Suspend Project**: Project Should Be Suspended Immediately

**Zone of Tolerance (Within-Subjects)**

Three Zone of Tolerance conditions were manipulated (None, Low and High) in two corresponding ways. Firstly, prior to making project recommendations, subjects were presented with a one page company brief that included the Senior Management’s strategic objectives for all IT project developments within that company. Secondly, they were presented with an industry analysis detailing some opportunities and risks within that industry.
The three companies, each representing one ZOT manipulation were presented as follows (see Figures 4.18, 4.19, and 4.20 respectively):

**No ZOT:** A home computing company operating in a highly competitive, cost-driven consumer technologies market space with intense competition from major industry players (such as Google, Microsoft and Apple). The focus of developments is on cost competitiveness using low-risk, stable technologies. There is little room for changes to a project’s size and scope without adversely affecting profitability;

**Low ZOT:** A company involved in custom business software developments were the focus of developments is client satisfaction and moderate flexibility in plans and budgets; and

**High ZOT:** A research and development company with a focus on high value investments over the medium to long term and a high degree of tolerance for the uncertainties surrounding the development of new technologies (albeit acknowledging a commensurately high risk).

The second means by which ZOTs were manipulated were through a condensed version of this one page summary on the pages relating to each individual project. Since each of the nine projects were presented to participating subjects on its own separate page, this summary acted as a salient ‘reminder’ to subjects of the Senior Management’s Directives regarding the project. Table 4.2 shows these condensed ZOT manipulations as it appeared to subjects when making a decision on each project.
<table>
<thead>
<tr>
<th><strong>Table 4.2: ZOT Manipulations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High ZOT Manipulation</strong></td>
</tr>
<tr>
<td>Our expectation of the Research and Development Division is that they produce high value investment opportunities for implementation and release in the medium to long term. As long as projects are strongly profitable, project managers can decide, to an extent, how much this quality should cost in terms of time and money. There is a degree of tolerance for the uncertainties of developing brand new technologies.</td>
</tr>
<tr>
<td><strong>Low ZOT Manipulation</strong></td>
</tr>
<tr>
<td>Our expectation of the Business Solutions division is that they must focus on the quality of the products they develop. While managing costs within budgets are highly important, it is crucial that we are a quality leader in this area of the business. We are going to closely monitor all project developments and approve those projects that demonstrate strong market value and whose cost and time budgets are proceeding on or close to plan.</td>
</tr>
<tr>
<td><strong>No ZOT Manipulation</strong></td>
</tr>
<tr>
<td>New competitive threats from Google, Microsoft, Apple and other major industry players have severely tightened the market for our products. The essence of the new market conditions is cost competitiveness and timeliness of delivery. Spending approvals will only be granted to project managers demonstrating the ability to ensure that very tight cost budget controls are placed on projects to maintain their viability in the market.</td>
</tr>
</tbody>
</table>
Variance (Within-Subjects)

Three budget Variance conditions (None, Low, High) were manipulated through the amount of budget slippage the project was experiencing to date as expressed through the absolute and percentage difference between budget vs. actual spend-to-date. This same variance was ‘requested’ by the project team for the coming period in which a recommendation was to be made. The three orders of magnitude of variance were expressed as randomly distributed between the following ranges (Table 4.3).

Table 4.3: Minimum and Maximum Budget Variances
(Randomly Assigned to Each Project)

<table>
<thead>
<tr>
<th>Variance Treatment</th>
<th>Minimum Variance</th>
<th>Maximum Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Variance</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Low Variance</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>High Variance</td>
<td>20%</td>
<td>25%</td>
</tr>
</tbody>
</table>

An example of the presentation of the Variance Condition - budget vs. actual financial information (in this case, a High Variance) condition is provided below (Table 4.4):

Table 4.4: Example - Project Cost Information

<table>
<thead>
<tr>
<th>Cost</th>
<th>Budget ($)</th>
<th>Actual ($)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Final Costs</td>
<td>594,000</td>
<td>625,593</td>
<td>24.5%</td>
</tr>
<tr>
<td>Spent To Date</td>
<td>502,484</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request From Project Team</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request From Project Team</td>
<td>59,400</td>
<td>73,953</td>
<td>24.5%</td>
</tr>
<tr>
<td>Team for Next Period</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Availability of Alternatives (Between-Subjects)

The study employed a between-subjects design to test the significance of Availability of Alternatives in EOC decisions. Two treatment groups received information about a project portfolio in which they either had access to (Between-Subjects Group I), or were denied access to (Group II) the remaining resources available in a budget if a project was to be abandoned (the wording of each of these treatments can be found in Figure 4.9a and 4.9b). Those in the With Alternatives treatment condition could choose whether to invest the remaining funds in other projects waiting for funding, or to invest the funds in a ‘company bank’ yielding a low rate of interest equivalent to government bonds. The reason for the inclusion of the ‘company bank’ option was to provide a ‘safe’ alternate use of funds and negate the influence of uncertainty in the ‘new’ project affecting the decision to withdraw from the current project. This is contrary to Arkes and Blumer’s (1985) experiments in which the only alternative when abandoning a project was to start a second one. This may confound subjects’ interpretations of the relative risk of continuing the current investment with the new project.

Subjects in the No Alternatives treatment group were instructed that remaining funds would be subsumed back into the company treasury and that any decision to abandon an investment would mean that the remaining resources that were available for the project would become forfeit. In this case, the choice to abandon a project does not create an alternative use of the ‘saved’ resources for the decision-maker since even if the decision-maker decides to abandon the investment, they are unable to put the resources saved to an alternative use.
Figure 4.9a: No Alternatives Manipulation Panel in Introductory Statement

**IMPORTANT NOTE:**

Should you choose to suspend a project, the remaining funds **CANNOT BE USED** to fund the commencement of other projects under your control.

Any remaining unspent funds will be forfeit from that company's budget.

You cannot reallocate funds from suspended projects to projects that are *already* under development.

Figure 4.9b: Alternatives Manipulation Panel in Introductory Statement

**IMPORTANT NOTE:**

Should you choose to suspend a project, the *remaining* unspent funds for that project can be used to EITHER:

1. Fund the commencement of a *new* project under your control that is still waiting for funding; OR
2. Deposit the remaining funds into the corporate bank with a low-interest yield equivalent to government bonds.

You cannot reallocate funds from suspended projects to projects that are *already* under development.

Figure 4.9c: Subject's Response Options in the Alternatives Manipulation

**Section D: Your Recommendation For Next Period Investment**

It is recommended that the project receive:

$___________

in the next period.

Recommended Status of this Project *(please select one of the following)*:

- On Track: Continue Without Change
- Some Concerns: Continue With Closer Monitoring
- In Trouble: Continue But Seek Ways To Minimise Loss

---------------············----·--OR ..................................

Suspend Project: Project Should Be Suspended Immediately

- And Use Remaining Funds to Commence a Project Awaiting Funding
- And Use Remaining Funds to Deposit in Corporate Bank
The scenario was controlled to ensure that projects were treated independently and that findings were not confounded by a decision-maker viewing the investments as a portfolio in which they may decide to terminate or de-escalate one investment to 'cover up' the cost slippages of another. If the task was properly understood by subjects, it should be clear that approvals by the Steering Committee will only be granted to projects that remain economically viable in their own right.

The Decision Task – Experimental Apparatus

Each subject was presented with an introductory statement and cover story prior to making their nine project investment decisions across three companies. The study placed the decision-makers in a scenario in which they were a consultant Project Activity Manager for three companies all within the Information Technology industry. Their role was to conduct end of period reporting to each of the three companies’ Senior Management for three IT project developments under their purview within each company. The decision-maker had to make project investment recommendations for each project with a caveat that they had to justify their decisions which were ultimately approved by the Steering Committee and that their professional reputation was staked on the quality of their decisions.

For each of the three companies (ZOT manipulation), decision-makers were provided with a snapshot of the industries’ risks and opportunities and a Steering Committee briefing that outlined the strategic objectives of project developments. For each of the three projects, decision-makers were provided with budget information and details of the constraints on their decisions. The budget information contained budget vs. actual details on costs to date and the budget information for
the coming period. In addition, they were provided with a ‘team request’ which was at variance with the budgeted costs for the coming period. Their decisions included (1) whether each project should be continued or not; and (2) If so, how much funding it should receive. The template used for each of the nine projects is presented in Figure 4.10.
### Figure 4.10: Project Template

#### Industry: Research & Development

**Section A: Senior Management Directive**

Our expectation of the Research and Development Division is that they produce high value investment opportunities for implementation and release in the medium to long term. As long as projects are strongly profitable, project managers can decide, to an extent, how much this quality should cost in terms of time and money. There is a degree of tolerance for the uncertainties of developing brand new technologies.

#### Section B: Project Cost Information

<table>
<thead>
<tr>
<th>Cost</th>
<th>Budget ($)</th>
<th>Actual ($)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Final Costs</td>
<td>605,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spent to Date</td>
<td>503,705</td>
<td>623,063</td>
<td>23.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Request From Project Team For Next Period</th>
<th>Budget ($)</th>
<th>Team Request ($)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60,500</td>
<td>74,839</td>
<td>23.7%</td>
</tr>
</tbody>
</table>

#### Section D: Your Recommendation For Next Period

**Investment**

It is recommended that the project receive: $ in the next period.

**Subject Response: Investment**

**Recommendation and Project Status**

Recommended Status of this Project (please select one of the following):
- On Track: Continue Without Change
- Some Concerns: Continue With Closer Monitoring
- In Trouble: Continue But Seek Ways To Minimise Loss

OR

- Suspend Project: Project Should Be Suspended Immediately
  - And Use Remaining Funds to Commence a Project Awaiting Funding
  - And Use Remaining Funds to Deposit in Corporate Bank

**Section C: Summary of Requirements**

You must make a recommendation for the funding amount you wish to allocate to this project in the next period. This recommendation can be the same or different from the Project Team's request and/or budget.

Senior management can choose to accept or reject your recommendation based on whether they believe you have allocated too much or too little. Your reputation with them depends on your ability to make good recommendations.

Should you choose to suspend a project, the remaining funds CAN BE used to EITHER fund the commencement of other projects awaiting funding, OR deposit it in the corporate bank with an low-interest yield equivalent to government bonds.

N.B. You cannot reallocate funds from suspended projects to projects that are already under development.

**State the reasons for your recommendation and why you think senior management should approve it.**

**Justification for Decision**

(N.B. Results not reported - negligible added value to the analysis)

---

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**Procedure**

Subjects were given a number of alternative times to attend the experiment session. Each session was held in a classroom at the University of Sydney. Upon arrival, subjects were instructed to take time to read through the Ethics materials and sign Participation Consent Forms as per the requirements stipulated by the Human Research Ethics Committee at the University. Subjects were given a short introduction about what to expect during the experiment task. They were told that they were to receive nine projects for three companies in which they needed to make investment decisions. Time was allowed for questions.

In order to preserve the ordering of decisions (randomised by subject) printouts were given to the students and they were instructed to not flip ahead (and supervised to ensure this). Table 4.5 describes the order in which projects were shown to subjects.

<table>
<thead>
<tr>
<th>Page(s)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participant Information Sheet</td>
</tr>
<tr>
<td>2</td>
<td>Participant Consent Form</td>
</tr>
<tr>
<td>3</td>
<td>Introductory Cover Story</td>
</tr>
<tr>
<td>4</td>
<td>ZOT Manipulation 1</td>
</tr>
<tr>
<td>5-7</td>
<td>Projects 1-3</td>
</tr>
<tr>
<td>8</td>
<td>ZOT Manipulation 2</td>
</tr>
<tr>
<td>9-11</td>
<td>Projects 4-6</td>
</tr>
<tr>
<td>12</td>
<td>ZOT Manipulation 3</td>
</tr>
<tr>
<td>13-15</td>
<td>Projects 7-9</td>
</tr>
<tr>
<td>16</td>
<td>Summary and Post-Test</td>
</tr>
</tbody>
</table>
Introductory Statement, Cover Story and Enhancing Ecological Realism

Each subject was provided with an introductory statement regarding the roles of project managers when making project investment decisions. After reading the introductory statement, subjects read the cover story detailing their role as a Consultant Project Activity Manager whose role is to “oversee the day-to-day progress on projects that [they] monitor and make sure that projects run according to the plans set out by the senior management of each company.” They were then instructed that was time to review the progress of their projects and make recommendations to senior management about each project.

In order to make the importance of ‘good’ project investment decisions, subjects were told the following,

“Your reputation is significantly affected by the quality of your recommendations to Senior Management. A poor recommendation may be to spend too much or too little on a project, or take actions that will lead to project failure.

“You know that a lot of projects are supported by Senior Management – some good and some bad – and you need too make recommendations that conform to both the Senior Management’s strategic directives as well as contribute to the value of each company.”

The reason behind providing this information is to discourage participants from making opportunistic investment decisions that are skewed excessively towards escalating projects to preserve their reputations or to kowtow to Senior Management
despite their assessment of the project as failing. It was anticipated that decision-makers should use their judgement to balance the competing influences of the Senior Management’s strategic directives, the progress of the project and the nature of the industry in which they operate. In other words, the subjects were induced to balance the relative importance of the ZOT manipulations (management’s strategic directives and the industry brief) with the Variance manipulation (the efficiency with which the project was progressing according to plan). The incentive was heightened by virtue of the fact that they were instructed that Senior Management “first considers [their] recommendations and then decides whether or not to approve [them]. They [Management] have the final say in how much gets allocated to each project and can decide on their own to increase or reduce funding to the project, or suspend it if it is not running to plan.”

To improve the experimental realism of the scenario, the level of completion and the size of each project were randomly varied over a normal distribution between 70% to 90%, and $500,000 to $700,000 respectively. Manipulation checks against the co-variation of the size of the recommendation against these two possibly exogenous influences on the tendency to escalate were considered.

*Random Allocation of Tasks*

Twelve randomised decision sequences were created to negate ordering effects and these decision sequences were randomly assigned to subjects. Zone of Tolerance manipulations were grouped together, so that the decision-maker could make project recommendations by company, and the order of the Variance conditions within each
company were also randomised. Thus the order of investment decisions was displayed in the following manner (as an example):

Table 4.6: Within-Subject Design With Randomised Ordering of Projects

To Test For ZOT X VAR Effects (Example)

<table>
<thead>
<tr>
<th>Zone of Tolerance Condition</th>
<th>Variance Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1 (No ZOT Condition)</td>
<td>Project 1 (No VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 2 (Low VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 3 (High VAR)</td>
</tr>
<tr>
<td>Company 2 (Low ZOT Condition)</td>
<td>Project 4 (Low VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 5 (High VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 6 (No VAR)</td>
</tr>
<tr>
<td>Company 3 (High ZOT Condition)</td>
<td>Project 7 (High VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 8 (No VAR)</td>
</tr>
<tr>
<td></td>
<td>Project 9 (Low VAR)</td>
</tr>
</tbody>
</table>

Methodology

Analysis Methodology - Univariate Analysis of Variance (ANOVA)

The 3 (ZOT) X 3 (Variance) X 2 (Alternatives) factorial design was tested using a univariate ANOVA employing a Type III Sum of Squares with a Bonferroni correction. This correction was required since the R/R Ratio used as the dependent variable did not satisfy the Levene's test for homogeneity of variance, although it did satisfy tests for normality. The ANOVA was conducting using the statistical software package SPSS 11.5. Prior to analysis, project abandonment decisions were removed for separate analysis as project investment decisions of effectively $0 are treated as missing values in an ANOVA.
Analysis and Results

Estimated Marginal Means of Recommendation / Request Ratio

The following chart (Figure 4.11) represents the mean investment decision per ZOT X VARIANCE group as a proportion of the original budget (project abandonment decisions excluded).

From a cursory look at above figure it would appear evident that there were dramatic differences between Variance condition, and a marked difference in the treatment of Alternatives conditions in the Low ZOT condition only. Subjects exhibited a general tendency to allocate funds at amounts closer to the budget than the Project Team request under the No or Low Variance conditions. In the No Variance (control group) condition, mean R/R Ratios were extremely close to 1.0, indicating that the subjects treated the control group as expected.
Chapter 4 – Proof of Concept Experiment

**Budget Variance**

A highly significant main effect was found for the Variance construct (F(2,409) = 92.013, p = .000, partial eta squared = .310) (H2 Supported, See Figure 4.12).

**Figure 4.12: Recommendation / Project Team Request Ratio (R by R)**

**Table 4.7: Recommendation / Project Team Request Ratio (R by R) Statistics**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>391.455(a)</td>
<td>18</td>
<td>21.747</td>
<td>5027.65</td>
<td>.000</td>
<td>.996</td>
</tr>
<tr>
<td>Alternatives</td>
<td>.012</td>
<td>1</td>
<td>.012</td>
<td>2.695</td>
<td>.101</td>
<td>.007</td>
</tr>
<tr>
<td>ZOT</td>
<td>.098</td>
<td>2</td>
<td>.049</td>
<td>11.375</td>
<td>.000</td>
<td>.053</td>
</tr>
<tr>
<td>Variance</td>
<td>.796</td>
<td>2</td>
<td>.398</td>
<td>92.013</td>
<td>.000</td>
<td>.310</td>
</tr>
<tr>
<td>Alt * ZOT</td>
<td>.001</td>
<td>2</td>
<td>.000</td>
<td>.091</td>
<td>.913</td>
<td>.000</td>
</tr>
<tr>
<td>Alt * Vnc</td>
<td>.021</td>
<td>2</td>
<td>.011</td>
<td>2.479</td>
<td>.085</td>
<td>.012</td>
</tr>
<tr>
<td>ZOT * Vnc</td>
<td>.060</td>
<td>4</td>
<td>.015</td>
<td>3.484</td>
<td>.008</td>
<td>.033</td>
</tr>
<tr>
<td>Alt * ZOT * Vnc</td>
<td>.001</td>
<td>4</td>
<td>.000</td>
<td>.065</td>
<td>.992</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>1.769</td>
<td>409</td>
<td>.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>393.224</td>
<td>427</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a R Squared = .996 (Adjusted R Squared = .995)
Recall that the Recommendation / Project Team Request ratio is used to measure the distance between a subject’s recommended investment in a project and the request for funding by the project team (Variance Treatment). This size and direction of this effect confirms the hypothesis that the size of magnitude of variance is significantly correlated with the tendency to fully or partially escalate projects with low variance and to deescalate projects or abandon projects with high variance. In other words, subjects displayed a tendency to allocate more to the project than the original budget (rather than correct the overrun through reduced allocations) when small budget overruns were requested by the project team (between 5% and 10%). Conversely, subjects tended to deescalate or abandon projects when high budget overruns (between 20% and 25%) except where the Zone of Tolerance was high, and this can be seen in Figure 4.13. As was expected, there was no tendency to either escalate or deescalate in the Variance control group (No Variance condition).

As further evidence of the effect of budget variances on the tendency to tolerate escalating commitment, the following chart represents the mean budget overrun tolerated in each of the ZOT, Variance and Alternatives Conditions (Figure 4.14).
A marginally insignificant main effect was found for Zone of Tolerance ($F(2, 409) = 11.375, p = .000$, partial eta squared $= .053$), albeit with a smaller contribution to the overall effect than the Variance construct (H1 Marginally Not Supported). In addition, a significant (albeit small overall) ZOT X Variance interaction effect was also displayed ($F(4,409) = 2.479, p = .012$, partial eta squared $= .033$) and was significant at the .05 level (H3 Supported). It is no surprise that ZOT seems to have an interaction effect during budget allocation decisions when taken into
consideration against the variance from expectations. What is surprising, however, is that subjects tended to display a ZOT through their reactions to budget variance as well as react to the ZOT built into the decision context.

![Estimated Marginal Means: ZOT](image)

**Figure 4.15: Recommendation by Request Ratio by Zone of Tolerance**

*(Combined across Variance Manipulations)*

*Alternatives*

The presence or absence of Alternatives was not found to be significant, either as a main effect ($F(1,409) = 2.695, p = .101$, partial eta squared = .007), nor did it display any significant interaction effects with the other factors in the study (H4 and H5 Not Supported). This may be due to poor operationalisation of the construct or that the operationalisation was not salient enough. Another interpretation is that alternatives were only considered after the decision to abandon was made, and this may be evidenced by the highly significant effect of variance in the overall model.

*Project Abandonment*

As stated previously, the cases in which projects were abandoned were excluded from all previous analysis. This was done for two reasons: Firstly, including cases in
which subjects decided to invest $0 into a project would skew the normal distribution of the remaining cases. Secondly, results from Analysis of Variance (ANOVA) techniques are often skewed or complicated due to missing values.

Using a binary logistic regression, the only significant factor on the decision to abandon a project was Variance ($p = 0.00$). Figure 4.16 provides an indication of the proportion of projects that were abandoned within each cell of the factorial design. As can be seen from the following figure, the High Variance condition saw the highest number of project abandonments. In the Low ZOT condition, the number of project abandonments differed from 33.3% of cases in the Alternatives condition to 18.5% of cases in the No Alternatives Condition. 37% of projects were abandoned in the No Alternatives / No ZOT / High Variance condition.

![Figure 4.16: Percentage of Abandoned Projects Within Each Factorial Cell](image)
Manipulation Checks and Post-Test Questionnaire

Order effects were not significant in the study (F(8,427) = 0.70, p > 0.68). Furthermore, project size (p > .30) and level of completion (p > .11) were not found to have significant effects on the recommendations using a linear regression against the R/R Ratio.

A post-test questionnaire was conducted in which all nine project recommendations were tabulated on one page. Subjects were then asked to review all their recommendations and were asked two questions: (1) if they were satisfied with their recommendations and (2) how they believed Senior Management would react to these recommendations. These questions were used as manipulation checks against order effects (if participants believed they were consistent across their decisions) and how ascertain salient the ZOT manipulations were in terms of their satisfaction of the experiment’s criteria that recommendations would be amenable to review. The post-test questionnaire confirmed that the overwhelming majority of subjects were content with their recommendations on review and that they considered the reactions of Senior Management in their decisions. No subjects displayed post-hoc reconsiderations relating to the consistency of their decisions across projects or across companies which, in a small way, serves to reinforce that the projects were indeed considered to be independent of one another by participating subjects.

Project Status

Using a univariate ANOVA, we can see subjects’ assessment of the status of the project was mostly dependent on the Variance (F(2,468) = 151.315, p = .000, partial eta squared = .393) and weakly dependent on Zones of Tolerance (F(2,468) = 4.163,
Chapter 4 - Proof of Concept Experiment

p = .017, partial eta squared = .017). Furthermore, there was a weak interaction effect evident between Variance and ZOTs (F(4,468) = 3.320, p = .011, partial eta squared = .028). The Availability of Alternatives was not significant (F(1,468) = .014, p = .905, partial eta squared = .000).

These results from the two dependent variables conform to the investment recommendations made by subjects. This would suggest that there is no evidence pointing to a bias in the findings due to cognitive dissonance and that subjects viewed their project decisions consistently when compared to their stated investment recommendations. In other words, a subject's affect and actions were consonant, their affective 'feelings' about the project were determined by the project context and that effective state was brought to bear on their investment recommendations.

Table 4.8: Project Status Statistics

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model Intercept</td>
<td>190.189(a)</td>
<td>17</td>
<td>11.188</td>
<td>19.580</td>
<td>.000</td>
<td>.416</td>
</tr>
<tr>
<td>ZOT Variance Alternatives</td>
<td>4.757</td>
<td>2</td>
<td>2.379</td>
<td>4.163</td>
<td>.016</td>
<td>.017</td>
</tr>
<tr>
<td>ZOT * VNC</td>
<td>7.588</td>
<td>4</td>
<td>1.897</td>
<td>3.320</td>
<td>.011</td>
<td>.028</td>
</tr>
<tr>
<td>ZOT * ALT</td>
<td>1.053</td>
<td>2</td>
<td>.527</td>
<td>.922</td>
<td>.398</td>
<td>.004</td>
</tr>
<tr>
<td>VNC * ALT</td>
<td>.399</td>
<td>2</td>
<td>.200</td>
<td>.349</td>
<td>.705</td>
<td>.001</td>
</tr>
<tr>
<td>ZOT * VNC * ALT</td>
<td>3.465</td>
<td>4</td>
<td>.866</td>
<td>1.516</td>
<td>.196</td>
<td>.013</td>
</tr>
<tr>
<td>Error</td>
<td>267.407</td>
<td>468</td>
<td>.571</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Corrected Total</td>
<td>2346.000</td>
<td>486</td>
<td>.571</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>457.597</td>
<td>485</td>
<td>.571</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a R Squared = .416 (Adjusted R Squared = .394)
Discussion

As stated at the beginning of this chapter, the purpose of this proof of concept experiment were twofold:

1. To establish the relationships between key constructs and variables (Zones of Tolerance, Variance and, as a secondary hypothesis, Alternatives); and

2. To establish the veracity and validity of the research method, in particular, the research design, subject selection and data collection methods.

This experiment served as an effective and parsimonious proof of concept device that empirically tested the effect of a Zone of Tolerance, Budget Variance and the Availability of Alternatives on the tolerance of budget variances. Using a 3 (ZOT) X 3 (VARIANCE) within-subjects design with X 2 (ALTERNATIVES) between-subjects treatment groups in order to test both the main and interaction effects of these constructs on a subject's willingness to tolerate escalating commitment to troubled projects.

