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RESEARCH ARTICLE

A CROSS-CULTURAL STUDY ON ESCALATION OF COMMITMENT BEHAVIOR IN SOFTWARE PROJECTS[1]

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Abstract

One of the most challenging decisions that a manager must confront is whether to continue or abandon a troubled project. Published studies suggest that failing software projects are often allowed to continue for too long before appropriate management action is taken to discontinue or redirect the efforts. The level of sunk cost associated with such projects has been offered as one explanation for this escalation of commitment behavior. What prior studies fail to consider is how concepts from risk-taking theory (such as risk propensity and risk perception) affect decision makers' willingness to continue a project under

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conditions of sunk cost. To better understand factors that may cause decision makers to continue such projects, this study examines the level of sunk cost together with the risk propensity and risk perception of decision makers. These factors are assessed for cross-cultural robustness using matching laboratory experiments carried out in three cultures (Finland, the Netherlands, and Singapore).

With a wider set of explanatory factors than prior studies, we could account for a higher amount of variance in decision makers' willingness to continue a project. The level of sunk cost and the risk perception of decision makers contributed significantly to their willingness to continue a project. Moreover, the risk propensity of decision makers was inversely related to risk perception. This inverse relationship was significantly stronger in Singapore (a low uncertainty avoidance culture) than in Finland and the Netherlands (high uncertainty avoidance cultures). These results reveal that some factors behind decision makers' willingness to continue a project are consistent across cultures while others may be culture-sensitive. Implications of these results for further research and practice are discussed.

Keywords: Software project management, escalation of commitment behavior, sunk cost, risk propensity, risk perception, uncertainty avoidance

ISRL Categories: EE, EE01, EE0101, EE06, EL0202

Introduction

One of the most challenging decisions confronting managers around the world is whether to continue funding a project when its prospects for success are questionable. Every day, managers have to make such decisions on projects that vary tremendously in type and size. Very often, the amount of money already spent on a project (level of sunk cost), along with other factors, can bias managers toward continuing to fund the project. In many instances, this results in "escalation of commitment" behavior[2] (Brockner 1992) in which failing projects are permitted to continue and good money is thrown after bad (Garland 1990).[3] In recent years, researchers have drawn upon escalation of commitment literature to understand why software projects are often continued for so long before appropriate corrective action is taken to abandon or redirect them (e.g., Drummond 1996; Keil 1995; Keil, et al. 1995a; Newman and Sabherwal 1996).

While escalation of commitment behavior is a general phenomenon that can occur with any type of project, software projects may be very susceptible to this problem. When a software project is underway, the intangible nature of its products (Abdel-Hamid and Madnick 1991) makes it difficult to obtain accurate estimates of the proportion of work completed. This difficulty manifests itself in the "90% complete syndrome,"[4] which may promote escalation of commitment behavior by giving a false perception that successful project completion is near. Besides the difficulty of measuring progress, software projects also tend to have volatile requirements (Abdel-Hamid and Madnick 1991; Zmud 1980) that cause project scope to change frequently. Projects that are subjected to such volatility are more difficult to manage and control. The mismanagement of software projects can lead to situations in which projects continue to absorb resources without ever delivering the intended benefits (Keil 1995). To alleviate such wasteful practices, managers need

[2]This behavior does not necessarily imply an increasing rate of investment over time. Rather, it refers to a growth in cumulative investments over time.

[3]Throwing good money after bad (often called "the sunk cost effect") represents one of several theoretical perspectives that explain why escalation of commitment behavior occurs (for good reviews, see Brockner 1992; Staw 1997; Staw and Ross 1987). This paper adopts a sunk cost perspective on escalation of commitment behavior. Many studies have yielded evidence supporting escalation of commitment behavior but a few studies have raised doubts about the reproducibility of this phenomenon (e.g., Armstrong 1996).

[4]This syndrome refers to the tendency for estimates of work completed to increase steadily until a plateau of 90% is reached. Software projects tend to be "90% complete" for half the entire duration (Brooks 1975).

to know more about factors that influence their willingness to continue a project so that they can minimize unnecessary expenditures and cut their losses when appropriate. Prior research has shown that sunk cost is one such factor (Garland 1990).

