Explaining Escalation of Commitment in Information Technology Investments

Research-in-Progress

Sarah S. Khan
National University of Science and Technology
School of EE and CS
Sector H-12, Islamabad, Pakistan
sarah.khan@seecs.edu.pk

Moutaz J. Khouja
University of North Carolina Charlotte
Belk College of Business
9201 University City Blvd, Charlotte,
NC 28223, United States
mjkhouja@uncc.edu

Ram L. Kumar
University of North Carolina Charlotte
Belk College of Business
9201 University City Blvd, Charlotte,
NC 28223, United States
rlkumar@uncc.edu

Abstract

Escalation of commitment to a failing course of action has been studied in the IT literature, where IT managers are shown to continue committing resources to bad project instead of terminating them. We make a case that escalation of commitment can be considered as the problem of not exercising an option to abandon a project at the correct (optimal) time. The value of a real option is time sensitive, and it’s realized value depends on the time of its exercise. IT literature suggests that managers may not be rational in their decision-making. We examine the implications of IT managers being bounded rational agents with time-inconsistent preferences, who apply intuitive thinking in managing abandonment option. Through modeling the option exercise decision with decision maker's time inconsistent preferences, we illustrate conditions under which managers with different time preferences might behave in a similar fashion or differently with respect to option exercise.

Keywords: IT Projects, Real Options, Escalation of commitment, Time preferences.

Introduction

Escalation of commitment to a failing course of action has been studied in the IS literature (Keil and Monte, 2000). Several studies on escalation of commitment have tried to provide relatively concrete evidence of the severity of this problem, especially in IT projects. However, it is difficult to have an exact dollar estimate. The extent of this problem may be derived from the IT project failure rates. Standish Group (2013) gives a number of 18% failed and 43% challenged IT projects as of 2012, leaving success rate to only 39%. Further, we see evidence in literature (Keil et al., 2000) that 30% to 40% IT projects show some signs of escalation during their life cycle.

IS managers are shown to continue committing resources to bad project instead of terminating them. Several factors that lead to escalation of commitment have been identified, such as, sunk cost effect, project completion effect, presence and absence of alternate courses of action etc. (Keil et al., 1995).
Escalation of commitment can be considered as the problem of not exercising an option (Dos Santos, 1991) to abandon a project at the correct (optimal) time. The value of a real option is time sensitive, and its realized value depends on the time of its exercise (Dos Santos, 1991; Kumar, 1999). A project is said to have a somewhat flexible abandonment option if it can be exercised at multiple points in time.

One school of thought explains that the presence of flexibility in abandonment option exercise time in projects leads to delay in their exercise (Adner and Levinthal, 2004), hence leading to escalation of commitment. Another school of thought argues that the flexibility in exercise time increases the abandonment option value. When a project has an abandonment option with low exercise time flexibility, managers may use lack option exercise flexibility as an excuse to decide on terminating a project prematurely (Zardkoohi, 2004). These studies discuss project factors highlight the need for improved understanding of the impact of exercise time on abandonment of projects. This research focuses on project abandonment options with flexibility in exercise time in order to better understand how managerial bias (time-inconsistent preference) impact their exercise time and realized value.

We find evidence in IS literature that managers may not be rational in their decision making (Tiwana et al., 2007, Khan et al., 2013). We examine the implications of IT managers being bounded rational agents (Tiwana et al., 2007) with time-inconsistent preferences, who apply intuitive thinking in managing abandonment option. We examine the relationship between managerial bias and time of abandoning IT projects. We focus on option to abandon whose value depends on the option exercise time (Kumar, 1996, 2002) and the realization of option value depends on its optimal exercise. The economics literature suggests that people could have a bias for the present when it comes to realizing some type of utility (Loewenstein and Prelec, 1992), and we argue that this, in turn, could affect IT projects’ abandonment decisions. Specifically, we explore the effects of time-inconsistent preferences on IT option to abandon exercise time and realized value in this study.

The following section discusses relevant literature. Subsequently, a model of time-inconsistent preferences in the context of an option to abandon projects with two exercise periods is presented. Conclusions and future research directions follow this.