We found a strong main effect for the effect of Variances on a tendency to escalate. The results show that as budget variances increase, a decision-makers' willingness to tolerate it increases to a point and then decreases. For small budget variances, in particular, decision-makers found it apt to tolerate said variances without much correction. On the other hand, larger budget variances tended to be corrected, either through correction back to the budget in the following period, de-escalation or abandonment.
That variances affect tolerance, in itself, is no profound finding. What is an original finding, however, is the effect of Zones of Tolerance on the willingness to tolerate budget variances. Zones of Tolerance have an interaction effect with budget variance. Thus, controlling the context around which these budget variances occur has a significant effect on the tendency to allow escalation of a project, particularly under conditions of high budget variance. In other words, when the organisational and structural conditions create low tolerance zones, decision-makers react appropriately to the constraints imposed upon them.

From this it can be seen that escalation is not entirely irrational, but rather takes the structural tolerance of budget variations as an undergirding influence. This effect has been suggested by Drummond (1994), but hitherto never tested empirically. Case studies do not permit such investigation since the organisational conditions are non-manipulable, and the precedent of single-shot, between-subjects decision tasks (as in previous experimental literature into escalation) does not allow for such a comparison. To this end, the research design employed in this experiment, hitherto untested in escalation literature, was also shown to give a richer picture of investment decisions under varying conditions than conventional escalation experiments.

Similar to the original studies of asymmetric loss functions within the forecasting field, as well as Lawrence and O’Connor’s original postulation of the Zone of Tolerance phenomenon, it can be seen that decision-makers respond appropriately to the conditions within which they are making a decision to tolerate setbacks. The existence of this behaviour strongly suggests that escalation of commitment need not
necessarily be irrational (i.e. acting completely antithetical to the reality of the project’s circumstances). Rather, decision-makers’ responses to the structural constraints imposed upon them suggest that escalation, despite its prevalence and gravity in the real world, can be controlled effectively through appropriate measures that constrain the tendency to tolerate setbacks to an unreasonable degree.

**Limitations of the Study**

Alternatives were not a significant contributor to the decision to escalate commitment to a course of action. There are several possible reasons for the failure to discover significant effects, the most likely of which can be seen to arise through a poor manipulation of the Alternatives construct (Type II Error). Similar manipulations of the Alternatives construct were used by Keil, Truex & Mixon (1995) and Schaubroeck & Davis (1994) and significant results were discovered. Their result was found even though the manipulation of the construct used a single alternative for investing funds in another project. In this study, it was argued that a manipulation presenting just one alternative – another project whose nature, risk and return were not stated – contained insufficient ecological realism. To that end, this study presented subjects with two alternatives: a new project for potential investment or to put remaining funds into a corporate account whose return was equivalent to that of government bonds. Nevertheless, despite the addition of a ‘safe’ alternative, no significance was found.

A second limitation of the study was the lab setting. Lab settings do not provide sufficient realism typical escalation situations, which are often fraught with high
emotions, organisational conflict and high ambiguity. In the absence of such strong emotive cues, subjects may exhibit a greater sensitivity to the demand characteristics of the lab setting. Many precautions were taken to negate such risks, the most important of which was that subjects were not told of the objective of the task prior to commencing it. However, while the results were treated as independent and random ordering of treatments were employed, it is not outside the realm of possibility to surmise that the objectives of the experimenter would eventually be discovered during execution of the task, due to some repeating patterns of budget variances (none, low, high). This would taint the subjects' responses with expectancy effects. Regardless however, ordering effects were not found to be significant upon post-test examination.

Implications for the Next Experiment

Understanding the components of decision-maker tolerance within an organisational context can be complicated and amorphous. In the next study, we will examine the effect of shifting project conditions over time on the amount of variances accepted by project managers. Tolerance is affected by many behavioural and organisational sources. For instance, changes of management, shifting user preferences or changes in resource availability all may have direct effects on how much tolerance is extended towards a project with deteriorating performance and likelihood of success.
Concluding Remarks

This proof of concept experiment sought to establish the relationships between the key constructs and variables used in this research programme. In particular, we sought to test the effects of Zones of Tolerance and Budget Variances on the tendency to escalate commitment to information systems projects. We postulated that the structural and organisational conditions that surround a project create boundaries within which budget variances (and, more generally, variations from expectations) are tolerated. As a secondary hypothesis, we examined the effects of Availability of Alternatives on the decision to escalate. Furthermore, the use of proof of concept-style research using experimentation establishes the veracity and validity of the research method. In particular, it seeks to establish the veracity of the research design, subject selection and data collection methods.

Decision-makers often respond to this ambiguity by tolerating a certain amount of variations from their original intentions. This study is an attempt to create a nexus between some the conflicting literature debating whether tolerance of escalation is inherently rational or irrational. Escalation is a historically laden and context-dependent phenomenon where real world ambiguity is often acknowledged by decision-makers as an unavoidable aspect of project management. Information systems escalation literature has typically focused on causes due to project management failures during development. Time and cost overruns of IS development projects are attributed to mismanagement during the development cycle, obstruction by stakeholders and the inability to accept uncompensated losses by abandoning failing projects (Abdel-Hamid 1988; Keil 1995; Keil et al. 1995;
Newman and Sabherwal 1996). The findings of previous IS escalation studies have relied largely on the retrospective rationality of project managers, who are often seeking to assign blame or to justify their persistence with failed initiatives. What is often ignored, however, are the ambiguities and the tolerance surrounding the smaller, seemingly innocuous setbacks early in the project’s development.

This study investigated the behaviour of decision-makers in escalation of commitment decisions under Zones of Tolerance, Budget Variance and Alternatives conditions. Most escalation situations occur gradually over time through small but cascading and compounding variations from expectations. We found that Zones of Tolerance and Variance are statistically significant contributors to the continuation of courses of action. As expected, we found that small variances from expectations (5%-10%) are likely to be tolerated rather than corrected and that large variances from expectations (20%-25%) are more likely to lead to de-escalation or abandonment decisions. This finding is at odds with Prospect Theory’s assertion that small variances from expectations are the largest carriers of marginal utility or disutility. Contrary to prior studies (and our expectations) we could find no significant effect of Alternatives on either the continue/abandon decision or as an interaction effect with either Zones of Tolerance or Variance. This study is a preliminary investigation to determine how the presence and function of ZOT’s affect resource allocation decisions. Nevertheless, decision-makers’ sensitivity to ZOT’s are intuitively and empirically valid phenomena and have been shown to be a key contributor to resource allocation decisions in general and escalation of commitment decisions in particular.
Your Role

You are to imagine that you are a Consultant Project Manager for a series of nine projects across three different companies (three projects per company). Your role is to oversee the day-to-day progress of the projects that you monitor and make sure that projects run according to the plans set out by the Senior Management of each company.

At the end of every period you report to the Senior Management on the progress of projects and make recommendations about how much should be invested into these projects in the coming period.

Senior Management first considers your recommendations and then decides whether or not to approve your recommendations. They have the final say in how much gets allocated to each project and can independently decide to increase or reduce funding to the project, or suspend it if it is not running to plan.

IMPORTANT NOTE:
Your reputation in these organisations is significantly affected by the quality of your recommendations to Senior Management. A poor recommendation may be to spend too much or too little on a project, or take actions that will lead to project failure.

You know that a lot of projects are supported by Senior Management — some good and some bad — and you need make recommendations that conform to both the Senior Management's strategic directives as well as contribute to the value of each company.

Your Task

It is now time to review progress in each of these projects and make a recommendation to Senior Management about funding these projects in the next period.

You will be provided with some key project information and you are required to make three recommendations for EACH project under your management:
1. Whether or not the project should be continued;
2. How much should be allocated to the project in the coming period; and
3. What you believe the status of the project should be.

-- Alternatives Manipulation Inserted Here --

See Figure 4.9a and 4.9b
**Senior Management Directive**

New competitive threats from Google, Microsoft, Apple and other major industry players have severely tightened the market for our products. The essence of the new market conditions is cost competitiveness and timeliness of delivery. The current projects have been approved for their market potential as well as their implementation of well known and stable technology platforms.

Project budgets were designed to realistically accommodate for all costs that will be incurred during development, but there is little room for significant changes to project size or scope without adversely affecting profitability.

Spending approvals from management will only be granted to project managers demonstrating the ability to ensure that very tight cost budget controls are placed on projects to maintain their viability in the market. This means that cost overruns are approved in exceptional circumstances only.

**Industry Analysis**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mobile devices are becoming more affordable and accepted in the consumer market, allowing software developers to access a large and growing market;</td>
<td>• Large, well-resourced competitors (such as Microsoft, Apple and Sony) use strongly competitive tactics such as bundling and prohibitively low prices to consumers to make competition extremely fierce.</td>
</tr>
<tr>
<td>• Development tools that used here typically involve well-known technologies that are stable and mature. It is relatively easy to estimate and manage costs during development; and</td>
<td>• Providers must be able to provide services at very competitive prices to beat competitors providing very similar services; and</td>
</tr>
<tr>
<td>• Consumer demands from their technologies from this sector tend to be less sophisticated and easier to satisfy than in other industry-based sectors of the market.</td>
<td>• Failure to be early entrant into these markets can often mean than slow developments may see investments lost to faster competitors;</td>
</tr>
</tbody>
</table>
Industry: BUSINESS SOFTWARE

Company Name: Harper’s Corporate Technologies

Senior Management Directive

Our expectation of this company is that they must focus on the quality of the products they develop. While managing costs within budgets are highly important, it is more important that we are a quality leader in the area of business computing.

We value our client industries and we must be flexible to accommodate a moderate degree of changes to plans. We are going to closely monitor all project developments and approve those projects that demonstrate strong market value and whose cost and time budgets are proceeding on or close to plan. This means that cost budget overruns are accepted in some circumstances but not in others depending on the project’s value to the firm.

Industry Analysis

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Key industries such as transport, logistics, retail and hospitality are beginning to see the benefits of mobile technologies to aid staff who are constantly moving and require constant communications with head office;</td>
<td>- Businesses are notorious for their demand for high quality at a reasonable price. Greater buyer awareness has seen quality standards in the industry rise very high;</td>
</tr>
<tr>
<td>- There has been a new and exciting resurgence of interest in ‘big-budget’ technology investment by businesses after the dot-com bust of the late 1990’s; and</td>
<td>- Businesses are now requiring strong after-sales service in this market. Products and services that are not adequately delivered will create additional after-sales support costs which erode profits; and</td>
</tr>
<tr>
<td>- Businesses seem willing to pay a little more than in the past for quality mobile devices and software.</td>
<td>- Products and services that do not meet quality specifications open suppliers up to the risk of lawsuits by disgruntled business clients;</td>
</tr>
</tbody>
</table>
Senior Management Directive
Our expectation of this Research and Development focused company is that they produce high value investment opportunities for implementation and release in the medium to long term.

There is a degree of tolerance for the uncertainties of developing brand new technologies. So long as projects are strongly profitable, project managers can decide, to an extent, how much this quality should cost in terms of time and money.

Spending approvals from management will be granted to projects demonstrating strong market profitability and evidence that the project will be delivered in a timely manner in the longer term. This means that cost overruns are accepted as long as they are not excessive and the project represents real value to the organisation.

Industry Analysis
Research and Development (R&D) within the technology sector continues carry a large element of risk because it relies on the development of new and untested technologies that may or may not deliver profitable products and services in the market. Although a large number of research and development project fail, the ones that succeed typically produce superior profits for the companies that invest in them.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A Harvard Business Review study shows that high-technology product launches—only 14% of all technology product launches—generate 61% of profits to the technology sector;</td>
<td>• New technologies may take longer to develop or may become more difficult and costlier than originally anticipated;</td>
</tr>
<tr>
<td>• Firms in the technology-industry must continually develop new technologies to remain competitive; and</td>
<td>• Technology under development may not be commercially successful; and</td>
</tr>
<tr>
<td>• Historically high failure rates in R&amp;D projects can often be offset by just a handful of highly successful R&amp;D-based innovations.</td>
<td>• Development may be technically unviable given the current state of technology.</td>
</tr>
</tbody>
</table>
Chapter 5 - Tolerance Over Time

--- CHAPTER 5 ---

EXPERIMENT 2: TOLERANCE OVER TIME

Introduction

In this experiment, we investigate the effect of time to a decision-maker’s tolerance. We examine a number of characteristics of a project’s performance that may change over time, namely (1) the effects of the stability of budget variances over time; (2) the magnitude of budget variances over time; and (3) the change in risk preference over time. Only a handful of experimental studies have investigated escalation decisions over time and these studies used only a limited number of time periods.

Confirming our conjectures regarding the effects of ZOTs and Time on the treatment of escalating courses of action we found a significant effect of ZOTs and a main significant effect of time on the evaluation of projects and the continuation decisions made by subjects within the decision task. Contrary to prior escalation studies examining risk preference in loss conditions, this study also shows that losses faced within escalation episodes can engender risk aversion, particularly if decision-makers operate under conditions where escalation is the less risky option when controlling project setbacks. This would appear to indicate that persistence despite costly setbacks causing escalating commitment episodes is more likely when organisational and structural constraints provide high tolerance that would absorb this increased spending.
Objectives of Experiment 2

Extending the Causal Model

In the first experiment, we examined how decision-makers react to budget variances at one point in time over several projects. In this second experiment, we seek to investigate the importance of time to a decision-maker's tolerance and examine a number of characteristics of a project's performance that may change over time. The contributory effects of time on tolerance to escalating projects may be driven by a number of qualities of the project and organisational context. In this study we focus our investigations upon three facets of temporal change within a project's development:

1. The effects of the stability of budget variances over time;
2. The magnitude of budget variances over time; and
3. The change in risk preference over time.

In the first experiment, budget variances were found to have a strongly significant effect upon escalation decisions. However, we examined these budget variances at specific and distinct points in time within a project. Much of the experimental literature into escalation have used single-shot decisions (notably Staw 1976, Arkes and Blumer 1958, Garland 1990, Conlon and Garland 1993 among others) However, there have been only a few studies that have examined escalation tendencies over a number of time periods.
Paucity of Studies Investigating the Effects of Time

Only a handful of experimental studies have investigated escalation decisions over time (specifically in reference to a tendency for consistency across decision points over time). Three experimental studies in escalation have examined the effects of time on escalation behaviour (Staw 1976; Staw and Fox 1977; Schmidt and Calatone 2002). However, these studies use a number of limited time periods (see Table 5.1). This study, by contrast, uses nine time periods to investigate the phenomenon.

<table>
<thead>
<tr>
<th>Study</th>
<th>Time Periods</th>
</tr>
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<tbody>
<tr>
<td>Staw (1976)</td>
<td>2</td>
</tr>
<tr>
<td>Staw and Fox (1977)</td>
<td>3</td>
</tr>
<tr>
<td>Schmidt and Calatone (2002)</td>
<td>3</td>
</tr>
<tr>
<td>Simonson and Staw (2002)</td>
<td>2</td>
</tr>
<tr>
<td>Brody and Kaplan (1996)</td>
<td>2</td>
</tr>
</tbody>
</table>

Staw’s (1976) experimental study used two time periods to examine the effects of personal responsibility on escalating projects, reasoning that “due to the simple consistency of actions over time, one might also expect individuals to increase their commitment to a decisional alternative for which they have had some prior choice” (p30). He operationalised the effect of personal responsibility by getting subjects to make an initial investment decision that they were responsible for in subsequent escalation episodes. Staw’s (1976) findings suggest that consistency with prior decisions may not be the only explanation of escalation tendencies across time. He states,
"It may well be true that, due to consistency in choice decisions, individuals will allocate more money to an investment alternative that was personally chosen at an earlier point in time (e.g., under high responsibility) than one chosen previously by someone else (e.g., under low responsibility). However, when the individual cells of the analysis of variance are examined [...] it appears that the main effect of personal responsibility is not fully explained by consistency" (p39).

Simonson and Staw (2002) also used a two-period decision task, but did not analyse these decisions within-subjects, choosing instead to use the initial decision as a baseline.

Staw and Fox (1977) sought to expand upon Staw's (1976) study in order to investigate whether escalation of commitment behaviour was a transient phenomenon (corrected in subsequent time periods) or one that was persistent over time. In doing so, they expanded the number of decision points from the original study from two to three (at three-year increments), to see if the third period saw correction of an escalation situation arising at time period two (with the first time period as the initial responsibility condition). They found a significant main effect of time as well as interaction effects with both personal responsibility and the efficacy of resources (how effective resource investment would be at addressing issues associated with the project). They also found that correction behaviour occurred between time periods, where negative information lead to significant correction in time period two, followed by a reversal of that correction in the third time period, suggesting that decision-makers tended to over-correct their allocations once
negative feedback was presented to them (see Figure 5.1). Staw and Fox (1977) therefore posit a pattern of behaviour (that no subsequent study has replicated) that "repeated negative information can lead to a sequence of escalation, discouragement and withdrawal, and then reescalation" (p448), leading to behaviour that is "quite dysfunctional over time" (p449).

Figure 5.1: Interaction of Personal Responsibility and Time

(Staw and Fox 1977)

Schmidt and Calatone (2002) while not ostensibly a study in the effects of time, used three within-subjects time periods to demarcate stage-gates of new product developments from a marketing perspective. They found that perceptions of new product failure, funding propensity and self-reported commitment changed during the new product development process. Interestingly, while Schmidt and Calatone (2002) found that managers identifying negative information and project status were less likely to allocate resources in subsequent time periods, they found that these same managers increased their perceptual commitment to the failing project.
The Effect of Time on Escalation Behaviour

Why Time is Integral to Escalation Behaviour

The effect of time is integral to studies of economic decision behaviour generally and escalation in particular. Simon (1976) considered the entropy of behaviour over time as a defining aspect of strategy,

"This time-binding character of strategies deserves the greatest emphasis, for it makes possible at least a modicum of rationality in behaviour, where without it, this would be inconceivable. For example, an individual who has spent seven years of his life preparing to be a physician and ten more years practicing that profession does not ordinarily have to spend any more time deciding whether he should be a physician or not" (Simon 1976, p68).

Literature into the effect of time generally falls into two categories: that which examines the effect of time on decision behaviour and that which examines the effect of time on the decision context. Behaviours that affect the nature of strategy and action over time are used as a basis for tendencies to complete tasks already started (Lewin 1935, Conlon and Garland 1993) and self-justification of prior decisions (Festinger 1957). Within a given decision context, ambiguity, costs and payoffs change, cascade and compound over time. The resultant effect within an escalation dilemma may be to entrap decision-makers into making initial investments then subsequently having to persist with those with past decisions after unanticipated losses occur (Brockner and Rubin 1985).
The Effect of Time on Decision-Making Behaviour

Conlon and Garland (1993) used theories of task completion to explain the psychological basis of the completion effect, the tendency to want to complete a task the closer one gets to the end of it. While the causal source of the completion effect is not adequately addressed even within escalation literature itself, Garland and Conlon (1998) provide a tentative explanation of the completion effect in terms of Lewin’s (1935) theories of goal satisficing. Lewin (1935) postulates that proximity to a goal, even if it is unattainable, creates an independent incentive to complete that goal. In situations where the primary goal is unattainable, the “attainment of a substitute goal, a consolation, or an encouragement is, for a child, to a rather considerable degree the equivalent of a genuine success” (p253). However Garland and Conlon (1998) fail to report that Lewin’s (1935) examination of this hypothesis comprised of experiments conducted by testing infants with tasks of varying difficulty. Whether these findings can be extrapolated to information systems projects is a matter for conjecture.

Kcil (1995b) finds that “a prior success may inhibit a decision-makers’s willingness to re-examine the current course of action, thus promoting escalation”. The effect of past decisions has also been found to be a significant determinant of future action, particularly in escalation situations. Staw (1976) applies the theory of cognitive dissonance to escalation by proposing ‘self-justification theory’. Cognitively, individuals strive for consonance in decisions post hoc. This behaviour may become aberrant when they “go beyond the passive distortion of adverse consequences in an effort to rationalise a behavioural error” (Staw and Fox, 1977, p432). This theory states that individuals are most likely to invest additional resources to failing projects
in order to justify their previous investment decisions. In such situations, suppressing negative information may become a causal source for escalating commitment to a failing project. Staw and Fox (1977) find that investment decisions under conditions of high personal responsibility are more unstable than under conditions of low personal responsibility, however did not find self-justification persisting over time.

There is research to indicate that a possible reason for the above behavioural phenomena is due to the humans' inability to accurately account for time. Soman (2001) postulates three reasons for humans' inability to account for time the same way as they would other resources:

1. Time cannot be inventoried or replaced;

2. It is not as easily aggregated as money; and

3. Accounting for money is a routine activity, whereas accounting for time is not.

Soman (2001) found no effect of sunk time on decisions because “people have neither necessary economic sophistication nor the perceptual apparatus to effectively account for time the same way as they account for money” (p171). Often, the memory and attribution of consequences of past decisions are imperfect, and decision-makers may base future decisions on fallible interpretations of these consequences. March and Olsen (1973) state,

"The past is important, but it is not easily specified or interpreted. History can be reconstructed or twisted. What happened, why it happened, and whether it had to happen are all problematic. [...] At any point in time,
individuals vary in the attention they provide to different decisions; they vary from one time to another. As a result, the pattern is uncertain and changing.”

(March and Olsen 1973, p12)

The Effect of Time on the Decision Context

Time has the effect of narrowing the feasible alternatives to a course of action (Simon 1976), binding decision-makers to particular courses of action and providing a history upon which future decisions are based (March and Olsen 1973). Perhaps the most important feature of the effect of time on the decision context is that it resolves ambiguity. Case study research by Keil (1995b) suggests that, in some circumstances, escalation is due to the project manager’s tenacious attempts to salvage the project from failure. Prior escalation studies have examined escalation by giving decision-makers the binary decision to either allocate the entire remaining budget to complete the project or to abandon the project immediately.

Negative information, however, does not always lead to considerations of project abandonment. Project teams may attempt to resolve problems that arise during development so that the project may stay viable. Therefore, in order to ascertain the veracity of ambiguous cues, project managers may decide to continue investment in projects with a view to addressing some of the sources of potential project failure. Similarly, project managers may adopt a ‘wait and see’ approach by delaying the decision in order to better understand the likelihood of success or failure of the project. This approach to addressing ambiguity in information systems development environments effectively involves ‘paying a premium’ for ambiguity reduction by
delaying the abandonment decision until such time as the ambiguities surrounding the likelihood of success are better understood (Kunreuther et al. 1995).

Ironically, tentatively continuing an investment to reduce ambiguity is seen as compounding the likelihood of failure by causing the very escalating commitment it seeks to avoid. Making continuous small investments in the hope of a large eventual pay-off has been termed by Brockner and Rubin (1985) as 'entrapment'. Brockner and Rubin (1985) exemplifies entrapment in a situation where one has waited 30 minutes for a bus and is considering catching a taxi. By waiting a little longer, one can hope to ‘salvage’ wasted time by continuing to wait for the bus to arrive, or one can catch the taxi at the expense of time lost and a costly taxi fare. The longer one waits for the bus, the more demanding the sacrifice in time becomes for the decision-maker. Ambiguous decision contexts may operate in the same way.

**Studies of Escalation over Time**

Escalation, by its nature, is a phenomenon with cumulative effects during the life of a project. Brockner’s (1992) definition of escalation defines the phenomena specifically as “repeated [rather than single shot] decision-making in the face of negative information about prior resource allocations” (p40). The result of time on the decision-making process is a result of responsibility for prior investments (Staw 1976, Garland 1990), proximity to goal attainment (Rubin and Brockner 1975), future expenditures (Brockner et al. 1981) and the history of failures associated with the project (McCain 1986).
Despite the emphasis of time and the history of prior decision-making, most of the
studies cited above employ single-shot decision tasks requiring the decision-maker to
imagine that they made the prior decisions, rather than actually making them. This is
often due to the practical limitations of paper and pencil studies in previous
experimental tasks. Those studies employing multiple time periods typically use a
limited number of iterations to test their phenomena. For example, in a test of initial
versus subsequent responsibility for decision-making Schultz and Cheng (2002) used
two time periods. Lant and Hurley (1999) use of seven time periods represents one of
the largest time period investigations to date within escalation research. They found
that "[p]rior resource commitments [...] appear to promote escalation of commitment,
even under conditions of negative feedback" (Lant and Hurley 1999, p432).

It is our conjecture that budget variances occurring in later time periods are more
likely to be accepted than in earlier time periods. The effect of time will be
particularly germane to our investigations of the interaction effects between time,
budget stability and budget magnitude (discussed in the next section). We also
propose a main effect of time on the tendency to escalate troubled projects:

**H1**: Time has a positive effect on the tendency to escalate troubled projects.

**Zones of Tolerance**

The investigation of incremental investments in projects over time is particularly
pertinent to our study of Zones of Tolerance. Case studies into escalation suggest that
escalation is more likely to occur due to setbacks compounding gradually over time,
rather than with sudden major setbacks. We have argued earlier that escalation is a
product of cascading and compounding problems over time that are tolerated because the cost of correcting them at that point in time was greater than the cost of tolerating them.

Given the inherent ambiguity within most decision contexts, certain variability in budgeted outcomes may be seen as a necessary component of an organisational context in flux. Setbacks, therefore, may be seen to be absorbed by the decision context given sufficient leeway encoded within Zones of Tolerance. When setbacks are viewed as relatively minor, Zones of Tolerance may induce decision-makers to actively prefer to not correct them, since they would not impose significant punitive damage on the resources or strategies of the organisation. In other words, returning to our definition of Zones of Tolerance, non-systematic setbacks that are viewed as temporary or ephemeral by decision-makers may not be corrected by decision-makers, particularly if the costs of not correcting them are immaterial, negligible or zero.