This paper has two objectives. First, it introduces and tests a richer theoretical model than has been examined previously in order to better explain decision makers' willingness to continue a software project. While previous studies have documented the sunk cost effect, there has been no attempt to develop a theoretical model that incorporates this effect within the broader context of decision making under conditions of risk and uncertainty. The proposed model extends existing models of escalation of commitment behavior by incorporating concepts from risk-taking theory. Besides level of sunk cost, a commonly-tested *situational factor*, this model includes risk propensity and risk perception, two *individual factors* from risk-taking theory, which may affect decision makers' willingness to continue a project (Singer and Singer 1986; Sitkin and Pablo 1992).

Second, this paper attempts to shed light on how cross-cultural differences may affect decision makers' willingness to continue a software project. Prior research has suggested that the sunk cost effect does vary across cultures but the reasons behind such variations are not clear (Keil et al. 1995a). Since risk propensity and risk perception are related to uncertainty avoidance, a cultural factor that distinguishes people from different cultures in terms of their risk-taking tendency (Hofstede 1991), the proposed model is tested with subjects from different cultures to identify cross-cultural variations.

Prior Literature on Sunk Cost Effect

Contemporary financial theory recommends that level of sunk cost should not be considered when deciding whether to continue or abandon a project (Bonini 1977; Howe and McCabe 1983). However, a review of the empirical literature (see Table 1) revealed that decision makers find it difficult to ignore the level of sunk cost when making such decisions. Besides showing that the sunk cost effect may be a critical factor contributing to escalation of commitment in software projects (e.g., Keil et al. 1995b; Mann 1996), this review revealed that the sunk cost effect may vary across cultures (e.g., Chow et al. 1997; Keil et al. 1995a; Sharp and Salter 1997).

Limitations of Previous Sunk Cost Studies

In reviewing the empirical literature on the sunk cost effect, two obvious limitations become apparent. First, previous studies have lacked an underlying theoretical model that can help to explain the sunk cost effect. Aside from vague references to prospect theory, there has apparently been no attempt to develop a robust theoretical model of the sunk cost effect.[5] Instead, prior studies have manipulated the level of sunk cost, usually as the sole independent variable, to assess its impact on decision makers' willingness to continue a project, the dependent variable. Such an approach has yielded simple models that do not incorporate intervening variables and cannot be analyzed using multivariate approaches. Perhaps as a result of this, the amount of variance explained in the dependent variable has been low. For example, Garland's (1990) analysis of variance model could only account for 8.5% of the variance in the dependent variable. Similarly, Keil et al. (1995a) could explain less than 14% of the variance in the dependent variable. To gain a better understanding of the sunk cost effect, a stronger theoretical model that can account for more of the variance in decision makers' willingness to continue a project is needed. This study integrates the sunk cost literature with the risk-taking literature to develop and test a theoretical model.

[5]Prospect theory posits that the framing of decision situations affects decision-making behavior and that gains and losses are evaluated with respect to some decision frame. People tend to be more risk-seeking if the decision situation is framed as a choice among loss scenarios (Kahneman and Tversky 1979; Tversky and Kahneman 1981), which is always the case for studies on the sunk cost effect.