**Literature Review**

**Time-Inconsistent Preferences**

The term Time-inconsistent preference refers to the preference for immediate utility over delayed utility (Fredrick et al., 2002). Experimental studies suggest that people have time-inconsistent preferences (Loewenstein and Prelec, 1992). For example, when two rewards are far away in time, people act relatively patiently (e.g., they prefer two apples in 101 days, rather than one apple in 100 days). However, when both rewards are brought forward in time, they act more impatiently (e.g., they prefer one apple today, rather than two apples tomorrow). Hence these individuals weight earlier reward higher as it gets closer. These time-inconsistent preferences are also known as “present-biased” preferences and represented via a simple utility model (O’Donoghue and Rabin, 1999):

\[ U^t (u_t, u_{t+1},..., u_T) \equiv \delta^t u_t + \beta \sum_{t=t+1}^T \delta^t u_t \]

In the model, \( u_t \) is the instantaneous utility that an individual receives at period \( t \), and the utility function \( U^t \) represents his intertemporal preferences at time \( t \). The parameter \( \delta \) is a simple discount rate for future utilities, and \( \beta = (0,1] \) is a self-control parameter that represents an individual’s time inconsistency in preferences. For \( \beta =1 \), these preferences are time-consistent; but for \( \beta < 1 \) the individual has a bias for present utility over the future.

We consider the individual at each decision time period as an agent who maximizes utility with regards to his current preferences while his “future selves” will determine future behavior according to the preferences that prevail at that time (O’Donoghue and Rabin, 1999). Therefore, a person’s belief about his future selves’ preferences becomes important, because evaluating future preferences differently does not mean that person has a bias for present. It is the self-awareness of time-inconsistent preferences that is
Explaining Escalation of Commitment in Information Technology Investments

important. An individual who is aware of his time inconsistency will anticipate future choices and choose accordingly (Caillaud and Jullien, 2000), as compared to an individual who lacks such awareness. There are four types of assumptions about individuals’ self-awareness, based on their actual self-control parameter $\beta$, and their perceptions about their future self-control parameter $\hat{\beta}$ (O'Donahugh and Rabin, 2001). If the person believes that in the future he will encounter self-control problem, i.e. $\hat{\beta} < 1$, he will choose his current behavior to maximize his current preferences (determined by his true self-control parameter $\beta$). With this formulation, people with standard time-consistent (TC) preferences (do not have a bias for present and are fully aware of it) have $\beta = \hat{\beta} = 1$, sophisticates (have a bias for present and are aware of it) have $\beta = \hat{\beta} < 1$, naïves (have a bias for present but believe otherwise) have $\beta < \hat{\beta} = 1$, and partial naïves (have a bias for present and are partially aware of it) have $\beta < \hat{\beta} < 1$. In this study, we consider two cases of self-awareness of managers i.e. TC and naïve. We examine the effects of the actual self-control parameter $\beta$ of the manager on the abandonment option exercise decision. TC with their actual self-control parameter $\beta$ and their perceptions about future self-control parameter $\hat{\beta}$ both equal to 1 will provide one extreme case with no bias for present and as a benchmark for comparison. Naïves with their actual self-control parameter $\beta$ less than 1 (showing bias for present) but their perceptions about future self-control parameter $\hat{\beta}$ equal to 1 showing their complete unawareness about their actual biased preferences will provide the other extreme case to capture the effects of present bias on abandonment option exercise decisions.

In the IT real options framework, it is assumed that managers exercise real options on time. However, this may not be true in practice. Suppose a manager initially plans to exercise an option to abandon project at a specific future time based on pre-determined criteria. Theoretically, the option exercise decision will be made at the pre-determined time if the criteria are met. However, cases of IS projects where exercising the option to abandon was difficult have been reported in the literature. It included Denver’s International Airport baggage system (Keil and Montealegre, 2000) and London’s Taurus stock exchange project (Drummond, 1996). In these cases, the size and scale of the project have been shown to play a major role in the difficulty in exercising option to abandon along with other factors like managers’ reputation, the political ramifications of abandoning, and the possible effect of abandonment on staff morale (Keil et al., 2000). We argue that such actions of IT managers can possibly be attributed to their time inconsistent preferences, and can be explained by varying self-control parameter.