We therefore posit an independent main effect of Zones of Tolerance and an interaction effect of ZOTs over Time:

H2: Zones of Tolerance have a positive effect on the tendency to escalate troubled projects.

H3: Zones of Tolerance have a positive interaction effect with Time on the tendency to escalate troubled projects.
Stability and Magnitude of Budget Variances

As opposed to the temporary setbacks detailed above, setbacks that are systematic may create budget variances that are uniform or predictable. It has been noted previously that prior experimental studies in escalation rely on large single-shot, single decision-point setbacks that fundamentally and dramatically increase the costs of the project or significantly threaten its viability. In this study, however, we examine the effects of the stability of budget variances over time. Time may have the effect of inuring project managers to budget variances that persist at stable levels over time. For example, if project managers persistently experience, say, 25% budget variances over multiple time periods, they may develop a tendency to adjust their expectations such that 25% overspend becomes the new status quo. This is akin to Lyytinen and Robey's (1999) assertion that organisations learn failure through repeated and systematic setbacks to projects. In their words, consistently repeated setbacks may be a product of "inefficient practices [that have] persisted so long that they have become impervious to change" (p86). By contrast, budget overruns that frequently change in magnitude over time may be less palatable to the decision-maker, who would be unable to settle on a status quo point of reference for an acceptable threshold of variation. It is our conjecture that stable budget variances tend to be corrected less than unstable variances over time. Formally, we hypothesise,

H4a: Stable budget variances over time are less likely to be corrected than unstable budget variances of the same magnitude.
**H4b:** Zones of Tolerance have an interaction effect with the stability of budget variances on the tendency to escalate troubled projects.

In a re-test of the findings of Experiment 1, we will re-explore the effect of the magnitude of budget variances with the addition of the Time construct:

**H5a:** Small budget variances are less likely to be corrected than large budget variances.

**H5b:** Zones of Tolerance have an interaction effect with the magnitude of budget variances on the tendency to escalate troubled projects.

**Risk**

"Risk is intrinsically embedded in time, and yet the temporal context continues to suffer from neglect in the research literature." (Das and Teng 1997, p69)

A large body of research is focused around escalation as a product of risk-seeking in the face of losses as conceived through Prospect Theory (Whyte 1986, Brockner 1992, Schaubroeck and Davis 1994, Johnstone 2002 among others). Prospect theory, proposed in Kahneman and Tversky’s (1979) seminal paper (the highest cited paper in the history of *Econometrica* and one of the biggest contributors to Daniel Kahneman’s Nobel Prize in Economics) goes some way to address how preferences are formulated and acted upon under conditions of uncertainty. With regard to the evaluation of preferences, Kahneman and Tversky (1979) postulated the existence of
a reference effect created through an initial value position and represents "the neutral point in the outcome space" (Tversky 1977, p212). As Kahneman and Tversky (1979) explain, prospect theory concludes that sensitivity to gains or losses are not evaluated in terms of total wealth, but by relative gains and losses from a reference point, such as a total budget or an expected return. Prospect theory's value function is hypothesised as concave for gains and convex for losses (see Figure 5.2).

In this case, gains and losses are determined in relation to a reference point that represents an initial asset position. From this reference point, the magnitude of gain or loss from this reference point is the main carrier of value, rather than the absolute amount of that change. Kahneman and Tversky (1979) exemplify this relativity by showing how individuals tended to value the difference between $100 and $200 much more than the difference between $1100 and $1200, even though there is no difference between the two in absolute terms. Furthermore, the value function is steeper for losses than for gains, since "losses loom larger than gains. The aggravation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount" (Kahneman & Tversky, 1979).

Figure 5.2: The Prospect Theory Value Function (Kahneman & Tversky, 1979)
Tversky (in Bell et al., 1977, p216) postulated that this reference point corresponds to the status quo, “although it may reflect one’s expectations or level of aspiration”. Furthermore, this reference point moves in response to realised gains or losses from prior events. Kahneman and Tversky (1979, p286) suggest that inappropriate or irrational decision-making occurs when there is a discrepancy between the reference point and the current asset position, because of “recent changes to wealth to which one has not yet adapted”.

Within the context of escalation behaviour, budget overruns are characterised as variations from expectations (i.e. a budget) into the loss domain resulting in increased risk-seeking behaviour. Given that decision-makers are risk seeking in the domain of losses, the hypothesised behaviour is that decision-makers feel apt to allocate more resources to bring themselves into the value-neutral or gains domain. One of the most well-known exemplars of the escalation phenomenon as it relates to risk behaviour can be seen in Tversky and Kahneman’s (1981) account of betting at a horse track. Their experiment demonstrated that a gambler who had lost most of their money by the end of the day would stake riskier, long odds horses in order to return to the asset position they had at the beginning of the day. This was seen to compound the problem, since betting on riskier options the more one loses will (probabilistically speaking) worsen the asset position of the gambler. We therefore posit that a decision-maker will weigh their risk preferences against the magnitude of budget variances. Specifically, we postulate,

H6: As variances increase as a proportion of a budget, decision-makers are likely to become increasingly risk-seeking.
Furthermore, it is our conjecture that ZOTs have a strong interaction effect with risk preference and risky behaviour. We postulate that Kahneman and Tversky's (1979) characterisation of risk-preference applies to budget variances that occur outside the Zones of Tolerance. In other words, the Prospect Theory value function may be interrupted by the boundary conditions inhered within the decision context. Within ZOTs, a value function may be interrupted such that variations from a reference point (such as a budget) may be negligible or zero. Therefore, we postulate:

**H7:** The size of a Zone of Tolerance has a moderating effect on the effect of Budget Variances on a decision-maker’s attitude to risk.

**Research Method**

*Experimental Design*

The research design consisted of a 2 (Variance Stability) X 2 (Variance Magnitude) X 2 (Zone of Tolerance) between-subjects treatment groups with an X 9 (Time Period) within-subjects treatments (with the tenth time period serving as a post-test). A non-orthogonal design was employed for the between-subjects treatments and each subject was required to make decisions on two projects; one from each column of Table 5.2. In other words, they received one project from the stable variance condition (either at low stable variance or high stable variance) and one project from the unstable condition (either a project whose budget variance progresses from low in Period 1 to high in Period 10, or vice versa). As for the within-subjects conditions, each subject made decisions on each project over ten periods, in which they made both Project Status determinations and decisions about how to address project risks.
Table 5.2: Design of Experiment 2

<table>
<thead>
<tr>
<th>Variance Magnitude (%) Overrun</th>
<th>Variance Stability Beginning – End of 10 Time Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low – Low (5%)</td>
<td>Low (0%) – High (50%)</td>
</tr>
<tr>
<td>High – High (25%)</td>
<td>High (50%) – Low (0%)</td>
</tr>
</tbody>
</table>

The ZOT between-subjects manipulation was operationalised through subjects receiving either a Low or High ZOT condition for each of their projects. It is argued that ZOT should be treated as between-subjects since each project was randomised such that interdependencies between either manipulation are ‘washed out’ by the randomised research design and through careful stipulation that each project is independent of each other. Upon completion of the first project, subjects were instructed that “you have completed the first project” and told that they were to now make some decisions on another project under their control. Thus, the two projects were explicitly stated as independent and no resources or decisions carried over between them.

Dependent Variables: Project Status and Risk Preference

Project Status

The Project Status measure becomes the primary dependent variable for this study. In Experiment 2, we removed the R / R ratio (from Experiment 1) in order to simplify the response to a more complex decision-task within the limitations of time and pragmatism. Furthermore, the ‘Alternatives’ condition was not manipulated, necessitating a slight change to the Project Status measure. This is illustrated in Figure 5.4.
Figure 5.3: Experiment 1 Project Status

1. The project is progressing on or close to track
2. Variations are occurring but no action needs to be taken at this stage
3. Variations are occurring and we need to be careful about future spending
4. Serious budget and scope cuts are needed for this project
5. The project should be suspended immediately

Experiment 2 was designed in a slightly more complex fashion than Experiment 1 given the introduction of time as a 9 factor-level within-subjects measure for time. To that end, the measure of Project Status was combined with their resource allocation decision. If subjects chose a project status stating that they were either satisfied with the project or that they needed to remain vigilant of budget overruns (values 1-3 in Figure 5.3), then the project’s funding continued uncorrected. If, however, the subject chose the option that ‘serious budget and scope cuts are needed for this project’ (value 4 in Figure 5.3), the project’s funding reduced by 10%. A graphical simulation depicted the effect of this project status prior to a subject confirming this option. Finally, subjects choosing the option ‘the project should be suspended immediately’ withdrew all funding from the project (value 5 in Figure 5.3).

A caveat must be noted at this point: while there is a certain amount of valid criticism that the selection of these measures and associated actions do not conform well to face validity considerations, the choice of manipulating the project in this way was to make way for measurement of an additional construct (Project Risk), in
which subjects were required to decide upon their treatment of how certain setbacks experienced by the project were to be handled. In truth, the decision to tie decision-makers’ selected project status with funding continuation was born of pragmatism—a need to condense the number of decisions a subject made within each of the ten time periods in order to ensure the experiment was completed in under an hour, given additional complexities in the task. As it stood, the experiment required 30 decisions by the subject. Retaining the bi-partite feedback structure of the first experiment would have required subjects to have made 50 decisions in under an hour.

Project Risk

The inclusion of project setbacks involving risky prospects in situ of the decision context provides us with the opportunity to examine the effect of risk preference and the interdependencies between the magnitude and stability of budget variances, Zones of Tolerance and time. In order to test risk preference, subjects were presented with a randomly assigned a risky decision at every second period within the 10 periods of each project, (i.e. five risky propositions for each project) (see Table 5.3). Decision-makers were asked to make a decision about the way in which a certain setback facing the project should be dealt with. Subjects were presented with a two-option choice of a ‘sure cost’ of resolving a setback versus the proposition of leaving the setback unaddressed with the risk that doing so would incur a higher cost in the

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9 Ideally, common dependent measures across all three experiments would improve the comparability between experiments and allow for better cross-analysis to enhance the richness of the findings. It would be worthwhile to retest these experiments with two common dependent variables (the resource allocation decision and the project status) measured in exactly the same way, however time and cost constraints did not allow for this to occur prior to the completion of this dissertation. Rather, appropriate care was taken when analysing these results and when making generalisations from the findings. Both the changes to the dependent measures and the reasoning behind them are discussed throughout this chapter and within the chapters detailing each experiment.
Table 5.3: List of Risk Options Presented to Subjects

<table>
<thead>
<tr>
<th>Risk Type (Schmidt et al., 2001)</th>
<th>Description Presented To Subjects</th>
<th>Sure Cost of Correcting</th>
<th>Risky Cost of Not Correcting</th>
<th>Probability of Risky Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of End-User Commitment</td>
<td>Your client users are starting to become suspicious of the new development and seem a bit resistant to change which might affect the implementation in the future.</td>
<td>$5,000</td>
<td>$6,250</td>
<td>80-100%</td>
</tr>
<tr>
<td>Misunderstanding Requirements</td>
<td>Discussions between Business Analysts and your client users have discovered that there is a possibility of previous misunderstandings about some of the project requirements.</td>
<td>$12,000</td>
<td>$24,000</td>
<td>40-60%</td>
</tr>
<tr>
<td>Lack of Knowledge / Skills</td>
<td>While developing the components of the graphical interface, you suspect that there might be a lack of knowledge about certain technologies being used within your team.</td>
<td>$2,000</td>
<td>$10,000</td>
<td>20-40%</td>
</tr>
<tr>
<td>Changing Scope / Objectives</td>
<td>Your client has come to you with some additional requirements for the project. These new requirements are not core to the project, but would be &quot;useful&quot; to the client.</td>
<td>$7,000</td>
<td>$8,750</td>
<td>80-100%</td>
</tr>
<tr>
<td>Introduction of New Technology</td>
<td>The technology platform you are using has just experienced a significant upgrade. You might consider paying additional unforeseen costs to upgrade your technology platform.</td>
<td>$11,000</td>
<td>$22,000</td>
<td>40-60%</td>
</tr>
<tr>
<td>Failure to Manage Expectations</td>
<td>Some of your developments to date may not be meeting user expectations and you might consider spending some effort to clarify them.</td>
<td>$4,000</td>
<td>$20,000</td>
<td>20-40%</td>
</tr>
<tr>
<td>Insufficient / Inappropriate Staffing</td>
<td>Your staff are getting a bit overworked and may you might consider bringing in some additional people from head office to join your team in order to meet your deadlines.</td>
<td>$10,000</td>
<td>$12,500</td>
<td>80-100%</td>
</tr>
<tr>
<td>Conflict Between Departments</td>
<td>There seems to be some disagreements between the client and your analysts about the best solution to a certain issue.</td>
<td>$6,000</td>
<td>$12,000</td>
<td>40-60%</td>
</tr>
<tr>
<td>Lack of Cooperation from Users</td>
<td>Your Business Analysts have reported that there is a possibility some users might not cooperate with them because they perceive the new system as a threat to their jobs.</td>
<td>$5,000</td>
<td>$25,000</td>
<td>20-40%</td>
</tr>
</tbody>
</table>
following time period. These setbacks were identified from the ten highest risks to a project as identified by Schmidt et al. (2001) and are listed in Table 5.3. Each setback was operationalised using two options – one certain cost and one risky cost - with identical expected utilities. These options were presented to the subject with the description of the issue, the certain cost of correcting the setback, the financial risk of not correcting it and the probabilistic likelihood that the risk will obtain (see Figure 5.5). If the subject chose to take a risk by not addressing the issue, a random number was generated. If this random number (between 0 and 1) was within the probability of obtaining, the cost was incurred. For instance, referring to Figure 5.4, if the risk was “highly likely” (a probability greater than 80%) and the subject chose to take the risk a random number greater than .8 would result in the risk obtaining in the following period. Subjects were informed of this and the additional cost was added to the following period’s expenses. Thus, the use of these gambles would allow one to identify (at least in theory) whether or not a decision-maker is risk-seeking or risk-averse at that point in time depending on whether they choose the certain or the risky option.

This approach used to analyse risky prospects relates to the commonly found escalatory behaviour of addressing issues through increased spending. To that end we attempted to balance the ecological validity of typical business problems (and their typical solutions) with the exigencies of research design. To address ecological validity, we used Schmidt et al.’s (2001) list of the ten biggest risks to project development as identified though a Delphi study of IT project managers. In order to address the latter issue of research design, these risky propositions are stated similar to those of Kahneman and Tversky (1979) in their study of Prospect Theory, with a
key difference that these risk options were embedded within context of an organisational decision dilemma. It seeks to test the conjectures of Whyte (1986), Brockner (1992), Schaubroeck and Davis (1994), Johnstone (2002) that a Prospect theoretic interpretation that loss aversion and increased risk-taking behaviour explain the escalation phenomenon.

Section B: Project Risk Assessment

Issues At End of Period 1 and Potential Issues Next Period (Period 2)

Actual spending exceeded the revised budget by 6.4% in the last period.

Your client users are starting to become suspicious of the new development and seem a bit resistant to change which might affect the implementation in the future.

In Order To Address This Issue Next Period (Period 2) Choose To Either:

(1) Incur this CERTAIN cost to avoid financial exposure to this risk: $5,000

OR (2):

Do not spend funds to fix this issue and risk financial exposure of: $6,250

With the probability of financial exposure: Highly Likely

Risk Likelihood: Interpretation

- Highly Unlikely ≤ 20%
- Relatively Unlikely 20%-40%
- Even Chance 40%-60%
- Relatively Likely 60%-80%
- Highly Likely ≥ 80%

Your Decision

Please Select

- Incur Additional Costs to Address This Issue
- Do Not Incur Additional Costs to Address This Issue

Figure 5.4: Risk Preference Operationalisation

Independent Variables: ZOTs, Budget Stability and Budget Variance

Zone of Tolerance (Within-Subjects)

Similar to Experiment 1, this study used a cover story describing the organisational context within which a project is operating. Unlike Experiment 1, however, this study used only two levels of ZOTs – low and high and corresponded to one project for each ZOT treatment. In the high ZOT condition, ‘Project Romulus’ was couched
within a Research and Development division. The Senior Management Directive for this project stated that the project was being developed as a high value investment opportunity for release in the medium to long term and that there were a number of uncertainties around developing new technologies. Further, subjects were instructed that spending approvals from management would be approved so long as the project demonstrated a potential for profitability and that it be delivered in a timely fashion in the longer term. An industry analysis of the Research and Development sector, followed outlining both risks and opportunities, stressed high failure rates of R&D projects, but added that those that succeed tend to have high returns (see Figure 5.5).

<table>
<thead>
<tr>
<th>Research and Development Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Project Romulus&quot;</td>
</tr>
</tbody>
</table>

**Project Aims:** To develop a high-technology encryption instrument for potential use in the aeronautical and maritime industries.

**Senior Management Directive**

Our expectation of this Research and Development focused development is that it produce high value investment opportunities for implementation and release in the medium to long term.

There is a degree of tolerance for the uncertainties of developing brand new technologies. So long as projects are strongly profitable, project managers can decide, to an extent, how much this quality should cost in terms of time and money.

Spending approvals from management will be granted to projects demonstrating strong market profitability and evidence that the project will be delivered in a timely manner in the longer term.

This means that cost overruns are accepted as long as they are not excessive and the project represents real value to the organization.

**Industry Analysis**

Research and Development (R&D) within the technology sector continues carry a large element of risk because it relies on the development of new and untested technologies that may or may not deliver profitable products and services in the market. Although a large number of research and development project fail, the ones that succeed typically produce superior profits for the companies that invest in them.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A Harvard Business Review study shows that high-technology product launches only 14% of all technology product launches - generate 61% of profits to the technology sector;</td>
<td>• New technologies may take longer to develop or may become more difficult and costlier than originally anticipated;</td>
</tr>
<tr>
<td>• Firms in the technology-industry must continually develop new technologies to remain competitive; and</td>
<td>• Technology under development may not be commercially successful; and</td>
</tr>
<tr>
<td>• Historically high failure rates in R&amp;D projects can often be offset by just a handful of highly successful R&amp;D-based innovations.</td>
<td>• Development may be technically unviable given the current state of technology.</td>
</tr>
</tbody>
</table>

**Figure 5.5: High ZOT Manipulation**

In the low ZOT condition, 'Project Remus' operated in a competitive environment in which large technology companies provided stiff competition. The subject was instructed by Senior Management that cost competitiveness and timeliness of
delivery were their main priorities. Further, they were instructed that spending approvals would only be granted to those projects displaying tight budget controls. Similar to the high ZOT project, the industry analysis included opportunities and risks with an emphasis on the stability and maturity of the technologies used for development and a significant market size. The risks included competitive threats as well as risks associated with failure to be an early entrant in the market (emphasising the timeliness constraint) (see Figure 5.6 below).

**Consumer Electronics Division**

"Project Remus"

**Project Aims:** To develop a cost-competitive IP telephony technology for potential use in the consumer market.

**Senior Management Directive**

New competitive threats from Google, Microsoft, Apple and other major industry players have severely tightened the market for our products. The essence of the new market conditions is cost competitiveness and timeliness of delivery. The current project has been approved for its market potential as well as their implementation of well known and stable technology platforms.

The project budget was designed to realistically accommodate for all costs that will be incurred during development, but there is a little room for minor changes to project size or scope without adversely affecting profitability.

**Spending approvals from management will only be granted to project managers demonstrating the ability to ensure that very tight cost budget controls are placed on projects to maintain their viability in the market.**

This means that cost overruns are approved in exceptional circumstances only.

**Industry Analysis**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Mobile devices are becoming more affordable and accepted in the consumer market, allowing software developers to access a large and growing market.</td>
<td>- Large, well-resourced competitors (such as Microsoft, Apple and Sony) use strongly competitive tactics such as bundling and prohibitively low prices to consumers to make competition extremely fierce.</td>
</tr>
<tr>
<td>- Development tools that used here typically involve well-known technologies that are stable and mature. It is relatively easy to estimate and manage costs during development; and</td>
<td>- Providers must be able to provide services at very competitive prices to beat competitors providing very similar services; and</td>
</tr>
<tr>
<td>- Consumer demands from these technologies from this sector tend to be less sophisticated and easier to satisfy than in other industry-based sectors of the market.</td>
<td>- Failure to be early entrant into these markets can often mean that slow developments may see investments lost to faster competitors;</td>
</tr>
</tbody>
</table>

**Figure 5.6: Low ZOT Manipulation**

**Magnitude of Budget Variance and Stability of Budget Variance**

Three levels of budget variance (no, low and high) were manipulated in Experiment 1. By contrast, this study reduced the number of stable budget variances conditions to two - low (an average of 6% across the entire project) and high (an average of
25% across the entire project), similar to the magnitudes used in Experiment 1. For the stable budget variance condition, these budget overruns remained relatively constant and persistent throughout the entire project. Table 5.4 delineates the per period budget variance for each condition.

In the case of unstable budget variances, two levels were adopted. In the Low-High treatment, budget variances increased by around 5% every period from Period 1 through to Period 10, starting at 3.7% and escalating to 47.7% (an average variance of 25.7% - similar to that of the high stable variance condition). In the High-Low treatment, these budget overruns were reversed, starting at 47.7% and gradually reducing over the ten periods (see Table 5.4).

The aim of the unstable variance treatment was to compare the decision behaviour of project managers between these treatments and those of the high stable variance treatment. In all three cases, the average budget overrun over the 10 periods averaged to around 25%. However, we conjecture that decision-makers would react differently in each case as budget overruns interact with ZOTs and as decision-makers attempt to address budget overruns for which no stable reference point (other than the budget) might exist.

This is the most significant departure from the previous experimental studies into escalation. As we have discussed earlier, no experimental study to date has investigated the escalation phenomenon with this many time periods, even though escalation itself is a time-dependent phenomenon, couched within the attenuation of alternatives, ambiguity and resources over time.
Table 5.4: Budget Variance and Stability Treatments

<table>
<thead>
<tr>
<th>Period</th>
<th>Stable Low</th>
<th>Stable High</th>
<th>Unstable Low-High</th>
<th>Unstable High-Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.4%</td>
<td>26.8%</td>
<td>3.7%</td>
<td>47.7%</td>
</tr>
<tr>
<td>2</td>
<td>6.6%</td>
<td>27.6%</td>
<td>7.8%</td>
<td>43.9%</td>
</tr>
<tr>
<td>3</td>
<td>9.1%</td>
<td>22.7%</td>
<td>12.8%</td>
<td>37.4%</td>
</tr>
<tr>
<td>4</td>
<td>5.4%</td>
<td>26.9%</td>
<td>15.6%</td>
<td>34.9%</td>
</tr>
<tr>
<td>5</td>
<td>5.7%</td>
<td>27.2%</td>
<td>24.4%</td>
<td>28.6%</td>
</tr>
<tr>
<td>6</td>
<td>7.0%</td>
<td>24.9%</td>
<td>28.6%</td>
<td>24.4%</td>
</tr>
<tr>
<td>7</td>
<td>5.1%</td>
<td>23.1%</td>
<td>34.9%</td>
<td>15.6%</td>
</tr>
<tr>
<td>8</td>
<td>6.6%</td>
<td>25.2%</td>
<td>37.4%</td>
<td>12.8%</td>
</tr>
<tr>
<td>9</td>
<td>5.2</td>
<td>23.2%</td>
<td>43.9%</td>
<td>7.8%</td>
</tr>
<tr>
<td>10</td>
<td>5.3%</td>
<td>23.1%</td>
<td>47.7%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Average</td>
<td>6.2%</td>
<td>25.1%</td>
<td>25.7%</td>
<td>25.7%</td>
</tr>
</tbody>
</table>

The Decision Task – Experimental Apparatus

The study was executed using a computer simulation of two projects that were developed over ten time periods each. Each subject was presented with an introductory statement and cover story prior to making investment decisions of the two projects (See Figure 5.7).
**Your Role**

You are to imagine that you are the project manager for two projects under development within Atticus Solutions. Your role is to oversee the day-to-day progress of the projects that you monitor, and make sure that projects run according to the plans set out by the Senior Management of each company. At the end of every period you report to the Senior Management on the progress of projects and make recommendations about how much should be invested into these projects in the coming period. You must also make some decisions about how to control the risks that the project may face and balance these decisions against the restrictions on how much you can spend on the project.

**Important Note**

Your reputation in these organizations is significantly affected by the quality of your recommendations to Senior Management. A poor recommendation may be to spend too much or too little on a project, or take actions that will lead to project failure. You know that a lot of projects are supported by Senior Management—some good and some bad—and you need to make recommendations that conform to both the Senior Management’s strategic directives as well as contribute to the value of each company.

**Your Task**

You will now be presented with your first project which you will have to manage over 10 periods. In reality, most projects do not finish exactly on time and on budget. Decisions about what to do with projects that are going over budget should be made on a case-by-case basis and you should consider what is in the best interests of the organisation when making investment decisions. This is because there is always the risk of circumstances arising that were unforeseen when plans were first made. That is a risk of doing business and a project manager must always be ready to adapt to changing circumstances. Cancelling projects that have already started often mean losing a lot of money that has already been spent. You may even lose your job or professional reputation if you are responsible for a project that had to be cancelled. HOWEVER THERE IS A POINT WHERE FAILING PROJECTS MUST BE ABANDONED. JUDGEMENT IS NEEDED TO KNOW WHEN PROJECTS HAVE TURNED FROM GOOD TO BAD.