Table 1. Empirical Research on Sunk Cost Effect

Study	Key findings
Arkes and Blumer (1985)	Level of sunk cost can influence people across a wide variety of decision contexts.
Northcraft and Neale (1986)	People fail to consider opportunity costs and frame their decisions as a choice between losses. Making opportunity costs explicit can alter framing of decisions and reduce sunk cost effect.
Garland (1990)	There is a linear sunk cost effect based on budget already invested. Higher percentages of sunk cost can lead to greater willingness to continue with a course of action.
Garland et al. (1990)	De-escalation of commitment can occur when sunk costs are positively correlated with unambiguous negative feedback.
Garland and Newport (1991)	Absolute sunk cost is actual dollar amount already expended. Relative sunk cost is percentage of total budget already spent. Relative rather than absolute sunk cost affects people's likelihood to commit additional funds to some action.
Simonson and Nye (1992)	Accountability can alleviate susceptibility to decision errors and reduce the sunk cost effect.
Conlon and Garland (1993)	People's willingness to continue a project are driven by level of project completion rather than level of sunk cost per se.
Heath (1995)	People are likely to escalate commitment when they fail to set a budget or when expenses are difficult to track.
Keil et al. (1995a)	Sunk cost effect can be reduced if people have an alternative project for which they can spend their money. Finnish subjects have a smaller tendency to escalate their commitment at high levels of sunk cost compared to U.S. subjects.
Keil et al. (1995b)	People are more apt to justify their decisions to continue a project based on level of sunk cost rather than level of completion.
Staw and Hoang (1995)	Amount of money spent to acquire NBA players influences how much playing time players get and how long players stay with NBA franchises, controlling for players' on-court performance.
Mann (1996)	Information systems auditors report that level of sunk cost was used as a justification for continuing in about 45% to 50% of software projects that escalate.
Chow et al. (1997)	Chinese subjects have a greater tendency to escalate their commitment on projects than U.S. subjects. Chinese subjects may be more concerned about saving face, due to their culture, and so more committed to their earlier decisions. Alternatively, Chinese subjects may be simply more willing to take risk.
Sharp and Salter (1997)	Asian managers are more risky than North American managers when making decisions involving potential long-term benefits for the firm, but Asian managers are less risky than North American managers when making decisions involving short-term financial gains. Asian managers may have a longer-term orientation than North American managers when making decisions.

Second, there have been few attempts to explore cross-cultural variations of the sunk cost effect. The few studies that have been carried out suggest that there may be cross-cultural differences in terms of decision makers' willingness to continue a project. Although various retrospective explanations have been offered for these findings, it is not possible to draw any firm conclusions because of the lack of a theoretical model that can account for such cross-cultural differences. In other words, it is not known whether the observed effects were actually due to cross-cultural differences, and if so, how these differences actually led to the observed results. Using a theoretical model with culturally-sensitive constructs from risk-taking theory, this study seeks to better understand how culture moderates decision makers' willingness to continue a project.

Theoretical Model and Hypotheses

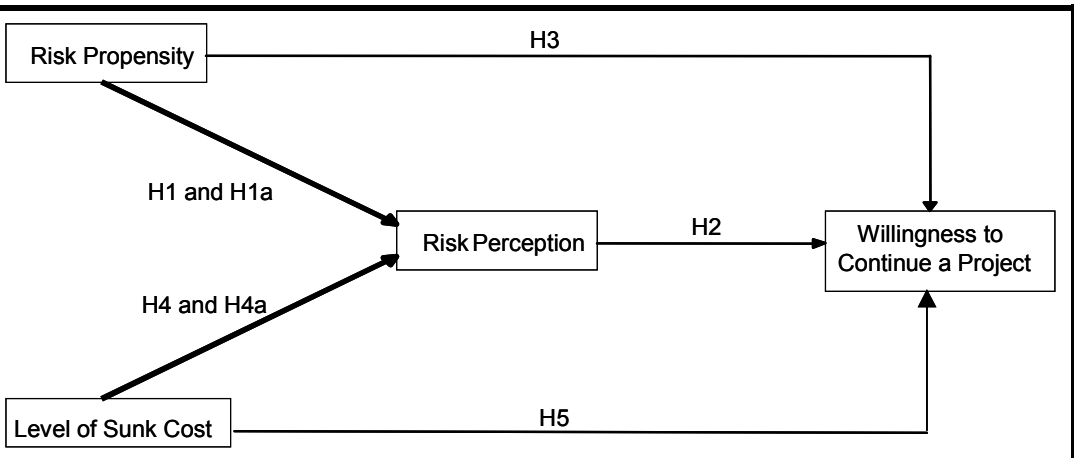
To build a theoretical model that can explain more of the variance in decision makers' willingness to continue a project, additional factors that potentially contribute to this behavior must be considered and incorporated. Such factors have been discussed in risk-taking theory, which posits that risk taking has positive and negative consequences (Arrow 1965). Although Charette (1989) defines software risk along risk-theoretic lines, the software risk management literature has largely focused on negative outcomes (Barki et al. 1993; Lyytinen et al. 1998). This is because continuing a software project involves uncertainty arising from inaccurate estimation of project progress and volatile project requirements (Abdel-Hamid and Madnick 1991). The greater uncertainty associated with continuing, rather than terminating, a software project is a risk that often leads to negative outcomes. Consistent with this focus, risk is defined as the non-zero probability that some undesirable outcomes will occur. This definition agrees with the risk-taking literature, which views uncertain courses of action (e.g., continuing a project in the hope that it will be successful) as risk-seeking behavior and certain courses of action (e.g., terminating a project) as risk-averse behavior.