Valuing Option to Abandon

We assume a simple IT project scenario, with some startup cost, and recurring operational costs. The benefits from the project can only be realized once the entire initial estimated costs are incurred. To value option to abandon, we use a binomial option valuation method (Cox et al., 1979) due to its simplicity, its requirements for estimating relatively few parameters, easy application to a single real option case, and its previous use in MIS research (Kambil et al., 1993; Benaroch, 2002; Dai et al., 2007).

The binomial option valuation method assumes that the underlying asset value follows a binomial multiplicative diffusion process. For a project with one period to exercise the option, starting at time $t=1$, the future payoffs value from the project may rise by factor $u$ with probability $p$ or fall by factor $d$ with probability $1-p$, by the exercise decision time $t_t = t_1 + \Delta t$. Hence, at the option exercise decision time in $t_t$, the expected value of the option payoffs will have only two possible variations. The value of the real option, $V$, is calculated via backward induction by:

$$V = p \max[0, s-u\pi] + (1-p) \max[0, s-d\pi]$$

for $n=1---------(eq.1)$

$u = e^{\sigma \sqrt{\Delta t}}, d=1/u$ (expected upward/downward movement in future benefits), $d < r < u$; $r =$ risk free rate; $T =$ project life (option expiration time); $\sigma =$ uncertainty around future payoffs; $p=(r-d)/(u-d)$, subjective probability of the event; $\pi =$ present value of the future benefits from the ongoing project (both tangible such as cost savings, and intangible such as organizational learning), and; $s=$ salvage value of the project (may include present value of the implementation/ operating costs of the project, benefits from switching
use of the invested resources, benefits from the partial implementation of the project, and selling of the equipment).

For an abandonment option with \( n \) periods until maturity, the option value depends on the same parameters, but is more complex. As long as the option value is greater than zero, the project value with an option to abandon will be greater than the project value without an option to abandon. Also, since the real option value is proportional to the underlying uncertainty around future benefits, the value of a project with uncertainty will be higher once the embedded real option is taken into account. Hence, the project value with an option to abandon will be greater than the project value without an option to abandon, when \( \sigma > 0 \). For simplicity, we assume \( \Delta t = T/n = 1 \).

**Conceptualizing Salvage Value**

In IT projects, the salvage value varies in terms of amount, certainty and time of realization. Some projects that result in marketable products could have tangible salvage value. Other projects, such as a customized billing system may not have a substantial or certain salvage value. The salvage value may also be a function of time, and may increase (the market for a product may develop), or decrease (due to technological changes), or stay constant as a project progresses. In general, the salvage value of the project as well as the uncertainty around the salvage value play an important role in determining the value at the option exercise time. The amount of uncertainty around the salvage value would depend on the project. The option exercise decision for a naïve manager will be depend on the uncertainty associated with salvage value of the project. To account for the dependency of salvage value on time, we assume salvage value “\( s \)” as a function of time and certainty:

\[
s_t = \alpha + \varphi(t - 1) + \varepsilon \quad \text{(eq. 2)}
\]

\( s_t \) = salvage value of the project in period \( t \); \( \alpha \) = base/initial salvage value of the project; \( \varphi \) = rate of change in salvage value. For \( \varphi = 0 \), salvage value of the project is constant over time. For \( \varphi < 0 \), salvage value of the project decreases over time. For \( \varphi > 0 \), salvage value of the project increases over time; \( t \) = time period at which salvage value is calculated. We consider \( t=1 \) as the commitment stage, and option cannot be exercised at the commitment stage. Hence salvage value at \( t=1 \) is not applicable and first salvage value is calculated at \( t=2 \); \( \varepsilon \) = a random variable with expected value of zero and known distribution, to account for salvage value certainty.

For simplicity we consider an IT project with *deterministic* salvage value, i.e., \( \varepsilon = 0 \). Further, we first analyze the constant salvage value case (\( \varphi = 0 \)), and then analyze the case of decreasing salvage value over time (\( \varphi < 0 \)). We further make the following assumptions:

- The salvage value (\( s \)) from exercising the option exceeds the exercise cost (\( d\pi \)), i.e. \( s > d\pi \) at \( t=2 \). This assumption will ensure that the option is deep in the money at \( t=2 \), and \( ud\pi > s > d^2\pi \) at \( t=3 \).
- \( u \) is greater than the risk free rate \( r \) and \( d \) is less than risk free rate \( r \), i.e. \( d<r<u \).
- Risk free rate, future payoffs, option exercise cost, and uncertainty around future payoffs are given and constant.