---

**Figure 5.7: Experiment 2 Cover Story**

The study placed the decision-makers in a scenario in which they were a project manager for two projects. Each project represented one level of the ZOT condition (either low or high) and one treatment of the variance condition (stable low, stable high, unstable low-high or unstable high-low). Their role was to make project status recommendations as part of end of period reporting to each of the two project’s Senior Management and to select how they were to address the various setbacks that occurred during the project (either paying to resolve them or taking a risk of higher spending in the following period by not resolving them). The experiment was operationalised using a computer simulation that dynamically updated budget and risk information each period. A main screen was used to track project status during each period and provided historical budget information, the Steering Committee brief, a panel displaying setbacks and risky options, and finally a panel where subjects entered their Project Status (see Figure 5.8).
Section A: Financial Scorecard

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Revised</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Budget</td>
<td>$594,000</td>
<td>$642,911</td>
<td>8.2%</td>
</tr>
<tr>
<td>Costs To Date (Period 11)</td>
<td>$423,400</td>
<td>$807,767</td>
<td>29.6%</td>
</tr>
<tr>
<td>Period 12 Budget</td>
<td>$0</td>
<td>$0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Section B: Project Risk Assessment

Actual spending exceeded the revised budget by 47.7% in the last period. The risks identified last period DID NOT manifest and you didn't need to spend anything to resolve it.

Section C: Steering Committee Brief

There is only a little room for minor changes to project size or scope without adversely affecting profitability. This means that cost overruns should be approved in EXCEPTIONAL CIRCUMSTANCES ONLY.

Section D: Project Manager Assessment

Overall Assessment of the Project

Please Select

Send Report

Figure 5.8: Project Template
Sample Selection

Overview of Subject Selection

A total of fifty subjects participated in the experiment. This experiment was conducted with 25 subjects for each of the two ZOT-Stability treatment groups. The decision on the sample size was made due to the presence of two between-subjects levels and a minimum of 25 subjects per treatment group. Subjects were recruited from final year undergraduate accounting students enrolled in an auditing and assurance course at the University of Sydney in 2006.

Subjects voluntarily participated in the task and were reimbursed for their time at a flat rate of $30 in cash, paid upon completion. Reimbursement was not tied with their performance of the decision task.

Selection Procedure

The researcher attended several tutorials for the accounting course attended by the students of the Undergraduate Business degree at the University of Sydney. The prospective subjects were presented with a brief announcement at the beginning of their tutorial classes. In this announcement they were told that the experiment related to a resource allocation task within a project management context that would test their judgement and decision-making skills. They were instructed that the experiment was to be conducted in the following week and would take up to one hour of their time. Further, they were told that there was no pre-requisite of prior knowledge of the task domain, no preparation necessary and participation in the task was completely voluntary. To stress the anonymity of their participation, they were assured that the lecturer-in-charge of the course in which they were enrolled would
not know who participated or their proficiency at the task and that the task was non-assessable.\footnote{All procedures relating to subject recruitment were approved by, and conformed with, the requirements of the Human Research Ethics Committee (HREC) at the University of Sydney. These are stringent controls imposed upon University researchers by the University in which all recruitment procedures, participation incentives (i.e. payments to participants), data collection instruments and analysis techniques must be approved by the HREC prior to the commencement of the research.}

**Sampling Method and External Validity Considerations**

Final year undergraduate students were chosen as an acceptable surrogate for Information Systems project managers. The advantages and disadvantages of selecting students for experimental tasks are examined in detail in the Research Methods section. Briefly, several studies on the effects of student samples on observed results have found little or no evidence of systematic differences between observed responses when compared to industry professionals (Peterson 2001, and Host et al. 2000 among others). It must be reiterated, however, that it would not be possible to make broad generalisations based on any empirical findings based on this research. However, external validity through generalisability is not the prime objective of this experiment.

By retaining students from the same class as the entirety of the sample, while posing significant challenges to external validity, serves to assist the research design. By selecting subjects from a relatively homogenous sector of the population of interest, the possibility of random error due to individual differences reduces as a validity threat. Random allocation of subjects to tasks can largely reduce and control for this validity threat.
Special Sampling Procedures for Student Samples

We employed a number of the suggestions from Carver, Jaccheri et al. (2003) on the use of students in IS-related experimental tasks (applied in Experiment 1 and discussed in more detail within the previous chapter).

1. The goals, measures and analysis method were not revealed prior to executing the experiment.

2. Subjects were given an opportunity for feedback to justify their decisions.

3. Subjects (if they so requested) were given the chance to receive feedback on their performance in the task.

4. Subjects were given a realistic time estimate of one hour to complete the task. While told the experiment would take up to an hour to complete. On average, subjects took between 45 minutes to one hour to complete the computer simulation task, including reviewing the cover material, making their project recommendations and completing the post-test questionnaire.

5. Finally, students were allowed to choose from a range of possible times to attend so as to avoid conflicts with their lesson schedules. Multiple session times were held over a one week period in which students could choose their preferred time for attendance (See Figure 5.3).
**Procedure**

Subjects were given a number of alternative times to attend the experiment session. Each session was held in a computer laboratory at the University of Sydney. Upon arrival, subjects were instructed to take time to read through the Ethics materials and sign Participation Consent Forms as per the requirements stipulated by the Human Research Ethics Committee at the University. Subjects were given a short introduction about what to expect during the experiment task. They were told that they were to receive two projects in which they needed to make investment decisions. Time was allowed for questions.

In order to preserve the ordering of decisions subjects were issued with a number that corresponded to a unique randomised treatment within the computer simulation. Table 5.5 describes the order in which projects were shown to subjects.

**Table 5.5: Presentation Order of Tasks Within the Simulation**

<table>
<thead>
<tr>
<th>Page(s)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participant Information Sheet</td>
</tr>
<tr>
<td>2</td>
<td>Participant Consent Form</td>
</tr>
<tr>
<td>3</td>
<td>Introductory Cover Story</td>
</tr>
<tr>
<td>4</td>
<td>ZOT Manipulation 1</td>
</tr>
<tr>
<td>5</td>
<td>Project 1</td>
</tr>
<tr>
<td>6</td>
<td>ZOT Manipulation 2</td>
</tr>
<tr>
<td>7</td>
<td>Project 2</td>
</tr>
<tr>
<td>16</td>
<td>Summary and Post-Test</td>
</tr>
</tbody>
</table>
Introductory Statement, Cover Story and Enhancing Ecological Realism

Each subject was provided with an introductory statement and cover story detailing their role as a project manager whose role is to “oversee the day-to-day progress on projects that [they] monitor and make sure that projects run according to the plans set out by the senior management of each company.” They were then instructed they were to review the progress of their projects and make recommendations to senior management about each project at the end of each period.

In order to make the importance of ‘good’ project investment decisions, subjects were told the following,

“In reality, most projects do not finish exactly on time and on budget.

“Decisions about what to do with projects that are going over budget should be made on a case-by-case basis and you should consider what is in the best interests of the organisation when making investment decisions.

“This is because there is always the risk of circumstances arising that were unforeseen when plans were first made. That is a risk of doing business and a project manager must always be ready to adapt to changing circumstances.

“Cancelling projects that have already started often mean losing a lot of money that has already been spent. You may even lose your job or professional reputation if you are responsible for a project that had to be cancelled.
“However, there is a point where failing projects must be abandoned. Judgment is needed to know when projects have turned from good to bad.”

“You know that a lot of projects are supported by Senior Management – some good and some bad – and you need too make recommendations that conform to both the Senior Management’s strategic directives as well as contribute to the value of each company.”

As with Experiment 1, The reason behind providing this information is to discourage participants from making opportunistic investment decisions that are skewed excessively towards escalating projects to preserve their reputations or to kowtow to Senior Management despite their assessment of the project as failing. By this, subjects were induced to balance the relative importance of the ZOT manipulations (management’s strategic directives and the industry brief) with the Variance manipulation (the efficiency with which the project was progressing according to plan).

Random Allocation of Tasks

Sixteen randomised decision sequences were created to negate ordering effects and these decision sequences were randomly assigned to subjects. The presentation of the ZOT, budget magnitude and budget stability conditions were completely randomised between the treatment groups, such that all possible permutations of these levels were tested. The treatments were ordered in this way to completely negate ordering effects for the between-subjects treatments and the ZOT treatment. Table 5.6 details the sixteen randomisation sequences.
Table 5.6: Randomised Ordering of Projects

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Methodology

Analysis Methodology – Repeated Measures Analysis of Variance (ANOVA)

The 2 (Variance Magnitude) X 2 (Variance Stability) X 2 (ZOT) between-subjects and X 9 (Time Period) within-subjects factorial design was tested using a repeated measures ANOVA and Kruskal-Wallis Chi Squares. Two separate analyses were conducted – one for the Project Status dependent variable and one for the project risk dependent variable.
Analysis and Results

*Dependent Variable: Project Status*

We found a significant effect of the Time Period (F(8,736) = 4.893, p = .000) on the evaluation of projects (Project Status) made by subjects within the decision task (H1 Supported). We also found a significant Time X Variance Magnitude interaction effect (F(8,736) = 3.423, p = .000). The Time X Variance Stability interaction effect was marginally insignificant (F(8,736) = 3.423, p = .073), although this result will be examined further in post tests. We could not find a within-subjects interaction effect between ZOTs and Time Period (F(8,736) = .5.329, p = .140) suggesting that subjects did not change their reactions to ZOTs over time (H3 Not Supported). The within-subjects effects are listed in Table 5.7.

**Table 5.7: Within-Subjects Effects**

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<th>Sig.</th>
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Chapter 5 – Tolerance Over Time

Table 5.8: Between-Subjects Effects

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The between-subjects effects in the model are listed in Table 5.8. Zones of Tolerance had a marginally insignificant main effect (F(1,92) = 9.467, p = .064) and a marginally insignificant interaction effect with Variance Stability (F(1,92) = 3.801, p = .054) (H2 and H4b Not Supported). Variance Magnitude and Variance Stability did not have independent main effects on the overall model (H4a, H5a and H5b Not Supported).

Post-Test Analyses of ZOTs and Unstable Budget Variances

Table 5.9 displays the means for the project status dependent measure. On its face, the disappointing results would seem to indicate that ZOTs did not have much effect on the overall model. However, a separate post-test analysis isolating the Variance Stability condition over time (n=50) shows a significant main effect of ZOTs under conditions of unstable budget variances (F(1,46) = 5.064, p = .029) (Table 5.10).
### Table 5.9: Means for Dependent Variable - Project Status

**Measure: Project Status**

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Table 5.9 (Continued): Means for Dependent Variable - Project Status

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Table 5.10: Between-Subjects Effects in *Unstable* Variance Treatments Only

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<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
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<th>Sig.</th>
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<td>19.701</td>
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<td>.055</td>
<td>1</td>
<td>.055</td>
<td>.014</td>
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<tr>
<td>Error</td>
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<td>46</td>
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We can see from Figure 5.9 above that Low ZOTs have the effect of heightening a subject's 'worry' about the project and this is reflected in the Project Status metric in the 'low to high' Budget Variance condition. Subjects facing projects in which the budget variances increased over the life of the project tended to become more concerned (as reflected by the project status) in the Low ZOT condition than in the High ZOT condition. This effect was more pronounced in the converse 'high to low'
be careful about future spending or that "serious budget and scope cuts are needed."

The project shows progressively increases in risk as subjects view their needs to action needs to be taken at this stage. Over time, we can see this in the conditions close to each and a project shows off of results that "variances are occurring but no condition," and a project shows off of results that "the project is progressing on or a project shows off of results that "are progressing on or the project shows to reflect the worsening budgetary position of the project." Note that variance condition in which budget variances begin low (i.e., less than 5% in period 1 and ends high (almost 50% in period 10) subjects tend to progressively worsen

An interesting behavioral phenomenon is evident in these findings. In the unstable

\begin{figure}[h]
  \centering
  \includegraphics[width=\textwidth]{figure.png}
  \caption{FIGURE 5.10: HIGH-LOW VARIANCE STABILITY CONDITION X ZOT}
\end{figure}

above and is represented by Figure 5.10 below.
By contrast, subjects with projects of the opposite unstable variance treatment, where budget variances progressed from *high* (i.e. over 50% in Period 1) to *low* (i.e. to less than 5% in Period 10), tended to report Project Statuses that were initially negative and remained that way throughout the entirety of the project (see Figure X above). In other words, where projects started well and ended poorly, subjects’ views on the project adapt commensurately with the level of budget variance. On the other hand, subjects never seemed to improve their assessment of a project that started poorly and ended well. Their concern and awareness of budget variances at the beginning of the project did not change even as project performance demonstrably improved. The mean project status over time between the two unstable variance treatments is directly compared in Figure 5.11 below.

![Chart](image)

Figure 5.11: Mean Project Status in Unstable Variance Conditions
Dependent Variable: Risk Preference

In this experiment, the binary Risk Preference dependent measure was coded thus: a choice of taking a risk and not correcting a setback (in the hope that the risk would not eventuate) was coded as -1 and the choice of the certain cost of correction was coded as +1. Therefore, in our analysis, risk-seeking behaviour would reveal average values of the Risk Preference dependent variable closer to -1 and risk aversion would reveal averages closer to +1 (with 0 representing indifference). The only significant effect on risk preference in this model is a main effect of ZOTs. A Kruskall-Wallis test reveals the Chi Square statistic $\chi^2(1, N = 487) = 5.923, p = .015$). H7 implied that ZOTs had an interaction effect with ZOTs in its effect on risk preference, yet we found an unexpected main effect of ZOTs on risk-seeking behaviour. We found no effect of either stable budget variances ($\chi^2(1, N = 249) = .265, p > .05$) or unstable budget variances ($\chi^2(1, N = 238) = .000, p > .05$) or an effect on risk preference due to time ($\chi^2(4, N = 487) = 6.151, p > .05$) (H6 Not Supported).

Figure 5.12: Risk Preference by ZOT and Variance

(Values closer to +1 indicate risk averseness, values closer to -1 indicate risk-seeking, 0 indicates indifference)
Figure 5.12 above reveals some interesting patterns of behaviour (in this diagram, values closer to +1 indicate risk averseness whereas values closer to -1 indicate risk-seeking, with 0 as the point of indifference). Under conditions of high ZOTs, decision-makers tend to be generally more risk-averse, and tend to be indifferent between risky options at low ZOTs. The only exception to this was that the difference between ZOT treatments was not significant for the High-Low variance condition \( \chi^2(1, N = 118) = .034, p > .05 \).

The marked difference in risk preference within the High-Low unstable Variance condition may be, at least in part, explained by the aberrant effects we observed within the Project Status metric of the same treatment. As discussed earlier, subjects in this treatment tended to start the project with negative Project Statuses and this persisted throughout the course of development. Perhaps this heightened sense of awareness over the project’s budget overruns washed out the effects of ZOTs as a dominant effect in risk preference.

**Project abandonment**

Of the 100 projects undertaken by subjects in this study (50 subjects, two projects), only five projects were abandoned, all of which were in the Low ZOT condition. Four of these projects in the unstable variance condition. Of these, two projects were abandoned in the High-Low condition where Period 1 saw a 48% budget variance. One of these projects was (rather presciently) abandoned in Period 1 while the second was de-escalated for first three periods before it was abandoned in period four. Two projects were abandoned in the Low-High variance condition mid-way
through the project, as budget variances started to exceed 25%. The fifth abandoned project was in the high stable variance condition and was abandoned in Period 8.

Discussion

The original hypotheses proposed in this Experiment did not seem to bear out upon testing. The only hypothesis to be supported (H1), however, supports one of the central tenets of this study - that time has a significant effect on the tendency to escalate commitment to a course of action. We did, however, make some unexpected findings in relation to the effect of the stability of variances and Zones of Tolerance on the overall model. We found that subjects who experienced high budget variances at the beginning of a project tended not to adjust their 'worry' of a project even as variances decreased over time. Under conditions of high ZOTs, decision-makers tend to be generally more risk-averse, and tend to be indifferent between risky options at low ZOTs. We also found an unexpected main effect of ZOTs on risk preference: risk-aversion under High ZOTs and indifference to risk within low ZOTs.

As a post-test, subjects were asked to evaluate their project's performance in the final time period of each project (period 10). Subjects were given a 5-point Likert-scale rating ranging from 1 (I am very satisfied with the way I managed this project) to 5 (I am very dissatisfied with the way I managed this project). We can see that the effect of high ZOTs where subjects tended to evaluate their performance more favourably than in low ZOT conditions. Their mean responses are presented graphically below and grouped by ZOT (Figure 5.13 and 5.14). A clear distinction is evident between the confidence with which decision-makers in high and low ZOT conditions. High
ZOT decision-makers tended to be more satisfied with the way they managed identical projects to those in low ZOT conditions. This general level of satisfaction, driven through the ZOT conditions can be seen to affect manifest behaviours throughout the experiment - affecting the vigilance with which projects were monitored, the tendency to detect and correct project setbacks and the tendency to vary risk preferences between high and low ZOT contexts.

![Figure 5.13: Self-Evaluation of Subject Performance – Stable Variances](image)

![Figure 5.14: Self-Evaluation of Subject Performance – Unstable Variances](image)
We are now starting to paint a richer picture of escalation behaviour over time. Time has a compounding effect on decision-maker’s perceptions of variations from expectations, particularly when budget variances change over time. Much of the limitations of prior studies owe to their low technology implementation, relying mostly on pen and paper to execute experiments and collect responses. Staw and Fox (1977) using three time periods, relied on a pencil and paper exercise where subjects needed to return their responses to the examiner after each time period (perhaps inducing greater experimenter expectancy effects in the process). In this study, by contrast, computer simulations allow for a faster, more interactive participant experience in which a larger number of responses can be collected in a shorter time, thus facilitating a multi-period escalation study.

Simon’s (1975) theories on the effect of time on fundamental strategy hold true – persistent variations from expectations tend to increase the frustrations of decision-makers over time. The relatively few project abandonments are evidence of the ‘Catch-22’ of time: as troubled projects yield persistent variations from expectations, they become simultaneously less palatable to continue as well as also harder to abandon. While it comes as little surprise that decision-makers tend to increase their vigilance of projects facing compounding setbacks over time, it is a key contribution of this study that we examine the effects of escalation across time.

In this study we also examined the effect of Zones of Tolerance and time on the escalation behaviour under various conditions of budget overruns. Perhaps the most significant finding from this study is the main effect of Zones of Tolerance and its undergirding influence on the treatment of fluctuating budget variances throughout a
project’s development. Zones of Tolerance have an impact upon the vigilance with which decision-makers apply to project overruns and setbacks, and also influence their risk preferences when dealing with said setbacks.

Perhaps the most important treatment within this study was the ‘low to high’ unstable budget overrun condition, the treatment most similar to escalation of commitment episodes. We can see that under conditions of high ZOTs, decision-makers tended to be less concerned about budget overruns and, as we can see from experiment 1, less vigilant about correcting overruns as they occur. The resultant effect of this high ZOT conditions is that decision-makers tended to tolerate budget overruns to a greater extent, take less action to reduce budget overspend (as shown by the risk preference results) and generally not detect escalation episodes as efficiently as under low ZOT conditions.

Contrary to prior escalation studies examining risk preference in loss conditions, this study shows that escalation episodes can also engender risk aversion, particularly if decision-makers operate under conditions where escalation is the less risky option when controlling project setbacks. Rather than 'cut corners' in order to reduce spending on projects, setbacks causing higher spending tended to be tolerated under high ZOT conditions to a greater extent than under low ZOT conditions. The implications of this are significant – they seem to indicate that persistence despite costly setbacks causing escalating commitment episodes is more likely when organisational and structural constraints provide high tolerance that would absorb this increased spending.
Limitations of the Study

The decision to reduce the number of key dependent measures to one (project status, with risk preference a secondary measure) was made due to the practical limitations of subjects' time as well as to facilitate easy understanding of the complex decision task. As it stood within the present study, subjects were required to make 30 decisions in all (10 project status decisions and five risk decisions on each of two projects). However, the single dependent variable of Project Status across time did not allow us to develop as rich a picture of the relationship between decision-makers' perceptions and behaviours in escalating projects. As we saw in Experiment 1, understanding the distinction and relationship between perception and behaviour is very important to understanding escalation. The use of one dependent variable did not fully capture the complexity of the thought-processes of decision-makers. In hindsight, it may have been worthwhile to include a metric to assess subjects' actual resource allocation behaviour (this is addressed in Experiment 3).

The dependent variable measuring risk was particularly problematic. We could find no significant effects of risk preference the model with the exception of the relationship to ZOTs. We challenged the efficacy of gambles to test risk behaviour within the literature review and these problems have seemed to bear themselves out. The problems with this dependent measure were twofold. In attempting to maintain the same style of risky option mix as Kahneman and Tversky (1979) we reneged some claims to face validity. In truth, studies involving Prospect theory in escalation have largely been theoretical (Whyte 1986, Johnstone 2002) or conjectured through survey data (Keil et al. 2000) and this study shows how difficult it is to apply.
expected utility models of risk within context of an organisational escalation dilemma.

**Implications for the Next Experiment**

In the next experiment we will reintroduce dependent variables associated with resource allocation in order to assess how resources are distributed *between* multiple projects in a portfolio in which escalation is evident. Further, we will use both time and cost metrics to garner a richer picture of resource allocation behaviour when multiple resources are distributed across multiple projects when one or more of those projects are escalating. We continue our investigation of time's effect on escalating situations as the effect of time is important, significant and under-investigated within the *oeuvre* of escalation research. In addition to this, we will return to a simpler (though still more complex than extant literature) mixed factorial designs of escalation tasks in order to improve upon the research design model and enhance the effectiveness of computer-based simulations in understanding escalation behaviour.
Concluding Remarks

In this experiment, we investigated the importance of time to a decision-maker’s tolerance. We examined a number of characteristics of a project’s performance that may change over time, namely (1) the effects of the stability of budget variances over time; (2) the magnitude of budget variances over time; and (3) the change in risk preference over time. Only a handful of experimental studies have investigated escalation decisions over time and these studies used only a limited number of limited time periods in their study. This has largely been due to the constraints imposed upon experiments by pencil and paper exercises that do not adequately allow for feedback and dynamic responses across a number of iterations of the task.

Confirming our conjectures regarding the effects of ZOTs and Time on the treatment of escalating courses of action we found a significant effect of ZOTs and a main significant effect of time on the evaluation of projects and the continuation decisions made by subjects within the decision task. We could not, however, find a within-subjects interaction effect between ZOTs and Time suggesting that subjects within this task did not change their perceptions or reactions to ZOTs over time. We also found a significant effect of the difference between low-stable and high-stable variances over time. However, we could not find an interaction effect between the stable budget variance treatment and time. While we could find no direct effect of the stability of budget variances on subjects’ decisions, we found a significant interaction effect between the stability of budget variances over time.
The only significant effect on risk preference in this model is a main effect of ZOTs. Contrary to prior escalation studies examining risk preference in loss conditions, this study shows that losses faced within escalation episodes can engender risk aversion, particularly if decision-makers operate under conditions where escalation is the less risky option when controlling project setbacks. This would appear to indicate that persistence despite costly setbacks causing escalating commitment episodes is more likely when organisational and structural constraints provide high tolerance that would absorb this increased spending.

In conclusion, the examination of the effects of ZOTs on risk and time on escalation were the two biggest contributions of this study. We are now obtaining a richer picture of the effects of ZOTs as a main effect that seems to permeate the behaviours and perceptions of decision-makers to the extent that decisions are skewed in the direction implied by the ZOT. We also found that the effect of time has not been fully appreciated nor explored in prior studies and this is worthy of further investigation in the final study of this research programme.
EXPERIMENT 3: RESOURCE ALLOCATION

BEHAVIOUR IN TROUBLED PROJECT PORTFOLIOS

Introduction

Over thirty years of research into the ‘escalation of commitment’ phenomenon has not yet identified credible early warning indicators that signal impending trouble. This study takes a significant step towards understanding how tolerance of minor setbacks (termed ‘Zones of Tolerance’, or ‘ZOT’s’) affect future tendencies to persist with a challenged course of action. Applying linear programming, it both theoretically and empirically demonstrates how tolerance for troubled projects systematically and sub-optimally draws resources away from well-performing projects within a portfolio. This experimental validates a hitherto unapplied method of measuring the extent to which decision-makers depart from objectively optimal decision strategies during escalation of commitment dilemmas.

By the time failure is inevitable, the decision to redirect or abandon a course of action can become exceedingly difficult, and extant literature has gone a long way towards exploring how sunk resources and psychological commitment inhibit difficult project abandonment decisions. This study examines the influence of
tolerance for setbacks, the extent to which alternative resource allocations are available and the way in which projects change over time. We hypothesise that ZOTs inhered within the decision context lead to increasingly suboptimal resource allocations between troubled and untroubled projects over time. The study compares objectively optimal resource allocation strategies against decision-makers’ actual allocation decisions in a portfolio of two projects.

Research Objectives

In this chapter, we will be opening a line of inquiry that has hitherto remained a major gap in escalation of commitment literature. We ask two questions which will serve as both a capstone to these investigations into Zones of Tolerance; and to establish the significance of these ZOTs on project management practice in the context of project portfolios.

Research Objective 1: To investigate how budget overruns within one project affect decision-making within an entire project portfolio?