Risk-taking theory suggests that risk perception and risk propensity of individuals affect their risk behavior (Sitkin and Pablo 1992). Given that the decision to continue a software project is risk-seeking behavior, risk perception and risk propensity are likely to affect decision makers' willingness to continue a project.[6] Risk perception is "a decision maker's assessment of the risk inherent in a situation" (Sitkin and Pablo 1992). Based on our definition of risk, an event is considered risky if its outcome is uncertain and may result in a loss (Barki et al. 1993; Mellers and Chang 1994). Risk propensity is the tendency of a decision maker to take risky actions (Kogan and Wallach 1964; Sitkin and Pablo 1992).[7]

Since risk propensity and risk perception are individual factors, they are likely to be shaped to some extent by a decision maker's cultural background. A cultural factor related to risk propensity and risk perception is uncertainty avoidance, defined as the extent to which people of a culture feel threatened by unknown situations (Hofstede 1991). High uncertainty avoidance cultures have a majority of people who accept only familiar risk and fear ambiguous situations. Conversely, people from low uncertainty avoidance cultures tend to be comfortable with ambiguous situations and unfamiliar risk. Given their greater comfort with risk, people from low uncertainty avoidance cultures may have higher risk propensity. Since they fear ambiguous situations less, people from low uncertainty avoidance cultures may also have lower risk perception. Hence, a theoretical model that includes individual factors in its explanation of decision makers' willingness

[6]In some organizational contexts, the decision to continue a software project may be risk-averse behavior. This issue is explored as a possibility for further research. However, it does not apply in this study. The mean score for Riskper3 and Riskper4 (see the appendix) is 3.61 on a scale of 1 to 5, showing that subjects in this study had indeed considered the decision to continue a project as risk-seeking behavior.

[7]Some scholars have conceptualized risk propensity as a general personality trait that causes decision makers to exhibit consistent risk-seeking or risk-averse tendencies across situations (e.g., Harnett and Cummings 1980). While agreeing that risk propensity is a personality trait, others have suggested that an individual's risk propensity is situation-specific (e.g., MacCrimmon and Wehrung 1990).



Note: Paths in **bold** are hypothesized to be culturally sensitive.

Figure 1. The Theoretical Model

to continue a project needs to be assessed for cross-cultural variations.

To overcome limitations of previous sunk cost studies, we propose a theoretical model to account for decision makers' willingness to continue a project (see Figure 1). It incorporates level of sunk cost (a situational factor) as well as risk propensity and risk perception (two individual factors). As in previous studies, decision makers' willingness to continue a project reflects escalation of commitment behavior. In this model, each path is a hypothesis to be tested. Given that certain paths (those in bold) may be moderated by culture, the model must be validated using data from several cultural settings.

The empirical literature suggests that risk propensity may impact risk perception (Brockhaus 1980; Vlek and Stallen 1980). When people have high risk propensity, they tend to be more risk-seeking in a given situation. Such risk-seeking decision makers are more likely to focus on positive outcomes and pay less attention to negative outcomes. Since software risk often results in negative outcomes, these decision makers may ignore software risk and underestimate the probability of a loss (Brockhaus 1980; Vlek and Stallen 1980). This leads to over-optimism, which lowers the risk perception of decision makers. Conversely, risk-averse decision makers tend to focus on negative outcomes and disregard positive outcomes. These decision makers may be very affected by software risk, which often results in negative outcomes, and overestimate the probability of a loss (Schneider and Lopes 1986). This results in over-pessimism, which elevates the risk perception of decision makers.