**Time Preferences and Option to Abandon Project**

The literature on time-preferences studies different cases based on the time orientation of costs (\( c \)) and benefits (\( \pi \)) (Brocas and Carrillo, 2001). The two cases studied the most are:

- **a)** *Immediate cost, future rewards case*, with intertemporal utility of \( \beta\pi - c \).
- **b)** *Immediate rewards, future cost case*, with intertemporal utility of \( \pi - \beta c \).

An option to abandon can be classified as either of the above cases, based on the characteristics of the salvage value. At a given exercise decision time \( t \), an IT manager has to evaluate the decision based on the benefits from exercising the option i.e. the salvage value of the project “\( s \)”, and the cost involved in
realizing the benefits i.e. given up future benefits from continuing the project “π”. We assume the constant salvage value case with \( q = 0 \) belongs to the immediate reward and future cost case. The salvage value is realized immediately by selling the project or its resources, in return for giving up the project and its future payoffs. Hence the salvage value of the project is the immediate reward and the project’s future payoffs are the future costs.

Typically there is more than one opportunity to exercise an option. We depict this real option exercise decision for two points in time in Figure 1, where IT manager decides after evaluating his/her utility at each stage. Figure 1 describes the necessary parameters that determine the utility from exercising an option to abandon.

![Figure 1: Timeline for a real abandonment option with two time periods until expiration](image)

At the commitment stage, \( t=1 \), both TC and naïve will commit to the project as long as project value is positive. Once committed to the project with option to abandon, the exercise decision will be based on how the project performs over time. For an option to abandon the project with expiration time of two periods \( (T=3) \), the manager has to decide at \( t=2 \) whether to exercise the option today or wait until maturity \( t=T=3 \).

Real abandonment options often do not have a fixed exercise time, and can be exercised any time before expiration. Decisions to terminate a poorly performing project can and must be made any time until a cutoff date. Therefore, viewing an option to abandon as an American put option helps in capturing the option exercise flexibility. A key property of an American put option is that, for an option with \( n \) periods, it might be optimal to exercise it any time before expiration, as long as the option is sufficiently deep in the money (Cox et al., 1979, Hull, 2008). For example, for a project performing poorer than the targeted performance at \( t=2 \), it might be better to terminate it and realize the salvage value. We utilize this property and assume that an option to abandon is an American style put option, that is sufficiently deep in the money at \( t=2 \), with salvage value greater than future payoffs if the project performed bad. This makes it optimal to exercise the option before the expiration date i.e. \( t^*=2 \) for a two period option (i.e. \( n=2 \)). The real option value at the project commitment stage to be exercised at \( t=2 \) is:

\[
V_{1,2} = \frac{(1-p)Max[0,s-dπ]+pMax[0,s-πu]}{r} \quad \text{(eq. 3)}
\]

And the real option value at the project commitment stage to be exercised at \( t=3 \) is:

\[
V_{1,3} = \frac{(1-p)^2Max[0,s-d^2π]+2p(1-p)Max[0,(s-βudπ)]p^2Max[0,(s-u^2π)]}{r^2} \quad \text{(eq. 4)}
\]

As long as \( r \) is positive, \( V_{i,j} \) \( (i \) is the option commitment time; \( j \) is the option exercise time) will always be positive for any \( t \), if \( s > d^2π \).

Bias for present comes into play when the rewards come near in the future (O’Donoghue and Rabin, 1999, Caillaud and Jullien, 2000, Della Vinga and Malmendier, 2004) and both types of managers will value this risky project and abandonment option equally.

**Lemma:** IT managers (both TC and naïve) will place the same value on an IT project with option to abandon with two time periods to expiration.

The lemma will hold if the option to abandon has more than one exercise time period.