Research Objective 2: To compare decision-making under ZOTs to a decision-maker’s achievement of optimal resource allocations?
As has been evidenced by this programme of research, escalation of commitment episodes often occur due to a lack of regard for budget limits placed on a project. It would seem clear from escalation of commitment case study literature that budget variances do not contain, in and of themselves, sufficient impetus to influence decision-maker to control or correct project setbacks despite representing one of the best measures of the efficiency with which a project plan is executed (Yetton et al. 2000). Rather, the greatest emphasis and influence on escalation seems to arise through managerial issues – most notably management support, user dissatisfaction and organisational conflict. If these issues are given preferential standing within a project management organisation, budget variances may become a secondary consideration.

Revisiting the Findings of Experiment 1 – Alternatives Reconsidered

In the first study, we could find no influence of alternative investments on the decision to escalate, and speculated that the lack of a finding (where other studies have found significance) may have been due to a poor operationalisation of the Alternatives construct. These findings were at odds with Keil et al. (1995a) and Northcraft and Neale (1986) and were consistent with the findings of Schaubroeck and Davis (1994) and Keil and Mixon (1994).

The operationalisation of the Alternatives construct in Experiment 1, consistent with those of Arkes and Blumer (1985) among many others, could be conjectured to have induced decision-makers to create the following decision structure: if the current project is deemed likely to fail, then abandon the project and take the alternative. That means that there is temporal precedence is given to decision regarding the
troubled project. That is, the decision to continue in the failing project arose before the decision to take an alternative course of action.

**Turning the Decision Structure Around**

Organisations have limited resource capacities. In short, there is an opportunity cost to every escalation decision. Expending resources in excess of that which was originally anticipated would necessarily imply that those resources are being taken away from other courses of action for which they may have been committed. Applying this to escalation of commitment dilemmas, one could argue that a project manager's decision to extend resources in excess of that which was originally anticipated creates opportunity costs to (at least) the value of the additional resources spent on the project. However, applying our new understanding of Zones of Tolerance, it is possible that these budget variances are not appropriately considered as opportunity costs by the decision-maker, since small budget variances are tolerated to the extent that they may be considered endogenous to the project and do not affect the project portfolio writ large. If this was the case, there may be a lack of consideration for the effects of these variances outside the project itself.

A possible weakness of the Alternatives manipulation in Experiment 1 as well as in the manipulations of Arkes and Blumer (1985) and Keil et al. (1995) is that it assumes that troubled projects are evaluated in isolation to the entire project portfolio. Indeed, the first two experiments made no assumptions about the effect of resource limits on project investment decisions and how those resource limits would affect other projects. This is a long-standing weakness within experimental escalation research – that single-shot decisions on single projects do not take into account the
overall impact of escalation decisions on the organisation's resources writ large and does not include consideration of technical side-bets (Becker 1960). As Drummond (1994) points out, projects are rarely, if ever, ad hoc ventures but reside within the organisation overall.

Consider: in real-world settings, would it not be more appropriate that project investment decisions in both failing and non-failing projects had to be made concurrently? This decision structure is more appropriate to project portfolios, where multiple project investment decisions are required at the same time. Thus, the decision-maker's choice of continuing with a troubled project in excess of original budget expectations would have to be made with the implication that such a decision would necessarily draw limited resources towards the failing project and away from other possible investments. This decision context is perhaps more appropriate to project portfolio management as opposed to project management, where portfolio-based requires decisions on a range of projects with common objectives.

Investigating the Effect on Project Portfolios

Project portfolios are characterised by multiple projects with common objectives that compete with one another for the limited resources available to the project organisation. In addition to this competition for resources, projects within a portfolio compete for the support and attention of senior management. This places greater emphasis on a more global resource focus that requires better governance and planning than discrete or ad hoc projects. Each project within a portfolio comprises one piece of the overall objectives of that portfolio. Resource allocation decisions
may become more complex as the need for efficient resource allocations and maintenance of management buy-in increases.

Managing a portfolio of projects requires a strong concentration on appropriate resource allocation. Project or programme managers must possess an ability to schedule the necessary resources during a specified period of time. Given resource limits, changes to resource requirements of any one project may affect all projects in the portfolio by diminishing the available resources available. Essentially, resource allocation decisions therefore become a maximisation problem, defined by Langholtz et al. (2003) as occurring when “the decision-maker is attempting to reach the maximum possible level of a goal while not consuming more than a fixed amount of resources” (p4).

Resource Maximisation in Escalation Situations

During escalation situations, projects experience setbacks which may cause additional resource requirements not previously anticipated when making initial budget decisions. When these resource demands change mid-development, project managers are forced them to make decisions about their response to these changing circumstances. If indeed a project manager chooses to tolerate these additional resource demands placed upon a project by these setbacks, then he/she would need to decide from where these additional resources should come from. When all resources in the project organisation are committed, the decision dilemma would necessarily require that resources be taken away from another activity.
Using Linear Programming to Evaluate Resource Allocation Behaviour

Linear programming (LP) is a mathematical tool that is used to find optimal resource allocation strategies when certain variables are known (Langholtz et al. 2003) and was first proposed by Danzig (1963) in his book *Linear Programming and Extensions*. Linear programming is a popular modelling technique used within the management sciences to discover possible optimisations where there are multiple resources used within competing activities. It is used primarily within the fields of logistics, scheduling and network optimisation (Langholtz et al. 2003).

While linear programming is a parsimonious way of addressing some fundamental questions in resource allocation strategies, it relies on a relatively simple picture of the decision context. The complexity of linear programming models increases as the number of resources and activities increases. Furthermore, “[t]he model is often difficult to construct because of the richness, variety, and ambiguity of the real world” (Danzig 1963, p 34). Generally, there are two varieties of common optimisation problems when using linear functions within LP —‘maximisation problems’ (based on the maximisation of some outcome based on constrained resource inputs) or ‘minimisation’ problems (the minimisation of resource expenditure to achieve certain outcomes). At its simplest, LP problems identify the feasible outcomes based on the resource constraints available and the linear functions that determine the combinations of possible outcomes.
Assumptions in Linear Programming

Danzig (1963) identifies some assumptions that must be made when simplifying decision tasks down to linear programming problems, namely assumptions of proportionality, non-negativity, additivity and the presence of a linear programming function. The *proportionality assumption* states that "the quantities of flow of the various items into and out of the activity are always proportional to the activity level" (p32). Put simply, this means that it is possible to assign a per unit resource requirement for each resource or activity. The *non-negativity assumption* states that "[w]hile any positive multiple of an activity is possible, negative quantities of activities are not possible" (Danzig 1963, p32). For the purposes of this study, this would simply mean that it is not possible to complete a negative amount of a project, nor assign a negative amount of cost or time (or any other resource) to a project. The *additivity assumption* requires that "the total amount specified by the system as a whole equals the sum of the amounts flowing out" Danzig 1963, p32). Finally, the *linear objective assumption* states that resources are finite and scarce. Furthermore, if the objective of the exercise is to, say, maximise the total completion of all projects in a portfolio, then the amount of resources expended on each activity directly affects this objective.

The Basic LP Representation of the Problem

This research does not attempt to further the voluminous literature on LP, but rather will apply its methods to the escalation problem. However, even at this basic level, we have identified a method of evaluating escalation situations that has hitherto never been applied in over 30 years of research into the phenomenon.
Say that you, as a project manager, were in charge a portfolio of two projects, Project E and Project N. Furthermore, assume that, there are two independent resources available to you: labour hours (time) and money (cost). In this case, one could reasonably assert that your objective as a project manager is to complete as much of the two projects as possible given the time and cost resource constraints incumbent upon you.

In order to put these constraints in proper mathematical form for LP, we can represent the problem of maximising the total completion of both projects, C, with the following:

Goal: \[ \text{Maximise } C = P_E + P_N \] (objective function) \hspace{1cm} (1)

Where

\[ P_E = \text{Percentage of the Project E completed within one period} \]
\[ P_N = \text{Percentage of the Project N completed within one period} \]

Note that \( P_E \) and \( P_N \) are expressed as a proportion of 100% completion of the project. For example, if \( P_E \) had a value of 0.1, this would mean that 10% of Project E is completed in that month.

Time and money are the two resource constraints incumbent upon you in order to maximise the sum of \( (P_E + P_N) \), and let us further assume that expenditure of both these resources can be expressed as a linear function of completion. Given this

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11 In practice, LP can be used to calculate optimality for any number of constraints and activities. This two-project (two-dimensional) illustration is used as a simple exemplar of the properties of LP when applied to escalation problems.
constraint, we can express both of these resources as variables within a linear function:

Subject to:  
\[
\begin{align*}
\text{Cost Budget} & \leq \{M_E \cdot P_E + M_N \cdot P_N\} \quad \text{(money constraint)} \\
\text{Time Budget} & \leq \{T_E \cdot P_E + T_N \cdot P_N\} \quad \text{(time constraint)} \\
\text{Where:} & \quad P_E, P_N \leq 0 \quad \text{(non-negativity constraint)}
\end{align*}
\]

Where  
\[
\begin{align*}
M_E = & \text{The money investment required to complete 1\% of the Project E} \\
M_N = & \text{The money investment required to complete 1\% of the Project N} \\
T_E = & \text{The time investment required to complete 1\% of the Project E} \\
T_N = & \text{The time investment required to complete 1\% of the Project N}
\end{align*}
\]

Formulae (2) and (3) simply state that there is simple multiplicative relationship between the overall cost and time budgets based on the per unit cost and time of both projects. Formula (4) represents the non-negativity constraint which stipulates that, for mathematical tractability, you cannot complete less than 0\% of either project in any given time period.
A Special Case of LP

The following illustrative case makes a critical assumption that represents just one possible syntax of alternatives available during LP programming. This research uses a portfolio of two projects in which time and cost efficiency is converse between projects as its example. In other words, we will use a case in which Project E incurs more cost per unit of completion than Project N, but uses relatively less time per unit of completion. To illustrate, in the first time period of this study, the following per unit cost and time requirements were used:

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Money ($)</th>
<th>Time (labour hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ME</td>
<td>MN</td>
</tr>
<tr>
<td>1</td>
<td>2400</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>TE</td>
<td>TN</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>120</td>
</tr>
</tbody>
</table>

**Table 6.1: Sample Monthly Cost and Time Requirements Per 1% Completion**

Total Money Budget (for one month) = $44,000

Total Time Budget (for one month) = 2,200 labour hours

You will notice that the cost to complete 1% of the Project E is $2400 (ME) while the cost per unit of completion for an equivalent 1% of Project N is $2000 (MN). Conversely, completing 1% of Project E takes 100 hours, whereas the time taken to complete 1% of Project N is relatively more resource intensive (120 hours). Put simply, Project E incurs more cost and less time to complete than Project N. This is an important assumption to make, as this study examines just one simple two dimensional problem in which an optimal is possible.
In this example, the optimal completion of Project E is 10% for that month, and the optimal completion of the Project N is also 10%. This results a total cost outlay (ME ·PE+ MN ·PN) of $44,000 (equal to the budget) and total of 2,200 labour hours (TE ·PE+ TN ·PN).

Representing the LP Problem Graphically

Given that the above constraints form two linear functions (one for each of the time and cost constraints) we can graphically represent this information in order to identify the feasible set of possible combination of \(PE\) and \(PN\) completion levels. Using the illustrative figures provided in Table 6.1, we can represent the above LP problem thus:

![Figure 6.1: Basic Graphical LP Representation](image-url)
In the above representation of the problem, we can see that the effect of the opposing
time and cost efficiencies of the two projects create a polygon known as the 'feasible
region' within which any combination of completion of the two projects is possible.
The region outside of this feasible set represents a violation of the time, cost or non-
negativity constraints. Since this is a maximising problem (as the project manager is
given the task of maximising her completion of both projects \( P_E + P_N \)), LP allows
us to identify the 'most attractive corner' which is illustrated above as the top-right
corner of the polygon. This corner denotes the maximum combination of \( P_E \) and \( P_N \)
possible within the feasible region. In this way, LP allows decision-makers to
determine (at least in theory) the optimal allocation of resources between multiple
activities given constrained resource inputs.

**Extending the LP Problem to Escalation Situations**

In the above example, completing 10% of Project E and 10% of Project N represents
the optimal allocation of time and cost resources in order to maximise the combined
completion of both projects. The use of LP in this way is not novel, however, as we
shall see, an extension of this problem can be applied to escalation situations -
hitherto never applied in escalation of commitment research.

As has been determined throughout this research programme, escalating projects are
characterised by increasing and unanticipated costs to complete a project. In the
previous two studies, we have seen that small increases in costs (i.e. small budget
variances) tended to be tolerated and this was particularly so if high Zones of
Tolerance inherent within the project context induced decision-makers to make
project investment decisions that favoured absorption of these variances, rather than correction.

Now let us apply the LP problem to a multi-period context. If the same linear functions and the same resource constraints were prevalent within each period up until completion of the two projects, then the decision-maker would, ceteris paribus, be apt to continue completing both projects at a rate of \( P_E \) and \( P_N \) each month until the completion of one project, and then subsequently invest all resources in following time periods into the completion of the second until completion of 100% of both projects.

Now let us say that \( P_E \) represents an escalating project and is experiencing setbacks that are resulting in increasing costs per unit of completion, while \( P_N \) represents a non-escalating project whose costs per unit do not change. In other words, \( M_E \) is increasing while \( M_N, T_N \) and \( T_E \) remained constant. The resultant effect on the graphical representation of the LP linear cost function would be to increase the gradient of the function to reflect the higher cost per unit to complete the escalating project \( P_E \). Graphically, we can represent this new situation thus:
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NEW Cost Constraint:

OLD Cost Constraint:

Time Constraint:

Figure 6.2: Graphical Representation of LP when Costs Increase

The above representation suggests that decision-makers would be best served by completing less of the escalating project (i.e. reducing $P_E$) and more of the non-escalating project (i.e. increasing $P_N$). The significance of this to the current research programme is significant. The previous two experiments found that decision-makers tend to allocate more to escalating projects when budget variances occur when, in fact, this case of objectively optimal linear modelling dictates that the optimal resource allocation strategy should be the opposite. In the previous experiments, we found that when faced with relatively small budget variances and Zones of Tolerance, decision-makers actively prefer to allow budget variances to be absorbed through greater resource expenditures on troubled projects. Most escalation literature seems to support these findings.
Positioning the Non-Escalating Project as an Alternative Investment

As stated earlier in this chapter, Experiment 1 could find no evidence that the presence of an alternative investment influenced a decision-maker in their extension of resources to troubled projects. This lack of finding may have been due to the poor operationalisation of the alternatives construct, although several experiments in related literature found significant results using similar techniques and measures (Arkes and Blumer 1985 among others). Positioning the alternative investment concurrently with the escalating project may shift the dynamics of the decision, particularly since the salience of the opportunity cost may emphasise to a decision-maker that tolerating budget overruns to a troubled project would necessarily entail drawing those same resources away from other projects within the portfolio.

In this study, we will seek to place the decision-maker in situ of a project portfolio within which resource allocation decisions have a direct and immediate impact upon the alternative course of action in terms of an opportunity cost. Manipulating a decision context in this way provides a more powerful test of the alternatives construct since (in this case) the opportunity cost is salient and immediate, as opposed to distant and notional. Furthermore, by operationalising the above problem as a multi-cycle decision, where the escalating project progressively deteriorates over time (such as in Experiment 2) one may be able to see just how close to optimal decision-makers allocate resources and the conditions within which they choose to depart from optimal in order to maintain investment in a troubled project.
Objectives of Experiment 3

The objective of this experiment is to establish a simple yet tractable model to measure the extent to which manifest resource allocations diverge from objectively optimal allocation strategies within escalation situations. Rather than examining the linear programming solution, this research uses a simple two-dimensional LP problem formulation as a base against which one may objectively evaluate how tolerance of variations affects the efficient use of scarce resources.

To that end, we postulate a number of founding research questions germane to the investigation:

Research Question 1:

To what extent do decision-makers efficiently allocate resources between projects when faced with escalating commitment to a project within a portfolio?

Possible Resource Allocation Strategies

There are a number of alternative decisions a project manager may make within this project context. Assuming a multi-period resource allocation task where the unit costs of the escalating project increased over time, s/he would maintain resource allocations close to optimal by progressively reducing their commitment to the troubled project over time (i.e. de-escalating the troubled project) and increasing their resource commitment to the project that was performing according to plan. Alternatively, if decision-maker behaved in a way that remains consistent with our findings in the previous two experiments, and tolerates the cost increases in the
troubled project in order to maintain planned completion levels, then we would see a progressive departure from optimal where s/he would be allocating too many resources to the escalating project and not enough to the non-escalating project. The resultant effect would be a sub-optimal resource allocation that would diminish the overall completion of both projects.

In the above example (which will serve as a template for the following experiment) we postulate that the optimal resource allocation strategy should be to draw resources away from escalating projects and towards non-escalating projects within a project portfolio\textsuperscript{12}. The results of this research programme thus far indicate that decision-makers, by contrast, have a tendency to maintain or increase resource commitments to troubled projects when budget variances exist within ZOTs. Even if a decision-maker maintains their commitment to the troubled project, this would represent a departure from the optimal allocation strategy. To that end we ask:

\textit{Research Question 2:}

How do decision-makers react to budget variances in a project that exists within a project portfolio and how adequate are their resource allocation adjustments when faced with setbacks to one or more projects within a portfolio?

\textsuperscript{12} It is important to reiterate that this represents a special case in which an optimal resource allocation point is possible within the LP problem space.
Influences Upon Resource Allocation Behaviour

Langholtz et al. (1994) provide the basic framework and essential structure upon which the present study is based. In their study, the researchers investigated the effects of 'harsh' and 'benign' environments on resource allocation behaviour in an experimental task involving the allocation of fuel and personnel between two US Coast Guard patrol boats. Langholtz et al. (1994) defined these two environments through the possibility of losses of either of these two resources. They defined 'benign' environments as characterised through situations where "heavy losses never occur" (p30) and 'harsh environments' as those in which "essential resources are so scarce that a lack of optimality can make continued activity impossible" (p30). In a compelling corollary to the current research, they state that

"We know little about peoples' strategies for coping with such a harsh environment, how they plan to prevent being caught off guard by unexpected losses, how they react to multiple losses, and how harsh an environment can get before people lose the ability to complete the task reliably" (p30).

Their findings give us a clue as to the possible performance by subjects on this task. They found that while subjects generally performed close to optimal (about 90% of the optimal solution) they found that subjects in the 'harsh' resource constraint environment performed particularly well, since subjects were forced to preposition themselves, consider savings strategies and generally allocate resources more carefully than in a benign environment in which their losses could be absorbed. However, they also found that while subjects in harsh resource conditions performed close to optimal, their allocation strategies were not sufficient to complete the task –
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an indication that while an attempt was made to carefully allocate resources, the adjustment was not sufficient to assure completion.

While the Langholtz et al.'s (1994) study provides a framework that is germane to the current investigation, there are some fundamental differences in the characterisation of the 'environment' and the way in which both harsh and benign environments would be operationalised. In their study, the researchers characterised 'failure' as one of resource depletion before the end of the task, and the 'environment' as the resource base of the decision task. By contrast, this research adopts a broader definition of project success and failure that corresponds closer to the nature of IT project organisations. Within these contexts, the environment is generally better defined through the strategic objectives, competitive environment and organisational characteristics that overlay the project organisation and the project team.

Furthermore, the definition of 'failure' as operationalised by Langholtz and his colleagues was seen as occurring when resources were depleted to the extent that the minimum requirements for a course of action could not be maintained. However, a definition of failure that is more amenable to information systems literature is predicated upon the withdrawal of one or all of the key decision-makers or stakeholders which would signify that the project can no longer maintain the support necessary for its eventual implementation (Sauer 1993).

This is where Zones of Tolerance come in. Rather than a resource-based view of project success, and an organisational 'environment' based on the amount and type
of those resources, a ZOT-view of the resource allocation process sees organisational decisions as interdependent upon resources, strategy, organisational mores and purpose. It is quite likely that ‘harsh’ (low) and ‘benign’ (high) Zones of Tolerance have a direct effect on resource allocation behaviour that is distinct from the resource limits (time and cost) incumbent upon the decision-maker.

This study will examine the effects of Zones of Tolerance, resource limits, time and variance within escalation situations involving multiple and simultaneously developed projects within an organisation’s project portfolio.

Zones of Tolerance

Research Question 3:

How do Zones of Tolerance affect a decision-maker’s ability to adequately adjust resource allocations when faced with setbacks to one or more projects within a portfolio?

Continuing the main theme of this research programme, we postulate that Zones of Tolerance will change the perspective that decision-makers bring to the resource allocation problem. As we have seen in the first two experiments, Zones of Tolerance have a significant effect on decisions to continue funding to escalating projects.

In a two-project portfolio similar to the LP problem discussed earlier in this chapter, we see how the optimal resource allocation strategy would be to complete less of an escalating project and more of a non-escalating project as the costs to complete the escalating project increase. We have seen through the last two studies, however, that
decision-makers tend to tolerate these cost increases when they lie within Zones of Tolerance (particularly under conditions of high ZOTs). If we were to extrapolate from the findings of the previous study, decision-makers would prefer to maintain their commitment to an escalating project (i.e. tolerate budget overruns). One of two decision outcomes is possible. The first would be that a decision-maker tolerates the budget overruns at the expense of the global project budget, in effect spending more than the resource limits placed upon them through the budget. The resulting effect would be to allocate resources at Point A in Figure 6.3. In this case, by virtue of the budget overrun, the decision-maker would be allocating resources outside of the feasible region. On the other hand, if the decision-maker chose to (or was compelled to) remain within the global budget constraints, the alternative course of action would be to draw resources away from the non-escalating project and towards the escalating project (Point B in Figure 6.3).

Figure 6.3: Feasible Strategies to Maintain Commitment to Escalating Project
Points A and B represent two options available to decision-makers should s/he choose to maintain their commitment to a troubled project. However, the ZOT studies conducted so far suggest that, while decision-makers would adjust their resource allocations somewhere between these two points, they may do so inadequately. Thus, we conjecture that as the ZOTs inherent within the decision context rise (i.e. become more lax) decision-makers would allocate their resources between the two projects in an increasingly suboptimal fashion. As a (completely unscientific) conjecture, it is likely that decision-makers would allocate resources between projects within the region ABC in Figure 6.2) if they were presented with Zones of Tolerance that permit such budget overruns. Put simply, decision-makers would be likely to adjust their completion of the escalating project (albeit insufficiently) while leaving completion on the non-escalating project unchanged. In consideration and support of Langholtz et al.'s (1994) findings we conjecture:

**H1:** Resource allocations will be relatively closer to optimal under conditions of low ZOTs than high ZOTs within project portfolios. That is, there is an independent effect of ZOTs on the efficient allocation of resources to escalating projects.

**Resource Limits**

Strict resource limits are a widely debated aspect of both organisational and strategic decision-making research, but their effectiveness in controlling resource allocation decisions and continue / abandon decisions is by no means universally accepted. Strict resource limits – characterised by resource exhaustion once breached –
represents a bright line which serves as an unambiguous, conspicuous and unique a focal point of interest.

Unlike the Zone of Tolerance manipulations used within this research programme, that employ ambiguous or fuzzy reference points to decision-making behaviour, resource limits serve as unambiguous constraints upon action; acting as a point of salience and a focal point which “fills the vacuum of indeterminacy” in an ambiguous problem space (Schelling 1980, p68). A wealth of related literature suggests that constrained resources lead to better organisational performance. This literature points to two main motivators of better decision-making performance under conditions of strict (as opposed to slack) resource constraints. In a longitudinal study of 900 private firms, George (2005) found that harsh resource constraints have a positive effect on firm performance and these results support the findings of Baker and Nelson (2005) and Mosakowski (2002). The argument made by these researchers is based on Lévi-Strauss’ notion of ‘bricolage’ – that decision-makers would be compelled to become more creative with what little is at their disposal, finding themselves only able to utilise the resources that are ignored by, or not captured by, larger and more resource-laden firms.

The alternate explanation of better resource allocations under strict resource constraints is put forward most notably by March and Shapira (1992) in their investigation of the effects of ‘survival reference points’ – those points that represent resource exhaustion. Under conditions of resource slack, they argue, decision-makers tend to allocate less attention to the actual decision-making process:
“Where slack is plentiful, it is pictured as leading to a relaxation of controls, reduced fear of failure, institutionalised innovation, increased experimentation, and thus to relatively high levels of risk-taking” (March and Shapira, 1992, p172).

Their findings suggest that attention to a survival reference point leads to a resultant reduction in risk-taking. Antonelli (1989) offers a somewhat contradictory account of manifest behaviour, finding evidence to suggest that research and development organisations are often driven by a ‘failure-induced’ model of innovation that occurs only after performance falls below some minimum threshold.

There appears to be some contradictory explanations of why resource constraints would improve decision-making. George (2005) and others argue that strict resource controls improve creativity – in essence increasing the novelty of approach with which those resources are used, hence increasing risk taking. March and Shapira (1992) on the other hand, argue that stricter resource constraints lead to more conservative investment strategies and decreased risk taking. The evidence from Experiment 2 suggests that riskiness may not be as important a factor in decision-making as has been suggested in previous literature.

By contrast, Langholtz et al. (1994) surmise that strict resource constraints affect the allocation of attention paid to the resource allocation decision process and that, under such conditions, resources are ‘husbanded’ more carefully. In short, a “harsh environment demands improved performance” (Langholtz et al. 1994, p42). Under such conditions, decision-makers are compelled to consider prepositioning and
saving strategies that may not have otherwise been considered under conditions of resource slack. They found that those decision-makers recognising the risk embedded within a harsh resource context tended to adjust their resource allocation strategies in the appropriate direction, however generally did not do so adequately enough to wholly stave off eventual failure. As a result, while resources were husbanded more carefully under strict resource constraints, decision-makers did not adjust their resource allocation strategy adequately enough to compensate for losses.