In every culture, there are people with high and people with low risk propensity because risk propensity is a personality trait,[8] but the translation of risk propensity into risk perception may be moderated by culture. People from low uncertainty avoidance cultures tend to be more comfortable with ambiguous situations and have less fear for negative outcomes (Hofstede 1991). Over time, they may have developed liberal lower limits[9] for

[8]However, average risk propensity of an entire population of people tends to be higher for low uncertainty avoidance cultures and lower for high uncertainty avoidance cultures.

[9]McCain (1986) showed that people did exhibit varying limits in terms of their tendencies to escalate a project. Given the strong causal relationship between risk per-

risk perception. Hence, people with high risk propensity may have very low risk perception while people with low risk propensity may still have high risk perception. Since risk perception varies greatly with risk propensity, the result is a strong path coefficient. Conversely, people from high uncertainty avoidance cultures tend to avoid ambiguous situations and fear negative outcomes (Hofstede 1991). Over time, they may have developed conservative lower limits for risk perception. Hence, people with high risk propensity may not have very low risk perception whereas people with low risk propensity may still have high risk perception. If risk perception does not vary greatly with risk propensity, the result is weak path coefficient. In short, uncertainty avoidance may magnify the inverse relationship between risk propensity and risk perception.

H1: In all cultures, risk propensity will have a significant inverse effect on risk perception.

H1a: The inverse relationship between risk propensity and risk perception will be stronger in cultures lower on uncertainty avoidance.

Few empirical studies have directly manipulated risk perception. However, many studies have examined the impact of variables (e.g., task nature, problem domain familiarity, and self-efficacy) that are thought to have exerted an indirect effect on risk behavior through changes in risk perception (Krueger and Dickson 1994; Slovic et al. 1982). Prior research suggests that decision makers tend to exhibit risk-averse behavior when risk perception is high and risk-seeking behavior when risk perception is low (e.g., March and Shapira 1987; Staw et al. 1981). As discussed above, a decision to continue a software project is a kind of risk-seeking behavior. Therefore, decision makers tend to be more willing to continue a project when their risk perception is low. Sitkin and Weingart (1995) report that decision makers tend to make more risky decisions when their risk perception is low. Their result provides support for the inverse relationship between risk perception and decision makers' willingness to continue a project.

H2: In all cultures, risk perception will have a significant inverse effect on willingness to continue a project.

Within a given context, decision makers may exhibit relatively stable tendencies to either take or avoid risky actions depending on their risk propensity (Harnett and Cummings 1980; Kogan and Wallach 1964; Sitkin and Pablo 1992). Therefore, risk propensity may be a determinant of decision makers' behavior when they are confronted with risky choices, including decisions about whether or not to continue a project. An issue that remains unresolved, however, is the extent to which the relationship between risk propensity and risk behavior is mediated by risk perception. It has been observed that people differ in risk propensity (Fishburn 1977; MacCrimmon and Wehrung 1990), but there is little consensus about how it affects risk behavior. Based on an extensive review of the risk literature, Sitkin and Pablo (1992) propose a theoretical model in which there is a direct effect of risk propensity on risk behavior. In an experiment, however, Sitkin and Weingart (1995) found no direct effect of risk propensity on risk behavior. Instead, they found the effect of risk propensity on risk behavior to be fully mediated by risk perception. Given that the theoretical literature suggests a direct effect of risk propensity on risk behavior, further research is warranted to determine if such an effect is direct, mediated, or partially direct and partially mediated.

H3: In all cultures, risk propensity will have a significant direct effect on willingness to continue a project.