---

Further details on model setup are available from the authors.
With \( \varphi = 0 \), salvage value “\( s_t \)” of the project at any time would be a constant “\( \alpha \)” according to equation 2. This assumption implies that the salvage value of the project will not change overtime, and it can be realized as soon as the project is terminated. As \( s_t = \alpha \), we dropped the subscript from \( s_t \). At the first decision point \( t=2 \), when the project does not perform well, the manager can exercise the option and realize salvage value by giving up future benefits from the project, or wait until \( t=3 \). The decision problem at \( t=2 \) for a manager will be:

\[
\text{Max} \ (V_{2,2}, V_{2,3}) \quad \text{----(eq.5)}
\]

where:

\[
V_{2,2} = \left( (1 - p)(s - d\pi) \right) \quad \text{----(eq.6)}
\]

and

\[
V_{2,3} = \frac{(1-p)^2 \text{Max}[0, \beta(s-d^2\pi) + p(1-p)\text{Max}[0, \beta(s-ud\pi)]]}{r} \quad \text{----(eq.7)}
\]

In equation (7), the term \((s - \beta ud\pi)\) will be negative, because \( ud\pi = \pi \) and \( s < \pi \). This condition implies that if the project recovers in \( t=3 \), it is worth continuing it. With the salvage value of the project at \( t=2 \) less than or equal to its average performance i.e., \( s \leq ud\pi \), the term \( \text{Max}[0, \beta(s-ud\pi)] \) will be zero for all values of \( \beta \). This will reduce equation (7) to:

\[
V_{2,3} = \frac{(1-p)^2 \text{Max}[0, \beta(s-d^2\pi)]}{r} \quad \text{(eq. 8)}
\]

An IT manager’s decision problem at \( t=2 \) is based on the output of the decision function \( \text{Max} \ (V_{2,2}, V_{2,3}) \). If the project is deep in the money at \( t=2 \), this will render \( V_{2,3} \) to equation (8). With \( V_{2,2} > V_{2,3} \), the decision problem by plugging in the values for \( V_{2,2} \) and \( V_{2,3} \) will look like:

\[
\left( (1 - p)(s - d\pi) \right) > \frac{(1-p)^2 \text{Max}[0, \beta(s-d^2\pi)]}{r} \quad \text{or} \quad \left( (s - d\pi) \right) > \frac{(1-p)\text{Max}[0, \beta(s-d^2\pi)]}{r} \quad \text{(eq. 9)}
\]

The condition in equation (8) will hold for any value of \( \beta \). This outcome indicates that if the IT project is deep in the money at \( t=2 \), managers will always exercise the abandonment option immediately to realize the salvage value. In this case, the present biased preferences of the managers do not impact their decision.

**Proposition 1:** The IT manager will exercise the abandonment option at \( t=2 \), irrespective of their time preferences, as long as the salvage value of a project is immediate and non-increasing.

With immediate salvage value, the manager will only wait until \( t=3 \) to exercise the option to abandon if the salvage value is increasing overtime, or if \( \varphi > 0 \). This will result in \( s_2 < s_3 \). Some value of \( \varphi \) will result in \( V_{2,2} < V_{2,3} \), indicating that higher option value can be realized if the abandonment option is exercised in \( t=3 \). Increasing salvage value over time will make the decision condition as:

\[
\left( (s_2 - d\pi) \right) < \frac{(1-p)\text{Max}[0, \beta(s_3-d^2\pi)]}{r} \quad \text{or} \quad \left( (\alpha + \varphi) - d\pi \right) < \frac{(1-p)\text{Max}[0, \beta((\alpha + 2\varphi)-d^2\pi)]}{r} \quad \text{(eq. 10)}
\]

Given the condition in equation (10), a TC manager with \( \beta = 1 \), will always wait to terminate the project. Interestingly, in this case, the naïve manager might terminate the project prematurely, because on one hand, increase in \( \varphi \) will result in \( V_{2,2} < V_{2,3} \). And at the same time, a lower \( \beta \) of a naïve manager would discount the net salvage value for \( t=3 \). Under these circumstances, there will be a critical beta (\( \beta^* \)), which will discount the net salvage value enough such that \( V_{2,2} = V_{2,3} \). We have not yet considered the case when the salvage value could increase over time (for example, due to implementation of key modules of a software that allow it to be salvaged at a higher price).