In light of the results of Experiments 1 and 2 that found that: (1) Zones of Tolerance tend to affect the adequacy with which resource investment strategies adapt to budget variances, and (2) that explicit risk was not as significant as the harshness or benignity of the environment; we propose that Langholtz et al.'s (1994) explanation of resource husbanding best conforms to our findings so far. Therefore we hypothesise that:

**H2:** Resource allocations will be relatively closer to optimal under conditions of strict rather than loose resource constraints within project portfolios. That is, there is an independent effect of resource constraints on the efficient allocation of resources to escalating projects.

**H3:** We further hypothesise that there is an interaction effect between Zones of Tolerance and resource constraints within project portfolios in the directions implied by H2 and H3.
Applying the construct of resource constraints to an LP problem, we are able to conjecture how decision-makers may view the problem and which alternative investment strategies they might consider. In the previous experiments, we have seen how decision-makers tend to tolerate small but escalating budget overruns. The tendency was to maintain their completion of a project under these conditions, rather than correct budget overruns or reduce investment in troubled projects. Under conditions of resource slack and within the context of an LP problem, we may conjecture that a decision-maker would replicate this pattern of behaviour (similar to Figure 6.3). If, say, the troubled project experienced escalating costs such that a new LP cost constraint was manifest (Figure 6.4), decision-makers with loose resource constraints would be able to maintain their commitment to both projects (Point A), effectively allocating resources outside the ‘feasible’ region and absorbing the cost increase.

Figure 6.4: Investment Strategies Under Differing Resource Constraints
If, on the other hand, the new cost constraint was fixed and inviolable, decision-makers would be forced to allocate funds within the feasible region, and would likely allocate funds somewhere between Points B and C. If decision-makers preferred to maintain their completion commitment to both projects despite budget overruns, harsh resource constraints would, *ceteris paribus*, most likely induce better relative optimality than loose resource constraints.

For H3, the strength of the interaction effect is clearly determined by the relative strength of the effect of each of the ZOT and resource constraint constructs. Generally, we can hypothesise both low ZOTs and harsh resource constraints combine to compel decision-makers to make the best resource allocation decisions (i.e. closest to LP optimality) and can be expressed in a matrix of interaction effects as in Figure 6.5 below:

![Figure 6.5: Hypothesised ZOT X Resource Constraint Interaction Effect](image)

**Figure 6.5: Hypothesised ZOT X Resource Constraint Interaction Effect**
Increasing Costs over Time

Revisiting the findings of Langholtz et al. (1994) within their follow-up paper (Langholtz et al. 1995, p275) the researchers found "curious, and potentially important result" that subjects did not seem to expect, nor plan for, possible losses, even the explicit risk of such losses was extremely high (75% in the case of the 1994 experiment). Rather, the subjects of the Langholtz et al. (1994) experiment reacted to losses only after they happened, and failed to anticipate losses by strategies of prepositioning or saving. "The lack of anticipation was shown by almost all subjects; the effect was large, robust, and replicable" and it "seems so potentially important that is deserves further research" (Langholtz et al. 1995, p275).

Despite high likelihood of losses within the tasks presented by Langholtz et al. (1994) and gains within the Langholtz et al (1995) task, subjects were repeatedly shown not to anticipate resource changes and consequently failed to adequately address these changes once they occurred.

Could this finding be relevant for escalation situations? In the first two experiments we did not objectively measure the efficiency or optimality with which subjects allocated funds when faced with escalating budget overruns. Our findings were limited to the extent to which adjustments were made by decision-makers within differing contexts. With the benefit of casting the escalation problem as a simple LP problem, we may now conjecture that the true effect of cost increases over time true within escalation dilemmas flows from a seemingly myopic treatment of budget variances that leads decision-makers to only address these as they occur (and insufficiently even when they do).
By applying escalating costs over time to a troubled project, we can see the effect on an optimal resource allocation strategy in Figure 6.6. As the costs of the escalating project increase, the optimal strategy would be to *decrease* the completion of the escalating project and to *increase* the completion of the non-escalating project from Points A through C (assuming that the time constraint remains constant).

![Figure 6.6: Optimal Allocation Strategies as Variances Escalate Over Time](image)

We can conjecture several possible reasons why this may not happen in escalation situations. As the Langholtz et al. (1994, 1995, 1997, 2003) studies have pointed out, learning may occur over time, but corrections tend to be inadequate and might deteriorate over time. If Zones of Tolerance or resource slack permitted such sub-optimal behaviours, decision-makers may not learn to adjust their resource allocations at all, since no punitive action would be evident or manifest by
maintaining their commitment to the troubled project. Indeed, it would confirm the surmise of Lyytinen and Robey (1999) that organisations fail to learn due to disincentives to learning and organisational designs. They suggest that a failure to learn and adjust to changing organisational influences over time create management myths of competence and a focus on short-term optimisation. In the case of escalation, the focus on the short-term would encourage decision-makers to incompletely assess the longer term viability of the project, so long as they are able to ensure its continued short-term support.

A second possible reason may confirm the findings of Experiment 1: that when faced with a troubled project with opportunity costs, decision-makers fail to see the effects on the portfolio writ large. By allocating more to troubled projects than suggested by the LP optimal, decision-makers are, in effect, taking resources away from well performing projects for the sake of maintaining or supporting poorly performing ones. Once again, we also hypothesise that Zones of Tolerance and resource constraints serve to either promote or inhibit such behaviours by influencing the attention paid towards the careful husbanding of resources, and thus we would expect an interaction effect to be evident.

**H4:** Decision-makers will skew their resource allocation behaviours towards escalating projects when budget variances increase over time to one or more projects within a project portfolio.

**H5:** There is an interaction effect between Zones of Tolerance and tolerated *budget variances over time* within project portfolios.
**H6:** There is an interaction effect between resource constraints and tolerated budget variances over time within project portfolios.

If we were to graphically represent the departure from optimal resource allocation strategy within a project portfolio under conditions of High ZOTs, we could do so similar to that in Figure 6.7. Simply put, the departure from optimal resource allocation would increase as the budget variance increases for both the escalating and non-escalating project. In the case of the escalating project, tolerance of budget variances is likely to result in over-commitment of resources to the escalating project and a commensurate under-commitment to the non-escalating project.

![Figure 6.7: Hypothesised Resource Allocation Behaviour in a Two-Project Portfolio with High ZOTs](image-url)
Conversely, under conditions of Low ZOTs we have seen that budget variances tend to be corrected to a greater extent than with High ZOTs. We could represent this correction behaviour as initial tolerance of low variances and correction of high variances (bringing resource allocations closer to optimal) (Figure 6.8). In practical terms, this could be evident through de-escalation of the troubled project once variances exceed that of the ZOT. We can further surmise that resource constraints would have a similar effect on resource allocation decisions.

![Figure 6.8: Hypothesised Resource Allocation Behaviour in a Two-Project Portfolio with Low ZOTs](image)

**Research Method**

**Sample Selection**

**Overview of Subject Selection**

A total of thirty-four subjects participated in the experiment. Subjects were recruited from postgraduate project management students enrolled at the University of New
South Wales and final year undergraduate project management students enrolled in a Business Information Systems course at the University of Sydney in 2007. Subjects voluntarily participated in the task and were reimbursed for their time at a flat rate of $20 in cash, paid upon completion of the task. Reimbursement was not tied with their performance of the decision task.

The sample size within each of the two between-subjects groups breaks down thus:

<table>
<thead>
<tr>
<th>Resource Constraint</th>
<th>Zone of Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harsh</td>
</tr>
<tr>
<td>Low</td>
<td>9</td>
</tr>
<tr>
<td>High</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

The sample size is relatively small compared to the previous experiments. This was due to the exigencies and limitations of the available sample of enrolled students that were homogenous to the samples used in the previous two experiments. Additional subjects from other courses may have threatened the homogeneity of the sample set and, thus, were not approached for participation. However, it must be noted that this sample size is in line with Langholtz et al.'s (1993, 1994, 1997) papers published within the journal *Organisational Behaviour and Human Decision Processes* (OBHDP), and this was seen as an appropriate benchmark for sample size determination (see Table 6.3 below).

<table>
<thead>
<tr>
<th>Study</th>
<th>Total Sample</th>
<th>Treatment Groups</th>
<th>Average Subjects per Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Langholtz et al. (1993)</em></td>
<td>24</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td><em>Langholtz et al. (1994)</em></td>
<td>30</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td><em>Langholtz et al. (1994)</em></td>
<td>20</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>
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Selection Procedure

The researcher attended one lecture for a project management course within the School of Business Information Systems which was attended by students of the Masters of Business degree at the University of Sydney. The researcher also attended one lecture for an undergraduate project management course within the Australian Business School at the University of New South Wales. The prospective subjects were presented with a brief announcement at the beginning of the class that the experiment was to be conducted. In this announcement they were told that the experiment related to a resource allocation task within a project management context that would test their judgement and decision-making skills. They were instructed that the experiment was to be conducted at various times during the following week and would take no more than one hour of their time. As with the previous studies, potential participants were told that there was no pre-requisite of prior knowledge of the task domain, no preparation necessary and participation was completely voluntary. To stress the anonymity of their participation, the lecturer-in-charge left the room during the presentation and potential participants they were assured that he would not know who participated or their proficiency at the task and that the task was non-assessable.

Following the announcement, an Expression of Interest form was passed throughout the class and subjects were asked to arrange a time to attend following the completion of the lecture. The Expression of Interest form requested subjects’ contact details (email and phone) and their preferred time to attend. The form also contained key information relating to human research ethics requirements mandated
by the University of Sydney. As with the previous experiments, all procedures relating to participant recruitment, experiment administration and handling of confidential information conformed to the requirements of the Human Research Ethics Committee (HREC) at the University of Sydney prior to the commencement of the research.

**Sampling Method and External Validity Considerations**

Postgraduate students were chosen as an acceptable surrogate for project managers (Remus 1986). Final year undergraduate students were also selected. The advantages and disadvantages of selecting students for experimental tasks are examined in detail in the Research Methods section. Once again it bears reiteration that it is not possible to make broad generalisations based on any empirical findings based on this research. As with previous experiments, external validity through generalisability is not the objective of this research programme. It should be noted, however, that the Zones of Tolerance and budget variance constructs are benefiting from several replications using different subjects and this goes towards enhancing the generalisability of these constructs to a limited extent.

**Special Sampling Procedures for Student Samples**

As with the previous experiments, we employed a number of the suggestions from Carver, Jaccheri et al. (2003) on the use of students in IS-related experimental tasks.

1. The goals, measures and analysis method were not revealed prior to executing the experiment.

2. Subjects were given an opportunity for feedback to justify their decisions during a post-test.
3. Subjects (if they so requested) were given the chance to receive feedback on their performance in the task upon completion.

4. Subjects were given a realistic time estimate of one hour to complete the task. On average, subjects took between 30-45 minutes to complete the computer-based task, including reviewing the cover material, making their project recommendations and completing the post-test questionnaire.

5. Finally, students were allowed to choose from a range of possible times to attend so as to avoid conflicts with their lesson schedules.

Design and Procedure

Experimental Design

A 2 (Zone of Tolerance) X 2 (Resource Constraint) between-subjects and an additional X 9 (Variance over Time) within-subjects factorial design was employed to test both the independent and interaction effects in the mixed model. In all, each subject made decisions on two projects simultaneously with 10 time iterations (the final time period was excluded to negate any 'end of game' effects\(^{13}\)). Of the two projects, one project faced escalating costs per unit of completion and the other faced zero or negligible cost increases. This experimental design was based on the Langholtz et al. (1993, 1994, 1997, 2003) investigations into resource allocation behaviour using linear programming principles.

\(^{13}\) See Analysis Results section for a discussion on the 'end of game' effect.
Linear Programming Experiment Design: The Optimal Model

The experiment was constructed such that the participating subject had a goal to maximise the total completion (the objective function) of both projects in the portfolio over 10 time periods. One of these projects experienced progressively escalating costs per unit and the other did not have cost increases. Subjects were given a global budget of both money (cost) and time (labour hours) in order to complete this goal. Both money and time represented the resources available to the decision-maker that had a direct linear relationship to the completion of both projects. In the case of this experiment, subjects were given $44,000 and 2,200 labour hours each month with which to complete as much of both projects as possible. We can represent the money and time budget constraints in simple terms (based on the treatment by Langholtz et al. 2003):

\[
\begin{align*}
\text{Total Monthly Money Budget} & \geq \text{Money Spent on Escalating Project} + \\
& \phantom{=} \text{Money Spent on Non-Escalating Project} \\
\text{Total Monthly Time Budget} & \geq \text{Time Spent on Escalating Project} + \\
& \phantom{=} \text{Time Spent on Non-Escalating Project}
\end{align*}
\]

Using formal linear programming conventions and we can express this goal thus:

Goal: \( \text{Maximise } C = P_E + P_N \) \hspace{1cm} \text{(objective function)} \hspace{1cm} (1)

Where \( P_E = \text{Per cent completion of the escalating project within one period} \)
\( P_N = \text{Per cent completion of non-escalating project within one period} \)
Subject to:  
\[ \begin{align*}
\$44,000 & \leq \{M_E \cdot P_E + M_N \cdot P_N\} \quad \text{(money constraint)} \quad (2) \\
2,200 \text{ hours} & \leq \{T_E \cdot P_E + T_N \cdot P_N\} \quad \text{(time constraint)} \quad (3) \\
\text{Where: } P_E, P_N & \leq 0 \quad \text{(non-negativity constraint)} \quad (4)
\end{align*} \]

Where  
\[ \begin{align*}
M_E &= \text{The money investment required to complete 1% of the} \\
& \quad \text{escalating project (} P_E) \\
M_N &= \text{The money investment required to complete 1% of the} \\
& \quad \text{non-escalating project (} P_N) \\
T_E &= \text{The time investment required to complete 1% of the} \\
& \quad \text{escalating project (} P_E) \\
T_N &= \text{The time investment required to complete 1% of the} \\
& \quad \text{non-escalating project (} P_N)
\end{align*} \]

Dependent Variables

Ratio of Stated Completion to Optimal Completion

As per the LP problem identified above, we require an objective function (project completion) to determine the linear association between the resources available (time and cost). The use of the percentage completion of both projects (escalating and non-escalating) within a two-project portfolio, we are able to identify:

1. the level of completion of both projects as decided upon by the decision-maker; and

2. the LP 'optimal' completions that are suggested by the LP function.
From this we would be able to determine any divergence between the optimal and stated resource allocation strategies and further be able to objectively measure the effect of the dependent variables (ZOT and resource constraints) upon the decision process. Project completion, thus, provides a metric that is relevant, salient, easily understandable (to the decision-maker) and easily measurable (for the researcher). To date, no experimental studies in escalation have used this metric as the dependent variable.

As can be inferred from the above model, the most appropriate key dependent variable would be the amount of project completion for each of the two projects (escalating and non-escalating) per period. By using this metric, we can identify (1) the actual investment strategy of the subjects, and (2) the distance of this from the optimal resource allocation model. By measuring the distance between stated completion and optimal completion one can assess whether a project is being over-invested or under-invested and how the decision to invest in one project affects the investment in the second within the portfolio. For instance, in a two-project portfolio, over-investment in one project would necessarily indicate underinvestment in another. Therefore, the formula used to calculate the dependent variable described is calculated thus:

\[
\text{Actual vs. Optimal Completion Ratio} = \frac{\text{Actual Project Completion by Subject}}{\text{LP Optimal Completion}}
\]

A subject completing a project at the LP optimal level would have an actual vs. optimal completion ratio of 1.0. A subject completing more of a project than what is prescribed as optimal would have a ratio of greater than 1. Alternatively, a subject
completing less than prescribed by optimal would have a ratio of less than 1.
‘Completion’ was operationalised as the amount of each project that is completed as a percentage of the entire project. Subjects were told prior in their briefing that the initial plan states that 10% of each project should be completed in each period. Therefore the subject (as the project manager) should have completed 100% of both projects over the course of the 10-period task.

Project Status

As with the previous two experiments, subjects were asked to rate their perceptions of both projects within each time period (Figure 6.9). From there, we are able to ascertain whether their progress towards completion is attendant with ‘worries’ about the project and allows us to garner some insight into how those worries manifest in behaviour.

Figure 6.9: Project Status Options

<table>
<thead>
<tr>
<th>How would you rate project Atticus?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The project is progressing on or close to track</td>
</tr>
<tr>
<td>2. Acceptable variations are occurring</td>
</tr>
<tr>
<td>3. Unacceptable variations are occurring</td>
</tr>
<tr>
<td>4. Serious budget and scope cuts are needed</td>
</tr>
<tr>
<td>5. The project should be suspended immediately</td>
</tr>
</tbody>
</table>

If a subject were to choose the fifth option, that the project should be suspended immediately, a warning message flashed up on screen stating “you are choosing to cancel Project [Name]. Are you sure you want to do this?” followed by a Yes / No required input by the subject. However, the project was not formally abandoned until
the subject decided to progress to the following period. As the subject chose to move to the next period, s/he received another warning that:

"You are about to cancel Project [Name] and lose all resources already spent on it! You will note be able to restart this project at a later time. Are you sure you want to cancel this project?"

The purpose of the multiple warning messages was twofold. Firstly, it eliminated the chance of user error and allowed the decision-maker to reverse their decision if they so chose. More importantly, it was structured in this manner to intentionally convey the salient difficulty and gravity with which a project abandonment decision would be made.

**Independent Variables**

**Variance Over Time (Within-Subjects)**

As distinct from Experiment 2, budget variance covaried with time. In this case, budget variance was manipulated through rising costs per unit of completion for the escalating project while the non-escalating project experienced minor variations in order to maintain some experimental realism (less than 5%). As $M_E$ and $M_N$ changed in each month, a new optimal completion strategy was required for each iteration. The optimal resource allocation points over the ten months suggest that resource commitments to the escalating project should *decrease* over time; whereas resource commitments for the non-escalating project should *increase*. Simply put, in this case LP suggests that the optimal resource allocation strategy is to divert resources *away* from the escalating project and *towards* the non-escalating project.
Over the ten periods given to complete as much of both projects as possible, the time constraints were left unchanged. However, the escalating project’s budget variance for money increased randomly and cumulatively between 3%-7% per period, with a final unit cost of almost 50% over the original budget. The non-escalating project’s budget variance varied randomly between 0% - 5% per period in order to retain a measure of experimental realism.

Table 6.4: Variance Manipulations

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Escalating Project (ME) (Budget Variance)</th>
<th>Non-Escalating Project (MN) (Budget Variance)</th>
<th>Time (labour hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money ($)</td>
<td>Escalating Project (T_E)</td>
<td>Non-Escalating Project (T_N)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2400 (0.0%)</td>
<td>2000 (0.0%)</td>
<td>100 120</td>
</tr>
<tr>
<td>2</td>
<td>2477 (3.2%)</td>
<td>2062 (3.1%)</td>
<td>100 120</td>
</tr>
<tr>
<td>3</td>
<td>2657 (10.7%)</td>
<td>2066 (3.3%)</td>
<td>100 120</td>
</tr>
<tr>
<td>4</td>
<td>2820 (17.5%)</td>
<td>2062 (3.1%)</td>
<td>100 120</td>
</tr>
<tr>
<td>5</td>
<td>3031 (26.3%)</td>
<td>2016 (0.8%)</td>
<td>100 120</td>
</tr>
<tr>
<td>6</td>
<td>3113 (29.7%)</td>
<td>2052 (2.6%)</td>
<td>100 120</td>
</tr>
<tr>
<td>7</td>
<td>3302 (37.6%)</td>
<td>2082 (4.1%)</td>
<td>100 120</td>
</tr>
<tr>
<td>8</td>
<td>3420 (42.5%)</td>
<td>2032 (1.6%)</td>
<td>100 120</td>
</tr>
<tr>
<td>9</td>
<td>3509 (46.2%)</td>
<td>2014 (0.7%)</td>
<td>100 120</td>
</tr>
<tr>
<td>10</td>
<td>3593 (49.7%)</td>
<td>2092 (4.6%)</td>
<td>100 120</td>
</tr>
</tbody>
</table>

In the first month, it was possible to meet the budgeted completion for both projects (10% per month) without incurring overruns. However, in period 2 onwards the cost of completion gradually but uniformly rises for the escalating project which makes meeting budgeted completion levels impossible without incurring budget overruns. Unit costs for the escalating project rose to almost 50% over budget during the task. Faced with these cost variances, the decision-maker can choose to either reduce their completion below planned levels, incur budget overruns, or a combination of the two. The optimal allocation strategy for each period is detailed below.
Table 6.5: Optimal Completion for High ZOT Escalating Project

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Variance (%)</th>
<th>Completion (P_E) (%)</th>
<th>Variance (%)</th>
<th>Completion (P_N) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>10.00</td>
<td>0.0</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>3.2</td>
<td>8.17</td>
<td>3.1</td>
<td>11.53</td>
</tr>
<tr>
<td>3</td>
<td>10.7</td>
<td>6.55</td>
<td>3.3</td>
<td>12.88</td>
</tr>
<tr>
<td>4</td>
<td>17.5</td>
<td>5.62</td>
<td>3.1</td>
<td>13.65</td>
</tr>
<tr>
<td>5</td>
<td>26.3</td>
<td>5.21</td>
<td>0.8</td>
<td>13.99</td>
</tr>
<tr>
<td>6</td>
<td>29.7</td>
<td>4.55</td>
<td>2.6</td>
<td>14.54</td>
</tr>
<tr>
<td>7</td>
<td>37.6</td>
<td>3.72</td>
<td>4.1</td>
<td>15.23</td>
</tr>
<tr>
<td>8</td>
<td>42.5</td>
<td>3.91</td>
<td>1.6</td>
<td>15.08</td>
</tr>
<tr>
<td>9</td>
<td>46.2</td>
<td>3.87</td>
<td>0.7</td>
<td>15.11</td>
</tr>
<tr>
<td>10</td>
<td>49.7</td>
<td>3.05</td>
<td>4.6</td>
<td>15.79</td>
</tr>
</tbody>
</table>

In table 6.5 above, the completion levels reported represent the LP optimal allocation for each month. Obviously, the total completion of either project cannot exceed 100%, but while the optimal completion of \( P_N \) combines to over 100% over the 10 months it was our conjecture that there will only be a small number of incidences of either project being finished early by subjects (which was the case).

Zone of Tolerance (Between-Subjects)

The Zone of Tolerance construct was operationalised in a slightly different way to Experiment 2 in order to account for some of the methodological weaknesses evident in that study. A similar high / low ZOT manipulation was used, albeit with less detail than in previous experiments (See Figure 6.10).
Figure 6.10: Senior Management Directives (ZOT Manipulation)

<table>
<thead>
<tr>
<th>Low ZOT Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>This project is to be released into a highly competitive market and there is little tolerance for budget overruns.</td>
</tr>
<tr>
<td>Money and time variances are approved in exceptional circumstances only.</td>
</tr>
<tr>
<td>Strict completion schedules apply.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High ZOT Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is some tolerance for time and cost overruns as long as the project is on track for its planned completion.</td>
</tr>
<tr>
<td>Money and time variances are accepted as long as the project is running on or close to schedule.</td>
</tr>
</tbody>
</table>

Consistent with the research programme so far, both the high and low Zone of Tolerance manipulations were presented to the decision-maker. The previous experiments were designed such that, while all ZOTs were presented to the decision-maker, project were discrete and treated as independent. In contrast to the previous two experiments however, both ZOT manipulations were presented to the decision-maker simultaneously (one for each project).

Decision-makers were required to allocate their global 'bank' of money and time between the two projects, and as such, were induced to consider trade-offs and opportunity costs to pursuing an escalating project. The reason for the designation of ZOT as a between-subjects factor is due to the allocation of the high and low ZOT condition between the two projects. Thus, half the respondents received the treatment where there was a low ZOT for the escalating project and a high ZOT for the non-
escalating project, while the other half of respondents received the opposite treatment.

In this experiment, we included an additional ZOT manipulation. Note that in the low ZOT condition (see Figure 6.9) included an expression stating that “strict completion schedules apply”. In this experiment, we sought to further strengthen the manipulation of the Low ZOT manipulation such that the Steering Committee would not approve any less than 7% of a low ZOT project in any given period (unless the subject decided to abandon the project). Subjects attempting to complete less than the required 7% per period in the Low ZOT condition received an error message stating that the project “has strict completion schedules that cannot be violated”. In the High ZOT condition, there was no minimum completion per period enforced on the subject.

As can be seen in Figure 6.11a below, including a 7% minimum on the project with the low ZOT treatment reduces the feasible region of resource allocations. It is important to note that imposing a constraint so that subjects cannot complete less than 7% of a Low ZOT project would change the calculation of an LP optimal if a low ZOT was applied to the escalating project. In this case, the resultant feasible region is represented by:
Chapter 6 – Project Portfolios

Figure 6.11a: Feasible Region with Low ZOT Minimum Completion Constraint

Figure 6.11b: Low ZOT Resource Constraints on Escalation Situations
If the costs associated with completing the escalating project were to increase, this may have the effect of moving the optimal point away from the intersection of the money and time constraint (See Figure 6.11b). The decision-maker would find themselves in a position of rapidly diminishing options (represented by the feasible region). While it is still possible to complete both projects, the non-escalating project is now also suffering from a diminished capacity for completion at the expense of the heightening costs of the escalating project. The objective of manipulating ZOTs in this way is to examine how behaviour manifests in this case.