**Deterministic and Decreasing Salvage Value in Time**

As an IT project progresses, it becomes more customized. With increasing customization, the project’s ability to be put to another use decreases and switching costs increase as well. We account for this
property in equation (2) with \( \phi < 0 \), which will result in \( s_t > s_{t+1} \). This will change our original assumption as follows:

- Salvage value “\( s_t \)” is decreasing over time due to \( \phi < 0 \) in \( s_t = \alpha + \phi t \). This will result in \( s_2 > s_3 \).
- Salvage value \( (s) \) from exercising the option at \( t=2 \) exceed the exercise cost \( (d\pi) \), i.e. \( s_2 > d\pi \). This assumption will ensure that the option at \( t=2 \) is deep in the money, and at \( t=3, s_3 > d^2\pi \).
- Salvage value \( s_3 \leq d\pi \). This implies that if the project performed on average at \( t=3 \), after recovering for a bad performance in \( t=2 \), it is better to continue it instead of terminating it. We use this assumption because due to high uncertainty and qualitative goals in terms of project payoffs for most IT projects, it is more realistic to continue an average performing project after investing in it than terminating it.

At the first decision point \( t=2 \), when the project does not perform well, the manager can exercise the option and realize salvage value \( s_2 \) by giving up future benefits from the project, or wait until \( t=3 \) to realize \( s_3 \) by abandoning the project. As described before, switch-use case is an immediate cost and future payoff case. With switching use of project as a source of a salvage value, it usually takes at least one period to materialize it, hence making the orientation of the salvage value towards future and making \( s_3 \) subject to discounting. The decision problem at \( t=2 \) for a naïve manager will be similar to equation (5): \( \text{Max}(V_{2,2}, V_{2,3}) \)

where:

\[
V_{2,2} = (1-p)(\beta s_2 - d\pi) = ((1-p)(\beta(\alpha + \phi) - d\pi)) \quad \text{(eq. 11)}
\]

and

\[
V_{2,3} = \frac{p(1-p)\text{Max}[0, \beta(s_3 - d\pi)] + (1-p)^2\text{Max}[0, \beta(s_3 - d^2\pi)]}{r} = \frac{p(1-p)\text{Max}[0, \beta((\alpha + 2\phi) - d\pi)] + (1-p)^2\text{Max}[0, \beta((\alpha + 2\phi) - d^2\pi)]}{r} \quad \text{(eq. 12)}
\]

In equation (11), the value from switching the project’s use, if exercised at \( t=2 \), will be discounted due to its future orientation. In equation (12), the value from switching the project’s use, if exercised at \( t=3 \), will be discounted for the same reason, along with payoffs from continuing the project.

In equation (11), with the assumption \( s_2 > d\pi \), the term \( (\beta s_2 - d\pi) \) will be either positive or negative, depending on the value of \( \beta \). For \( \beta > 1 \), the condition \( \beta s_2 > d\pi \) will hold on the discounted salvage value. For \( \beta > 0 \), the term \( (\beta s_2 - d\pi) \) will become negative. So for some value of \( \beta \), the term \( (\beta s_2 - d\pi) \) will become negative, hence making \( V_{2,2} \) negative.

In equation (12), with the assumption \( d\pi \geq s_3 > d^2\pi \), the term \( \text{Max}[0, \beta(s_3 - d\pi)] \) will be zero for \( \alpha \leq \beta \leq 1 \). So we take it out of the equation (12), making it look like as follows:

\[
V_{2,3} = \frac{(1-p)^2\text{Max}[0, \beta(s_3 - d^2\pi)]}{r} = \frac{(1-p)^2\text{Max}[0, \beta((\alpha + 2\phi) - d^2\pi)]}{r} \quad \text{(eq. 13)}
\]

In equation (13), the term \( \text{Max}[0, \beta(s_3 - d^2\pi)] \) will be positive for any value of \( \beta \). This will make \( V_{2,3} \) positive for any value of \( \beta \).

A TC manager with \( \beta = 1 \), will evaluate the decision function \( \text{Max} \ (V_{2,2}, V_{2,3}) \), and will decide based on the output. The assumptions discussed above will result in:

- Positive \( V_{2,2} \), because the condition \( \beta s_2 > d\pi \) will hold on the discounted salvage value in equation (11).
- Positive \( V_{2,3} \), because the term \( \text{Max}[0, \beta(s_3 - d^2\pi)] \) in will be positive for any value of \( \beta \) in equation (12).
- \( V_{2,2} > V_{2,3} \), because of \( s_2 > d\pi, \phi < 0 \), and \( d < r < u \).
The difference between $V_{2,2}$ and $V_{2,3}$ will be the cost of waiting and will be:

$$V_{2,3} - V_{2,2} = -\frac{e^{\sigma}(e^{\sigma}-r)(\pi-\pi e^{\sigma}r-r(s+\varphi)+e^{\sigma}r(s+2\varphi)+e^{2\sigma}((-1+r)s+(-2+r)\varphi))}{(1+e^{2\sigma})^2 r}$$  \hspace{1cm} (14)

Based on equation (14), the decision of a TC manager would be to terminate the project at $t=2$.

A naïve manager with $\beta < 1$, will exhibit present-bias for project future payoffs, and salvage values at different time periods. As for some value of $\beta < 1$, the term $(\beta s - d\pi)$ in equation (11) will become negative, it will make $V_{2,2}$ negative as a result. A negative $V_{2,2}$ implies that it will seem less attractive to IT manager to terminate the project at $t=2$. As $V_{2,3}$ is positive for any value of $\beta$, a naïve manager will see $V_{2,2}=V_{2,3}$ for a specific value of $\beta$ leading him to delay the termination decision. We call this value of $\beta$, critical $\beta$ ($\beta^*$).

**Proposition 2:** There is a $\beta^* = \frac{\pi(-1+e^{2\sigma})r}{\pi r+e^{2\sigma}(s+\varphi)+e^{3\sigma}((-1+r)s+(-2+r)\varphi)+e^{\sigma}(\pi-r(s+\varphi))}$, such that for IT projects with abandonment option with two exercise periods and decreasing salvage value:

If $\beta \leq \beta^*$, the manager will not exercise the option optimally in period 2.

If $\beta > \beta^*$, the manager will exercise the option optimally in period 2.

As Proposition 2 shows, $\beta^*$ is a function of $\pi$, $s$, $r$, $\varphi$, and $\sigma$. A naïve IT manager with a self-control parameter less than or equal to $\beta^*$ will delay exercising the abandonment option at $t=3$ and realize the salvage value later than not waiting until $t=3$ to exercise the option and realize its optimal value.

**Conclusion**

This research seeks to improve understanding of the phenomenon of escalation of commitment in the context of managing IT projects. We contribute to the extant literature on IT project management and real options as well as the literature on escalation of commitment, by integrating these streams of research with the economics literature on time-inconsistent preferences. Our analytical modeling seeks to illustrate how time-inconsistent preferences could affect option exercise. Prior IS research on real options (Benaroch, 2002) has emphasized how managers could recognize abandonment options in managing projects. It is not enough for managers to recognize option to abandon in a project and intuitively evaluate their value, but they need to be aware of their time-preferences, and understand that this could affect option exercise. To better manage IT projects, it is important to make optimal exercise decisions for the option to abandon embedded in them. By optimally exercising the option to abandon, the project value can be salvaged in the form of savings on the project, knowledge building, or by putting the resources to another use. We show that there is a chance of suboptimal exercise decisions motivated by a manager’s desire to delay realizing the costs associated with project abandonment. This suboptimal exercise may even lead to the whole project being unsuccessful, over time and over budget. In occurrences like Denver’s International Airport baggage system and London’s Taurus stock exchange project, the size of the project, managers’ reputation, the political and human resource ramifications of abandoning (Keil et al., 2000), could accentuate present-bias of IT managers in terminating these projects.

Furthermore, organizations may design incentives based on a fraction of project value, instead of on project completion, to align managerial actions with project performance and mitigate such effects (Khan et al., 2013). For example, rewards should be set based on periodic project performance, to encourage bold yet necessary decisions like abandoning projects that have lost value, on time. The propositions presented above illustrate conditions under which managers with different time preferences might behave in a similar fashion or differently with respect to option exercise. Other conditions in which option exercise behavior differs depending on time preferences are being explored, e.g. project characteristics like “salvage value” might play a significant role in predicting the escalation of commitment among managers with time inconsistent preferences. The work is in its initial stages, and we intend to extend it further by conducting a static analysis of derivatives of how $\beta$ behaves with respect to other parameters.
Explaining Escalation of Commitment in Information Technology Investments

References