When adding a strict schedule of completion to a project, we change the optimal resource allocation points by adding the further constraint of a minimum completion for the Low ZOT project:

Where: \[ P_E \geq 7 \] (Low ZOT for Escalating Project) \hspace{1cm} (5a); or
\[ P_N \geq 7 \] (Low ZOT for Non-Escalating Project) \hspace{1cm} (5b)

In the between-subjects treatment where the low ZOT condition is enforced for the escalating project, the optimal resource allocations change from Table 6.4 above to Table 6.6 below.
Table 6.6: LP Optimal When ZOT for Escalating Project is Low

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Escalating Project</th>
<th>Non-Escalating Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variance (%)</td>
<td>Completion (PE) (%)</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>3.2</td>
<td>8.17</td>
</tr>
<tr>
<td>3</td>
<td>10.7</td>
<td>7.00</td>
</tr>
<tr>
<td>4</td>
<td>17.5</td>
<td>7.00</td>
</tr>
<tr>
<td>5</td>
<td>26.3</td>
<td>7.00</td>
</tr>
<tr>
<td>6</td>
<td>29.7</td>
<td>7.00</td>
</tr>
<tr>
<td>7</td>
<td>37.6</td>
<td>7.00</td>
</tr>
<tr>
<td>8</td>
<td>42.5</td>
<td>7.00</td>
</tr>
<tr>
<td>9</td>
<td>46.2</td>
<td>7.00</td>
</tr>
<tr>
<td>10</td>
<td>49.7</td>
<td>7.00</td>
</tr>
</tbody>
</table>

From this we can see the influence of management controls on optimal resource allocation. By stating strict minimum completion levels we find that it would still be possible in this instance to complete the non-escalating project: optimal resource allocation allows for a theoretical cumulative completion of 106.27% over the ten months. However, the margin for error is smaller. We also see the portfolio effect of such constraints, as failing projects that maintain commitment in effect draw scarce resources away from projects performing well.

Resource Limit Manipulation – Harsh vs. Benign Budget Conditions

A further between-subjects manipulation was used to determine whether or not the subjects were permitted to invest resources in excess of the total monthly budget. Around half of the subjects had strict resource constraints in which they were not able to allocate resources in excess of the $44,000 and 2,200 labour hours budgeted for that period. The other half were allowed to allocate resources in excess of these monthly budgets. Subjects in both groups were not permitted to save resources from previous budgets for future spending.
Under loose resource budget constraints it becomes possible to complete projects in excess of the LP optimal. In effect, a decision-maker could allocate resources outside the feasible region and therefore maintain their 10% per period completion of both projects. It is therefore up to that decision to determine their reaction to budget variances and Zones of Tolerance when determining if such allocations are appropriate this determination and this is integral to our continuing investigation into the influence of ZOTs and budget variances on the decision-making process in escalation situations.

The Decision Task

The experimental task used to examine these phenomena used a computer-based simulation. The screen used to manage these projects is presented in Figure 6.12. The task was to place subjects in the position of project managers who have to allocate a monthly budget of $44,000 and 2,200 labour hours between two projects under their control, one of which was escalating (Project Atticus, indicated by Point A in Figure 6.12) and one of which was non-escalating (Project Lazarus, Point G in Figure 6.12). Their goal was to maximise the combined completion of both projects within 10 time periods (Point F on Figure 6.12). The original plans for both projects state that 10% of each project should be completed each month, thus stipulating that both projects were planned to be completed in ten months.

For each of the two projects, decision-makers were provided with a Steering Committee briefing that outlined the strategic objectives of the project (ZOT manipulation) (Point B in Figure 6.12). Further, decision-makers were provided with
budget information (Point D in Figure 6.12) and details of the constraints on their decisions (Point J in Figure 6.12). Each month, subjects were given revised money and time investment constraints (Point C in Figure 6.12). These constraints were expressed as the money and time required to complete 1% of each project. A 'calculator' was displayed to allow decision-makers to compute the total money and time investments for each project in each month (Point K on Figure 6.12) as well as a graphic to track the level of completion of both projects as compared to budget (Point H on Figure 6.12).

For each time period, subjects had to make four decisions, two for each project. They could not manipulate any other information on the screen other than the lower panel in Figure 6.12. Their decisions included (1) how much of each project should be completed within the time period (Point E on Figure 6.12); and (2) what their assessment of the project’s progress should be (Point I on Figure 6.12). Upon making these decisions, the subject moved to the next time period iteration.
### Project Scorecard

**BEGINNING OF MONTH 7 OF 10**

Both Projects have **EQUAL** Strategic and Economic Value

<table>
<thead>
<tr>
<th>Project Atticus</th>
<th>Project Lazarus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Senior Management Directives:</strong></td>
<td><strong>Senior Management Directives:</strong></td>
</tr>
<tr>
<td>This project is to be released into a highly competitive market and there is little tolerance for budget overruns.</td>
<td>There is some tolerance for time and cost overruns as long as the project is on track for its planned completion.</td>
</tr>
<tr>
<td><strong>Investment Required Per 1% Completion</strong></td>
<td><strong>Investment Required Per 1% Completion</strong></td>
</tr>
<tr>
<td>Last Month</td>
<td>This Month</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$2,117</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Investments To Date</strong></td>
<td></td>
</tr>
<tr>
<td>Completion</td>
<td>60.0%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$144,010</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Spending Calculator For Month 7</strong></td>
<td><strong>Spending Calculator For Month 7</strong></td>
</tr>
<tr>
<td><strong>How Much Will You Complete In Project Atticus This Month?</strong></td>
<td><strong>How Much Will You Complete In Project Lazarus This Month?</strong></td>
</tr>
<tr>
<td></td>
<td>4.1 %</td>
</tr>
<tr>
<td><strong>How would you rate project Atticus?</strong></td>
<td><strong>How would you rate project Lazarus?</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Allocate Resources and Move To Next Period</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Investments To Date**

<table>
<thead>
<tr>
<th>Completion</th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.0%</td>
<td>62.0%</td>
<td>62.0%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$144,010</td>
<td>$171,150</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>1000</td>
<td>5000</td>
</tr>
</tbody>
</table>

**Completion To Date**

<table>
<thead>
<tr>
<th>Completion</th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.0%</td>
<td>62.0%</td>
<td>62.0%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$144,010</td>
<td>$171,150</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>1000</td>
<td>5000</td>
</tr>
</tbody>
</table>

**Budget vs. Actual**

<table>
<thead>
<tr>
<th>Completion</th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.0%</td>
<td>62.0%</td>
<td>62.0%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$144,010</td>
<td>$171,150</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>1000</td>
<td>5000</td>
</tr>
</tbody>
</table>

**Subject Response:**

**Project Status**

**J. Budget Constraint Manipulation**

**K. Budget Calculator**

**Figure 6.12: Screen Shot of Decision Task**

---

**F. Time Period**

**G. Lazarus: Non-Escalating Project**

**H. Budget vs. Actual Completion Graphic**

---

**E. Subject Response:**

**Completion**

---

**D. Budget vs. Actual Information**

---

**C. Variance Manipulation:**

**Unit Costs for Completion**

---

**B. ZOT Manipulation**

---

**A. Atticus: Escalating Project**

---

- 302 -
Procedure

Subjects were given a number of alternative times to attend the experiment session. By contrast to previous experiments, the experiment was administered using smaller subject groups owing to the added complexity of the task. Each session was held in a computer laboratory at the University of Sydney. Upon arrival, subjects were instructed to take time to read through the Ethics materials and sign Participation Consent Forms as per the requirements stipulated by the Human Research Ethics Committee at the University.

Subjects were given a short introduction in which screen shots were displayed to explain the processes involved in the task how the computer simulation worked. To avoid experimenter expectancy effects, subjects were not told about the nature of the research, except that they would be allocating a budget of money and time between two projects over ten periods and their goal was to complete as much of the two projects as they could. Time was allowed for questions. Table 6.7 describes the order in which projects were shown to subjects. This order conforms to the experimental procedures used in the previous two experiments.

<table>
<thead>
<tr>
<th>Screen</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participant Information Sheet</td>
</tr>
<tr>
<td>2</td>
<td>Participant Consent Form</td>
</tr>
<tr>
<td>3</td>
<td>Introductory Cover Story</td>
</tr>
<tr>
<td>4</td>
<td>Experiment Task</td>
</tr>
<tr>
<td>5</td>
<td>Summary and Post-Test</td>
</tr>
</tbody>
</table>
Introductory Statement, Cover Story and Enhancing Ecological Realism

Each subject was provided with an introductory statement regarding their role as a Project Manager whose responsibility was to allocate resources to projects at the beginning of every month (see Figure 6.13). As with the previous experiments, subjects were told the following,

"Your reputation is significantly affected by the quality of your recommendations to Senior Management. A poor recommendation may be to spend too much or too little on a project, or take actions that will lead to project failure.

"In reality, most projects do not finish exactly on time and on budget. Decisions about what to do with projects that are going over budget should be made on a case-by-case basis and you should consider what is in the best interests of the organisation when making investments in projects.

Subjects were given information about the nature of the task, including their global budget, Steering Committee Directives, details that 10% each project was originally planned for each period, and the fact that costs for completion may vary over time. These instructions remained available via a projector at the front of the room while participants progressed through the task.

Random Allocation of Tasks

Four variations of the task were created and randomly distributed between subjects (see Table 6.8). The variance-over-time within-subjects construct manipulation remained constant throughout all treatments.
Table 6.8: Randomisation for Experiment 3

<table>
<thead>
<tr>
<th>Randomisation</th>
<th>Resource Limits</th>
<th>ZOT for Escalating Project</th>
<th>ZOT for Non-Escalating Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harsh</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Harsh</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Loose</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Loose</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

**Post-Test Questionnaire**

Upon completion of all 10 periods, subjects were shown a screen (see Figure 6.14) in which they were presented with the final results of their allocations over the ten months and asked to choose from the following options:

1. Their overall satisfaction with the way they managed each project
   - *I am very satisfied with the way I managed the project.*
   - *I am somewhat satisfied with the way I managed the project.*
   - *I am neither satisfied nor dissatisfied with the way I managed the project.*
   - *I am somewhat dissatisfied with the way I managed the project.*
   - *I am very dissatisfied with the way I managed the project.*

2. Their priorities when managing each project
   - *Finishing the project on time*
   - *Keeping the project within the time and cost budgets*
   - *Following the Senior Management Directives*

3. Their estimation of how costs per unit increased over the course of 10 months (numeric percentage).
Hieronymus Solutions Pty. Ltd.

Your Role

You are to imagine that you are an Information Technology project manager within Hieronymus Solutions Pty Ltd.

At the beginning of every month you report to Senior Management on the progress of your projects and decide how much should be invested into them for that month.

How To Complete This Task

You will be presented with two IT-focused projects which you will have to manage over 10 months.

The original plans state that 10% of each project should be completed every month (i.e. both projects should be 100% completed in 10 months).

You have a monthly budget of $44,000 and 2200 labour hours that you can allocate between the two projects. This monthly budget cannot be saved for future months.

YOU DO NOT HAVE THE AUTHORITY TO APPROVE BUDGET OVERRUNS.

Your goal is to complete as much of each project as possible without violating the Senior Management Directives set for each project.

Each month you will be given the time and cost required per 1% completion of each project which may vary over time. You can use this to calculate total spending.

Both projects have EQUAL strategic and economic value to the organisation.

However, each project has a different Steering Committee Directive and you should take these into consideration when allocating resources.

Important Note

Your reputation is significantly affected by the quality of your decisions. A poor decision may be to spend too much or too little on a project, or take actions that will lead to project failure.

In reality, most projects do not finish exactly on time and on budget. Decisions about what to do with projects that are going over budget should be made on a case-by-case basis and you should consider what is in the best interests of the organisation when making investments in projects.

Cancelling projects that have already started often mean losing a lot of money that has already been spent. You may even lose your job or professional reputation if you are responsible for a project that had to be cancelled.

HOWEVER THERE IS A POINT WHERE FAILING PROJECTS MUST BE ABANDONED. JUDGEMENT IS NEEDED TO KNOW WHEN PROJECTS HAVE TURNED FROM GOOD TO BAD.

Click Here to Begin

Figure 6.13: Introductory Statement for Experiment 3
Please Answer Some Final Questions...

### Project Atticus

<table>
<thead>
<tr>
<th></th>
<th>Budget</th>
<th>Actual</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion</td>
<td>100.0%</td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$240,000</td>
<td>$301,935</td>
<td>25.8%</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>10,000</td>
<td>10,000</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**How satisfied are you with the way you managed Project Atticus?**

- [ ] Please Select

**What was your biggest priority when managing this project?**

- [ ]

**Estimate Project Atticus' unit costs increase between periods 1 and 10.**

- [%]

### Project Lazarus

<table>
<thead>
<tr>
<th></th>
<th>Budget</th>
<th>Actual</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion</td>
<td>100.0%</td>
<td>60.4%</td>
<td>-39.6%</td>
</tr>
<tr>
<td>Money ($)</td>
<td>$200,000</td>
<td>$123,535</td>
<td>-38.2%</td>
</tr>
<tr>
<td>Time (hours)</td>
<td>12,000</td>
<td>7,248</td>
<td>-39.6%</td>
</tr>
</tbody>
</table>

**How satisfied are you with the way you managed Project Lazarus?**

- [ ]

**What was your biggest priority when managing this project?**

- [ ]

**Estimate Project Lazarus' unit cost increase between periods 1 and 10.**

- [%]

Figure 6.14: Post-Test Questions for Experiment 3
Analysis and Results

Controlling for the 'End of Game Effect'

Although subjects were presented with ten time periods within which they were given the goal of completing as much of both projects as possible, we excluded the tenth (final) time period from our analysis. The reason for this is due to our endeavour to achieve a robust experiment design. The ‘end of game effect’ occurs when subjects treat the final period of a task as a capstone, making resource allocation decisions that are different to the resource allocation decisions of the previous nine time periods. There may be a motivation to complete anything outstanding in the project, and thus incur significant budget overruns in doing so. Van Bruggen et al. (1998) were able to negate their ‘end of game effect’ by not actually informing subjects about which iteration would be their final for the task. However, this experiment was designed a little differently and with a different purpose. Instead, we eliminated period 10 from our analysis in order to negate the possibility of finding false positives in our budget overrun and completion metrics.

Difference between Resource Allocation Behaviour and LP Optimal

Consistent with our expectations, decision-makers failing to correct early variations from expectations can be shown to significantly diverge from optimal allocations when ample tolerance exists within the decision context. Conversely, when there is low tolerance for variations within the context, we see earlier detection and correction of variations from budgets and more optimal resource allocation behaviour overall. A second interesting finding is that decision-makers tend to make allocation decisions that are closer to optimality when the organisational constraints
manifest low tolerance and, counter-intuitively, when provided with loose, rather than strict, resource constraints. This is possibly due to a belief that loose resource constraints connote the ability to freely move resources between projects.

We found some striking evidence of how Zones of Tolerance affect a decision-maker’s ability to achieve optimal allocation of resources (see Table 6.9). In a compelling confirmation of our conjectures that high Zones of Tolerance permit decision-makers to continue to allocate funds to failing projects, we found a significant main effect of ZOTs \( (F(1,30) = 26.166, p = .000) \) on the ratio of stated resource allocation decisions vs. optimality \( (H1 \text{ Supported}) \). As budget variances increased over time (from 0 to almost 50%), subjects attempted to de-escalate their commitment to the escalating project by reducing its completion (see Figure 6.16). However, they did so insufficiently and failed to adequately adjust their resource allocations to take this into account.

**Table 6.9: Between-Subjects Results for Experiment 3**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>710.632</td>
<td>1</td>
<td>710.632</td>
<td>3456.352</td>
<td>.000</td>
</tr>
<tr>
<td>ZOT</td>
<td>5.380</td>
<td>1</td>
<td>5.380</td>
<td>26.166</td>
<td>.000</td>
</tr>
<tr>
<td>Resource</td>
<td>.478</td>
<td>1</td>
<td>.478</td>
<td>2.323</td>
<td>.138</td>
</tr>
<tr>
<td>ZOT * Resource</td>
<td>.967</td>
<td>1</td>
<td>.967</td>
<td>4.704</td>
<td>.038</td>
</tr>
<tr>
<td>Error</td>
<td>6.168</td>
<td>30</td>
<td>.206</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As Figure 6.16 below indicates, a simple comparison of mean completion by project reveals that while subjects made an attempt to control escalation and they did not adjust their completion of escalating projects sufficiently. This was particularly the case when the escalating project was experiencing high ZOTs (see Figure 6.15). Even at low ZOT’s, where the optimal completion level was strongly suggested
through a ‘minimum completion per period’ constraints, subjects tended to complete more than they were required to in order to maintain their achievement of budgeted completion targets.

Turning to a ratio comparison of allocation vs. optimal, recall that a decision-maker’s allocations are more optimal the closer they are to 1.0 over time. When an escalating project experienced high ZOTs the resource allocation decisions became increasingly sub-optimal over time. By contrast, when an escalating project experienced low ZOTs, their resource allocation decisions were much closer to optimality. Interestingly, Figure 6.16 below suggests some correction behaviour at around period 6 (when cost overruns reached almost 30% above the original budget on the escalating project – similar to that of our ‘high variance’ conditions in the first two experiments).
As budget variances within the escalating project rose over time, decision-makers tended to also reduce the completion of the non-escalating project in order to compensate for the increasing costs of the troubled one; in effect drawing resources away from good investments in favour of bad ones. Figure 6.17 below indicates that while escalating projects were typically heavily over-invested, projects that perform well suffer by association. By maintaining commitment to an escalating project, we can see how the strain on resources draws funds away from well performing projects.

In the case where there was a high ZOT for an escalating project (and low ZOT for a non-escalating one), we found that the non-escalating project in the portfolio gradually and progressively went under-invested in an LP optimal sense. On the other hand, in the case of escalating projects in low ZOT and non-escalating projects in high ZOT, we see that correction behaviour brings both projects closer to optimal.
Escalating costs over time had a significant main effect on the proximity to optimal allocations within this decision task ($F(8, 232) = 3.790, p = .000$) as well as a significant interaction effect with ZOTs ($F(8, 232) = 5.008, p = .000$) (H4 and H5 Supported, see Table 6.10). What this indicates is that decision-makers failed to learn over time that they were insufficiently adjusting their completion rates on projects. In fact, their decisions tended to get worse (i.e. further from optimal) over time as costs increased. This was largely due to their attempts to bolster their completion of the escalating project while keeping completion of the non-escalating project relatively unchanged.

These results tend to confirm our previous findings that the stability of variances over time tends to play a hand in a decision-maker’s inability to manage troubled projects effectively. As in Experiment 2, we can see how unstable and rising costs over time create decision dilemmas that do not seem to improve with time. Subjects
did not seem to radically adjust their resource allocation strategies even after it became clear that a project was experiencing significant cost overruns. Rather, subjects seemed to prefer to ‘tweak’ their allocation strategies and, in this case, this was insufficient to guarantee successful completion of either project.

Table 6.10: Between-Subjects Results for Experiment 3

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>47.172</td>
<td>1</td>
<td>47.172</td>
<td>127.351</td>
<td>.000</td>
</tr>
<tr>
<td>Project * ZOT</td>
<td>13.853</td>
<td>1</td>
<td>13.853</td>
<td>37.400</td>
<td>.000</td>
</tr>
<tr>
<td>Project * Resource</td>
<td>.235</td>
<td>1</td>
<td>.235</td>
<td>.633</td>
<td>.432</td>
</tr>
<tr>
<td>Project * ZOT * Resource</td>
<td>2.419</td>
<td>1</td>
<td>2.419</td>
<td>6.530</td>
<td>.016</td>
</tr>
<tr>
<td>Error(Project)</td>
<td>11.112</td>
<td>30</td>
<td>.370</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period</td>
<td>1.709</td>
<td>8</td>
<td>.214</td>
<td>2.982</td>
<td>.003</td>
</tr>
<tr>
<td>Period * ZOT</td>
<td>2.732</td>
<td>8</td>
<td>.341</td>
<td>4.767</td>
<td>.000</td>
</tr>
<tr>
<td>Period * Resource</td>
<td>.316</td>
<td>8</td>
<td>.040</td>
<td>.551</td>
<td>.817</td>
</tr>
<tr>
<td>Period * ZOT * Resource</td>
<td>.450</td>
<td>8</td>
<td>.056</td>
<td>.786</td>
<td>.616</td>
</tr>
<tr>
<td>Error(Period)</td>
<td>17.193</td>
<td>240</td>
<td>.072</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project * Period</td>
<td>7.475</td>
<td>8</td>
<td>.934</td>
<td>7.377</td>
<td>.000</td>
</tr>
<tr>
<td>Project * Period * ZOT</td>
<td>10.791</td>
<td>8</td>
<td>1.349</td>
<td>10.649</td>
<td>.000</td>
</tr>
<tr>
<td>Project * Period * Resource</td>
<td>.523</td>
<td>8</td>
<td>.065</td>
<td>.516</td>
<td>.844</td>
</tr>
<tr>
<td>Project * Period * ZOT * Resource</td>
<td>.763</td>
<td>8</td>
<td>.095</td>
<td>.753</td>
<td>.645</td>
</tr>
<tr>
<td>Error(Project*Period)</td>
<td>30.400</td>
<td>240</td>
<td>.127</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Resource Limits

We did not find a main effect from resource constraints (F(1,30) = 2.323, p = .138) (H2 Not Supported). However, we did find a significant ZOT X Resource Limit interaction effect (F(1,30) = 4.704, p = .038) (H3 Supported). There was no discernible effect from the interaction between budget variances over time and resource limits (F(8,240) = .316, p = .817) (H6 not supported). Figure 6.18 below indicates that there appeared to be a difference between the allocation / optimal ratios of low vs. high ZOTs when resource limits were harsh. However, this difference is smaller under conditions of benign resource constraints. Thus while resource
constraints did not seem to have a direct main effect, the interaction effect suggests just how salient the ZOT manipulation was and how it impinged upon the decision-making processes of subjects.

Figure 6.18: Ratio of Allocation vs. Completion of Escalating Project

Why would resource limits not be significant upon a subject’s ability to achieve optimality, except as an interaction effect with ZOTs? On the face of it, strict resource limits would seem to drive decision-makers to look for resource allocations that lay within the feasible set, thus setting a constraint upon their decisions that would positively affect their achievement of optimality.

Project Status

A second set of interesting findings can be found when tracking a subject’s ‘worry’ about their resource allocations against their allocation decisions. The Project Status dependent variable was coded using the values in Figure 6.9. In sum, escalating projects affect the way subjects viewed the untroubled projects in their portfolios. Project status experienced a direct main affect from the time-variance condition
(F(8,240) = 18.479, p = .000) and through the ZOT condition (F(1,30) = 7.949, p = .000). This can be seen graphically through Figure 6.20 below.

**Figure 6.19: Project Status Across Time**

As we can see from the figure above, a particularly marked difference between the 'worry' that was exhibited when the escalating project experienced high ZOTs. Despite the fact that subjects in the high ZOT condition for escalating projects tended to allocate their resources in a much more sub-optimal fashion, subjects within that condition tended not to be as worried about the effects of the escalating project on the portfolio. In other words, a decision-maker's ability to extend tolerance to absorb escalating projects seemed to be less concerned about their resource allocation decisions to the entire portfolio. This would confirm Lyttinen and Robey's (1999) conclusion that decision-makers tended to focus on local optima and did not learn from experiences when learning was inhibited by the decision context. By contrast, decision-makers finding themselves managing an escalating project through a 'difficult' (i.e. low ZOT) organisational context tended to perform better and improve their decision-making and resource allocation behaviour over time.
ZOTs Promote Careful Resource Allocations

Langholtz et al.'s (1994) conjectures about careful husbanding of resources seem to bear themselves out through this research. Low ZOT’s created ‘harsh’ environments (to use Langholtz et al.’s (1994) term) that force decision-makers to consider the implications of their decisions and weigh them against stricter organisational mores. The end result is a better overall allocation of resources and earlier detection of escalating projects. By contrast, organisational conditions that are considerably more generous tended to allow decision-makers to absorb the overruns of poorly performing projects, thus (in many cases) failing to identify and correct troubled projects.

Perhaps the most compelling evidence if this can be seen through the post tests. Subjects were asked how much they thought the costs per unit of each project changed from period 1 to period 10. Bearing in mind that the answer to this question was that the escalating project’s costs per unit rose 50% during this time; Table 6.11 below shows a marked difference between the low and high ZOT conditions in this estimate.

Table 6.11: Post-Test Estimate of Budget Overruns

<table>
<thead>
<tr>
<th>ZOT for Escalating Project</th>
<th>Escalating Project Variance</th>
<th>Non-Escalating Project Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>18.34</td>
<td>7.00</td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>15.339</td>
<td>8.515</td>
</tr>
<tr>
<td>High</td>
<td>10.04</td>
<td>5.17</td>
</tr>
<tr>
<td>N</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>13.682</td>
<td>9.439</td>
</tr>
</tbody>
</table>
In a marked difference between the two groups, both of which experienced identical cost increases, subjects in the low ZOT escalating project condition estimated that costs rose 18%, while those in the high ZOT condition estimated only 10%. This would indicate that low ZOTs actually made decision-makers pay more attention to the cost and budget metrics of the project, and that they were more aware of these budget variances as they occurred. This can be seen through the greater amount of correction behaviour in the low ZOT condition, and the lack of correction behaviour in the high ZOT condition.

Project Abandonments

The number of abandoned projects was very low. Only five out of the 35 subjects (14.3%) decided to abandon a project in their portfolio. Of these, four abandoned the escalating project and one abandoned the non-escalating project (with high ZOTs and harsh resource limits). Interestingly, no projects were abandoned in the ‘harsh’ resource limits treatment group (see table 6.12). It would be difficult to make any conclusions from this low number of project abandonments about what induces one to abandon a project, and the fact that the abandoned escalating projects were in the benign, rather than harsh, treatment condition seems contrary to our overall findings.

Table 6.12: Count of Abandonment Decisions for Escalating Projects

<table>
<thead>
<tr>
<th>ZOT</th>
<th>Res</th>
<th>Harsh</th>
<th>Benign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Discussion

To summarise our results: decision-makers attempted to maintain their completion of the escalating project while keeping completion of the non-escalating project relatively unchanged during escalation of commitment episodes occurring within project portfolios. We found a significant main effect of ZOTs on the ratio of stated resource allocation decisions vs. optimality (H1 Supported). As budget variances increased over time (from 0 to almost 50%), subjects attempted to de-escalate their commitment to the escalating project by reducing its completion. However, they did so insufficiently and failed to adequately adjust their resource allocations to take this into account. We did not find a main effect from resource constraints (H2 Not Supported) nor from the interaction between budget variances over time and resource limits (H6 not supported). Nonetheless, we did find a significant ZOT X Resource Limit interaction effect (H3 Supported). Escalating costs over time had a significant main effect on the proximity to optimal allocations within this decision task as well as a significant interaction effect with ZOTs (H4 and H5 Supported).

It has been discussed previously in the literature review and by Yetton et al. (2000) that project managers tend to disregard budget variances as critical to project success. As a result, decision-makers tend to absorb budget variances, particularly when the organisational context allows for this absorption to pass without significant downside for the decision-maker. Despite this, budget variances are a good measure of the efficiency with which project managers execute organisational plans and strategy.
This research challenges the conventional wisdom that budget variances are of secondary importance to the success of projects. It both theoretically and empirically demonstrates how budget variances can affect entire project portfolios. Decision-making behaviour in escalating projects can now be seen to lead to suboptimal resource allocations, thus constraining the successful development and implementation of other, non-escalating projects. In these situations, project managers can be seen to insufficiently adjust to escalating situations and, in effect, draw resources away from well performing projects to bolster underperforming ones.

Project management literature into escalation and project failure are often driven by the pursuit of early warning signals. In truth, escalation situations are so multidimensional and context specific that such indicators may be difficult to ascertain. What seems more germane to the problem is to enhance the attention paid to the resource allocation process. Under conditions of low Zones of Tolerance, where organisational constraints and oversight are strong, decision-makers were shown to husband resources and detect escalation situations earlier more effectively. By contrast, under conditions where ZOTs were high, little if any correction behaviour was evident.

Yet even when ZOTs are low and a decision-maker identifies escalating costs early in a project’s progress, they tend to insufficiently adjust their resource allocations to reflect the true extent of the escalation situation. Perhaps this confirms Langholtz et al.’s (1994) conclusion that decision-makers have rather impulse-driven reactions to setbacks and address them as they happen, rather than anticipating for them ahead of time. This study supports this notional idea of reaction to budget variances, since
decision-makers tended to inadequately correct budget variances despite these variances increasing in a uniform pattern (from 0% in period 1 to 50% in period 10). This was particularly pronounced under conditions of high ZOTs where budget variances were systematically absorbed by subjects.

Low Zones of Tolerance on poorly performing projects seems to direct attention to setbacks and also improves the focus on the alternate investments and opportunity costs within the organisational context. This is evidenced by the increase in 'worry' for both escalating and non-escalating projects when setbacks are evident within projects under low ZOTs. In other words, when low ZOT projects experience problems, decision-makers are compelled to consider the entire portfolio. In a related finding, perhaps the reason why setting global resource limits do not have a main effect on allocations to individual projects. Budget limits have greater effect when combined with strong ZOTs (hence the significant interaction effect between ZOT and resource limits). Conversely, high ZOTs on a project experiencing setbacks seems to inure decision-makers from seeing the effects of setbacks on the whole portfolio. In sum, when projects are situated in contexts allowing the absorption of setbacks, decision-makers tend not to identify and correct them and fail to appreciate the effect of these setbacks on the entire portfolio. This is evidenced quite markedly in Figure 6.16 where escalating projects under high ZOTs not only were allowed to continue uncorrected, but the situation was compounded since subjects did not exhibit 'worry' for the other project in the portfolio.
Limitations of the Study

The natural limitations to experimental settings (student samples, lack of realism) play an unaviodable role in limiting the extent to which we may make generalisations from these findings. However, three studies have now empirically established the effects of Zones of Tolerance on decision-making behaviour.

It must also be noted that this experiment used a special case of LP problem in which an optimal was evident and achievable by the decision-maker. It would be interesting to explore how different variations on the L problem would manifest different behaviour. In particular, one interesting counter-intuitive anomaly would arise in the following case (Figure 6.20).
In the above example, a stable cost constraint but a shifting time constraint (indicating time overruns on the escalating project) would suggest that the new LP optimal would require one to increase their completion of the escalating project and decrease completion of the non-escalating project. It would be difficult to make a reasonable business case from this new recommended optimal as it would appear to encourage the escalating project to the detriment of the non-escalating project. Yet it would be interesting to see how decision-makers reacted to a situation such as this.

Concluding Remarks

This study takes a significant step towards understanding how tolerance of minor setbacks affects future tendencies to persist with challenged courses of action. It examined the influence of tolerance for setbacks, the extent to which alternative resource allocations are available and the way in which projects change over time. We hypothesised that ZOTs inhered within the decision context lead to increasingly suboptimal resource allocations between troubled and untroubled projects over time. The study compared objectively optimal resource allocation strategies against decision-makers’ actual allocation decisions in a portfolio of two projects.

Applying linear programming, we both theoretically and empirically demonstrates how tolerance for troubled projects draws resources away from well-performing projects within a portfolio. It validates a hitherto unapplied method of measuring the extent to which decision-makers are departing from an objectively optimal decision strategy during escalation of commitment dilemmas. Consistent with our expectations, decision-makers in ZOT conditions permitting absorption of cost
increases fail to detect early variations from expectations and failed to correct escalating projects. By contrast, subjects in low ZOT conditions tended to be more aware of increasing costs and generally attempted to correct said variations, leading to better resource allocations overall. However, subjects generally failed to adequately adjust their resource allocation strategies to ensure optimal completion of their projects and can be particularly shown to significantly diverge from optimal allocations when ample tolerance exists within the decision context.
--- CHAPTER 7 ---

CONCLUSION

The Basic Premises of the Research

This research programme has made novel and significant extensions to over thirty years of escalation of commitment literature. The escalation problem is relevant to contemporary project management practice and IS project development and has been shown to be a pervasive problem that, as yet, does not have an adequate solution. The research detailed here has provided a critical clue in developing a methodical approach to addressing the issue – by managing our behavioural reactions to extant boundary conditions inhered within ZOTs, we are able to identify problems faster, more efficiently and with greater awareness of project setbacks.

Project performance is characterised by the metrics of time, cost and functionality. Along with project completion, budget variances are the key measure of the efficiency with which a project manager executes the planning, development and implementation of projects (Yetton et al. 2000). The efficiency with which IS projects meet their time, cost and quality objectives in a project setting has not improved with time, despite the improvements in development technologies such as reusable components and object-oriented design that should make IS developments and implementation less time consuming and more efficient, customisable and better suited to meeting organisational requirements (Welke 1994).
This research programme investigated the phenomenon known as the escalation of commitment: the tendency to persist with troubled projects despite evidence suggesting that setbacks within the project could lead to its eventual failure. The tendency to escalate commitment to troubled projects by investing greater amounts of time, money and effort than originally anticipated, have been shown to be strong, persistent and contrary to conventional economic prescriptions. There should be few technical reasons for organisations to “experience the backlogs and delays that plagued systems development 20 years ago” (Lyytinen and Robey 1994, p85). Yet information systems development projects are notoriously prone to escalation of commitment and failure. The pervasive problem of time and cost overruns is compounded by a seemingly cavalier attitude to budget overruns by IS project managers that has been supported in a number of studies (Ewusi-Mensah and Przasnyski 1991; Yetton et al. 2000). We asked ourselves three questions at the outset that informed the direction of the research programme:

**RQ1:** To what extent are setbacks tolerated by a project’s constituents?

**RQ2:** To what extent can setbacks be absorbed by the environment within which the project is undertaken?

**RQ3:** Is there an interaction between a decision-makers tolerance of project setbacks and the extant conditions evident in the organisational environment?
In order to answer these questions we postulated that project support, escalation and failure are determined primarily through a decision-makers reaction to Zones of Tolerance, the extant set of boundary conditions within which variations from expectations are recognised but carry no significant utility or disutility to the decision-maker. Within a Zone of Tolerance, variations from expectations are considered comparatively small and (importantly) acceptable.

Escalation of commitment dilemmas find their foundations within the extant organisational environment within which a project is undertaken and it was argued that the organisational and structural factors are the undergirding structure upon which the economic, social and moral incentives and disincentives within the organisation are based. These factors can either promote or inhibit escalation and are posited to be of fundamental importance to projects that are (as in reality) situated among a portfolio of differing activities with interdependencies and common constituencies. We made two propositions that were tested in three experimental studies:

Proposition 1: Decision-makers' reactions to variations from expectations associated with a project (overruns, errors, setbacks and other problems) depend upon Zones of Tolerance inherent within the project context.

Proposition 2: It is therefore proposed Zones of Tolerance are constructed through the interplay of organisational and structural factors within the decision context that define the economic, social and moral incentives and disincentives for continuing with projects experiencing setbacks.
Zones of tolerance therefore, are a product of the distance between reference points inherent within the organisational and structural context such as time and cost budgets, explicit strategic directives, the nature of the industry and the qualities of the alternative courses of action available. Rather than tolerance being viewed as inherent to the decision-maker, we surmised that this tolerance is a product of the context of the decision and the proximity of outcomes to these reference points (Figure 7.1).

We examined how the presence of a Zone of Tolerance affects project managers’ willingness to tolerate budget variances (in both cost and time) and project slippage within IS developments. This willingness to tolerate resource expenditures in excess of initial expectations is dependent upon the qualities of the behavioural, environmental and resource constraints imposed within a project setting.
Empirical Demonstration

Experiment 1: Proof of Concept

In the first study, we empirically demonstrated how decision-makers tolerate minor variations from expectations, and how, if these seemingly minor variations are allowed to cascade and compound over time, they create the historically antecedent conditions typical of escalation of commitment episodes. Paradoxically, we found that comparatively low budget overruns (which tend to be tolerated) lead to greater total resource commitments than high budget overruns (which tend to be corrected). In addition, we find that alternatives to the decision to escalate commitment to troubled projects had no significant effect on the said decision, contrary to prior studies (Arkes and Blumer 1985, Conlon and Garland 1993, Shaubroek and Davis 1994, Keil et al. 1995a).

Experiment 2: Extension of Concept – Projects Over Time

In this experiment, we investigated the importance of time to a decision-maker's tolerance. We examined a number of characteristics of a project's performance that may change over time, namely (1) the effects of the stability of budget variances over time; (2) the magnitude of budget variances over time; and (3) the change in risk preference over time. Confirming our conjectures regarding the effects of ZOTs and Time on the treatment of escalating courses of action we found a significant effect of ZOTs and a main significant effect of time on the evaluation of projects and the continuation decisions made by subjects within the decision task. We also found a significant effect of the difference between low-stable and high-stable variances over time, and a significant interaction effect between the stability of budget variances over time.
Confirming our conjectures regarding the effects of ZOTs and Time on the treatment of escalating courses of action, we found a significant effect of ZOTs and a main significant effect of time on the evaluation of projects and the continuation decisions made by subjects within the decision task. This study also shows that losses faced within escalation episodes can engender risk aversion, particularly if decision-makers operate under conditions where escalation is the less risky option when controlling project setbacks. This would appear to indicate that persistence despite costly setbacks causing escalating commitment episodes is more likely when organisational and structural constraints provide high tolerance that would absorb this increased spending.

**Experiment 3: Project Portfolios**

In the final experiment, we hypothesised that ZOTs inhere within the decision context lead to increasingly suboptimal resource allocations between troubled and untroubled projects over time. Applying linear programming, we both theoretically and empirically demonstrated how tolerance for troubled projects draws resources away from well-performing projects within a portfolio. Consistent with our expectations, decision-makers in ZOT conditions permitting absorption of cost increases fail to detect early variations from expectations and failed to correct escalating projects. By contrast, subjects in low ZOT conditions tended to be more aware of increasing costs and generally attempted to correct said variations, leading to better resource allocations overall. However, subjects generally failed to adequately adjust their resource allocation strategies to ensure optimal completion of their projects and can be particularly shown to significantly diverge from optimal allocations when ample tolerance exists within the decision context.
**Contributions to Theory**

Zones of Tolerance were originally postulated as a phenomenon by Lawrence and O'Connor (2005) within forecasting research. We extend the concept of Zones of Tolerance and apply them to a wider organisational context, empirically demonstrating how ZOTs are germane to organisational decision-making writ large. This research programme takes a significant step towards understanding how tolerance of seemingly minor setbacks affects future tendencies to persist with challenged courses of action, and by doing so challenges the conception of the boundary between rational and irrational behaviour. We showed how escalation of commitment, while seemingly irrational, finds its root causes within ostensibly rational (albeit sub-optimal) micro-decisions that cascade and compound into dilemmas that threaten the very survival of strategic courses of action. Using both behavioural decision-making apparatus and by applying linear programming (in Experiment 3), these studies theoretically and empirically demonstrate how tolerance for troubled projects is extended when variations from expectations manifest within Zones of Tolerance. Furthermore, it demonstrates ways in which the structural and organisational constraints on decision-making affect the way in which decisions are made and troubled projects are handled.

The third study, based on Langholtz’s (2004) application of linear programming, makes another conclusion hitherto never discussed within escalation of commitment literature. It theoretically and empirically demonstrates the ways in which troubled projects draw resources away from well-performing projects within a portfolio. It validates a hitherto unapplied method of measuring the extent to which decision-
makers are departing from an objectively optimal decision strategy during escalation of commitment dilemmas.

At the outset of this research we stated that internal validity was of higher priority than claims to external validity and generalisability. To that end we extended escalation of commitment literature through the use of mixed factorial designs (both within- and between-subjects) to give a truer picture of escalation occurring over time. This has been a perennial weakness of extant literature to date. By failing to experimentally validate theoretical escalation phenomena without these designs gives a partial, incomplete of the phenomenon and fails to address face validity within experimental design. Using computer-aided simulations (in Experiments 2 and 3), we overcame the limitations of traditional pencil and paper studies and created decision tasks that were dynamic and more complex than previous research designs. In doing so we opened up possibilities of more detailed and thorough experimental investigation into decision-making and resource allocation behaviour.

**Contributions to Practice**

This research programme demonstrates how organisational contexts affect the micro-decisions made within it. Projects are rarely if ever ad hoc but rather reside within portfolios of related action, and these interdependencies are of crucial importance to maintaining continued management support and funding. We held the micro-decisions of project management practice 'under the microscope' and significant questions are posed about the effectiveness of conventional project management tools and techniques in controlling behavioural tendencies that contribute to sub-optimal resource allocation. It is argued that such practices need to be held to account
against the realities of human judgement and decision-making behaviour, and it is shown through these empirical studies that manipulating Zones of Tolerance have significant effects of human judgement within the organisational context and represent, in some cases, stronger controls against escalation of commitment behaviour than conventional project management techniques.

Of the project management tools currently available to decision-makers in projects there are few if any commonly accepted project management techniques that advocate the imposition of bright line budget limits, of which a breach would represent serious correction or stoppage of the project. Rather, budget overruns are usually dealt with on an ad hoc basis – and decisions to approve resource expenditures in excess of budget expectations depend greatly on the level of tolerance for these overruns expressed either by decision-makers or through the environments in which they operate. The standard project management technique of incorporating resource slack into project plans is evidence of this phenomenon.

**Future Research Directions**

Several interesting avenues of research can be scaffolded upon the theoretical and empirical findings of this research. One of the simpler inquiries that could be conducted would be to investigate the effect of variable ZOTs over time. In other words, one may ask how decision-makers react to changing tolerance and variable ZOTs over time. This may occur, for example, upon changes to senior management or staff during a project's development, or shifting competitive pressures from the external environment.
Project management research is constantly looking for (perhaps non-existent) early warning indicators that signal impending trouble and the potential for failure. One proposed avenue of inquiry would be to discover other early warning signals (beyond that of budget variances) that would indicate that a project is experiencing a *loss of control*\(^\text{14}\). Even when operating *within* ZOTs, are there metrics or indicators that a project manager is losing control over the project? How do project managers react to a perceived loss of control? Do permissive ZOT conditions mask this loss of control and, by extension, do certain ZOT conditions heighten a project managers awareness of control?

Another interesting avenue of inquiry is to incorporate signal detection theory into a theory of tolerance (Swets 1964). Signal detection theory and its related theories (such as statistical detection processing and receiver operating characteristic (ROC) analysis) are used within the management sciences and psychology to discriminate between signal and noise. In this way, we would be able to discriminate between the 'noise' from the inherent ambiguity, variability and imprecision of budget estimations and a 'signal' from more systematic variations from expectations that indicate a project is troubled. In this way, one might be able to develop a model of detecting systematic variability *even while they are occurring within ZOTs* that might not otherwise be picked up by project managers. Furthermore, one might be able to combine a theory of ZOTs into signal detection by using ZOTs to vary the sensitivity with which signals are detected within the project or portfolio.

\(^{14}\) This research programme is already underway with a colleague at Clemson University.
In the opening of the literature review we analogised tolerance thus: you are sitting in a restaurant waiting to meet a blind date who is running late. Unsure of whether she will turn up at all, how long would you wait before your tolerance runs out and you decide to go home? We speculated that if your blind date shows up and the date is worthwhile, then your persistence would be considered rational, indeed rewarded. You only ‘fail’ if you decide to go home. Similarly, a project manager continuing their support for an escalating project may be rewarded if it turns out to be an eventual success and punished if it were eventually abandoned.

Then again, perhaps our tolerance for setbacks will always be driven by the value and substance of the goal we are pursuing. As Holden Caulfield sagely observes in *Catcher in the Rye*,

“If a girl looks swell when she meets you, who gives a damn if she’s late? Nobody.”

(Salinger, 1994, p124-125)
SUMMARY OF RESEARCH PROGRAMME

Summary of Research Programme

Research Objective

We posit a Zone of Tolerance (ZOT) as the extant set of boundary conditions within which variations from expectations are recognized, but carry no significant utility or disutility to the decision-maker.

Overarching Research Questions

1. To what extent are setbacks tolerated by a project’s constituents?
2. To what extent can setbacks be absorbed by the environment within which the project is undertaken?
3. Is there an interaction between a decision-maker’s tolerance of project setbacks and the extant conditions evident in the organisational environment?

Experiment 1 – Proof of Concept

*Proposition 1:* Decision-makers’ reactions to variations from expectations associated with a project (overruns, errors, setbacks and other problems) depend upon Zones of Tolerance inherent within the project context.

H1: There is a main effect of Zones of Tolerance on the willingness of a decision-maker to tolerate escalating commitment to troubled projects.

*Marginally Not Supported (F(2, 409) = 11.375, p = .000, partial eta squared = .053).*

H2: The magnitude of budget variance has a negative effect on the willingness of a decision-maker to tolerate said variances.

*Supported (F(2, 409) = 92.013, p = .000, partial eta squared = .310).*
**Proposition 2:** Zones of Tolerance are constructed through the interplay of organisational and structural factors within the decision context that define the economic, social and moral incentives and disincentives for continuing with projects experiencing setbacks.

**H3:** There is an interaction effect between the magnitude of budget variance and Zones of Tolerance on a decision-maker's willingness to accept said variances.

Supported \( F(4,409) = 2.479, p = .012, \text{ partial eta squared} = .033 \).

**Proposition 3:** The availability of alternatives has a negative effect on the tolerance for variances outside a ZOT.

**H4:** Decision-makers are more likely to escalate commitment to a course of action when there are no alternatives to the investment. Not Supported.

Not Supported \( F(1,409) = 2.695, p = .101, \text{ partial eta squared} = .007 \).

**H5:** There is an interaction effect between alternatives and Zones of Tolerance on a decision to escalate commitment to a course of action. Not Supported.

Not Supported \( F(2,409) = .091, p = .913 \).

**Experiment 2 – Tolerance Over Time**

It is our conjecture that budget variances occurring in later time periods are more likely to be accepted than in earlier time periods.

**H1:** Time has a positive effect on the tendency to escalate troubled projects.

Supported \( F(8,736) = 4.893, p = .000 \).

Non-systematic setbacks that are viewed as temporary or ephemeral by decision-makers may not be corrected by decision-makers, particularly if the costs of not correcting them are immaterial, negligible or zero.

**H2:** Zones of Tolerance have a positive effect on the tendency to escalate troubled projects.

Not Supported \( F(1,92) = 9.467, p = .064 \).

**H3:** Zones of Tolerance have a positive interaction effect with Time on the tendency to escalate troubled projects.

Not Supported \( F(8,736) = .5.329, p = .140 \).
Time may have the effect of inuring project managers to budget variances that persist at stable levels over time. By contrast, budget overruns that frequently change in magnitude over time may be less palatable to the decision-maker, who would be unable to settle on a status quo point of reference for an acceptable threshold of variation.

H4a: Stable budget variances over time are less likely to be corrected than unstable budget variances of the same magnitude.

*Marginally Not Supported* \((F(1, 92) = 0.157, p = .693)\).

H4b: Zones of Tolerance have an interaction effect with the stability of budget variances on the tendency to escalate troubled projects.

*Marginally Not Supported* \((F(1, 92) = 3.801, p = .054)\).

We re-explore the effect of the magnitude of budget variances with the addition of the Time construct:

H5a: Small budget variances are less likely to be corrected than large budget variances.

*Not Supported* \((F(1, 92) = 2.350, p = .129)\).

H5b: Zones of Tolerance have an interaction effect with the magnitude of budget variances on the tendency to escalate troubled projects.

*Not Supported* \((F(1, 92) = .682, p = .411)\).

A decision-maker will weigh their risk preferences against the magnitude of budget variances.

H6: As variances increase as a proportion of a budget, decision-makers are likely to become increasingly risk-seeking.

*Not Supported* (stable variances: \(\chi^2 (1, N = 249) = .265, p > .05\), unstable budget variances: \(\chi^2 (1, N = 238) = .000, p > .05\)).

H7: The size of a Zone of Tolerance has a moderating effect on the effect of Budget Variances on a decision-maker’s attitude to risk. *Not Supported*.

*Not Supported* \((\chi^2 (4, N = 487) = 6.151, p > .05)\).

Note: H7 implied that ZOTs had an interaction effect with ZOTs in its effect on risk preference, yet we found an unexpected main effect of ZOTs on risk-seeking behaviour.
Appendix A – Summary of Research Programme

Experiment 3 – Resource Allocation Behaviour in Troubled Project Portfolios

Research Objective 1
To investigate how budget overruns within one project affect decision-making within an entire project portfolio.

Research Question 1
To what extent do decision-makers efficiently allocate resources between projects when faced with escalating commitment to a project within a portfolio?

H1: Resource allocations will be relatively closer to optimal under conditions of low ZOTs than high ZOTs within project portfolios. That is, there is an independent effect of ZOTs on the efficient allocation of resources to escalating projects.

Supported \( (F(1,30) = 26.166, p = .000) \).

Research Question 2
How do decision-makers react to budget variances in a project that exists within a project portfolio and how adequate are their resource allocation adjustments when faced with setbacks to one or more projects within a portfolio?

H2: Resource allocations will be relatively closer to optimal, under conditions of strict rather than loose resource constraints within project portfolios. That is, there is an independent effect of resource constraints on the efficient allocation of resources to escalating projects.

Not Supported \( (F(1,30) = 2.323, p = .138) \).

H4: Decision-makers will skew their resource allocation behaviours towards escalating projects when budget variances increase over time to one or more projects within a project portfolio.

Supported \( (F(8, 232) = 3.790, p = .000) \).

H6: There is an interaction effect between resource constraints and tolerated budget variances over time within project portfolios.

Not Supported \( (F(8,240) = .316, p = .817) \).
Research Objective 2
How to compare decision-making under ZOTs to a decision-maker's achievement of optimal resource allocations?

Research Question 3
How do Zones of Tolerance affect a decision-maker's ability to adequately adjust resource allocations when faced with setbacks to one or more projects within a portfolio?

H3: There is an interaction effect between Zones of Tolerance and resource constraints within project portfolios in the directions implied by H2 and H3.

Supported \( F(1, 30) = 4.704, p = .038 \).

H5: There is an interaction effect between Zones of Tolerance and tolerated budget variances over time within project portfolios.

Supported \( F(8, 232) = 5.008, p = .000 \).

H6: There is an interaction effect between resource constraints and tolerated budget variances over time within project portfolios.

Supported \( F(8, 240) = .316, p = .817 \).


Bibliography


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Bibliography


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