Existing evidence concerning the sunk cost effect (e.g., Arkes and Blumer 1985; Garland 1990; Keil et al. 1995a) suggests that as the level of sunk cost increases, the likelihood that decision makers will continue a project increases correspondingly. While this behavior is consistent with the kind of cognitive bias explained by prospect theory (Kahneman and Tversky 1979; Tversky and Kahneman 1981), another explanation is that an

ception and risk behavior (Sitkin and Weingart 1995), it is plausible that the varying limits of people to escalate a project result from differences in their limits for risk perception.

inverse relationship exists between level of sunk cost and risk perception. Such a relationship may exist, for example, if decision makers equate level of sunk cost with level of project completion. This possibility cannot be ignored because level of sunk cost and level of project completion are often manipulated jointly in experiments. A higher perceived level of project completion may result in a lowering of risk perception. If this explanation is true, higher levels of sunk cost should lower risk perception of decision makers, causing them to be more willing to continue the project. Research is warranted to determine if the commonly observed relationship between level of sunk cost and decision makers' willingness to continue a project is mediated by risk perception.

This translation of level of sunk cost into risk perception may be moderated by culture. As discussed earlier, people from low uncertainty avoidance cultures may have developed liberal lower limits for risk perception over time. Thus, people confronted with a high level of sunk cost may have very low risk perception while people confronted with a low level of sunk cost may still have high risk perception. Since risk perception varies greatly with the level of sunk cost, the result is a strong path coefficient. Also, people from high uncertainty avoidance cultures may have developed conservative lower limits for risk perception over time. Thus, people confronted with a high level of sunk cost may not have very low risk perception whereas people confronted with a low level of sunk cost may still have high risk perception. When risk perception does not vary greatly with level of sunk cost, the result is a weak path coefficient. Thus, uncertainty avoidance may magnify the inverse relationship between level of sunk cost and risk perception.

H4: In all cultures, level of sunk cost will have a significant inverse effect on risk perception.

H4a: The inverse relationship between level of sunk cost and risk perception will be stronger in cultures lower on uncertainty avoidance.

Previous studies (e.g., Arkes and Blumer 1985; Garland 1990; Keil et al. 1995a) have suggested a direct relationship between level of sunk cost and decision makers' willingness to continue a project. However, these studies have never tested the possible mediating role of risk perception (as represented by H4 and H4a). Therefore, to assess whether this relationship is direct, mediated, or partially direct and partially mediated, it is necessary to add a hypothesis asserting that level of sunk cost has a direct effect on decision makers' willingness to continue a project.

H5: In all cultures, level of sunk cost will have a significant direct effect on willingness to continue a project.

Design and Methodology

Consistent with previous studies that investigated decision makers' willingness to continue a project, laboratory experiments were used to address the research questions. This approach allowed extraneous variables to be controlled so that causal relationships between constructs in the theoretical model could be tested with minimal interference from extraneous variables. Therefore, results of this study should have strong internal validity. Each experiment had a single-factor, four-cell design (each cell corresponding to a different level of sunk cost, presented to subjects in the form of a scenario).

Cultures

The work of Hofstede (1991) and Keil et al. (1995a) suggested that people from different cultures might engage in different risk behavior when exposed to the same decision situation. As discussed above, people from low uncertainty avoidance cultures might have developed a lower limit for risk perception, and thus be more willing to continue a project, than people from high uncertainty avoidance cultures. To assess the cross-cultural hypotheses in our theoretical model, matching experiments were conducted in three cultures (Finland, the Netherlands, and Singapore) which differ on uncertainty avoidance. Finland, the Netherlands, and Singapore have uncertainty avoidance scores of 59, 53, and 8,

respectively (Hofstede 1991).[10] These differences on uncertainty avoidance were assessed using a manipulation check (described below).

These three cultures were selected for several reasons. First, the bulk of prior work in this area had been carried out in the U.S. and it would be interesting to see if earlier results apply in other cultures. Second, people from these three cultures have high literacy levels and comparable language skills because they were educated in English and one other major language. Third, these three cultures represent developed countries, each with a nation-wide technology infrastructure and a fast-growing computer software industry.

Scenario

The experimental scenario and manipulations used in this study were identical to those employed by Keil et al. (1995a). Subjects were asked to play the role of president of a small computer software company that had been developing a software product for external sale. After receiving information on the level of sunk cost, subjects were told that another company had just started marketing a similar software package that was reported to have more functionality and greater ease of use. Based on this information, subjects were asked to provide an indication of their willingness to continue the software project. Four versions of this scenario, each corresponding to a different level of sunk cost in relation to the total budget, were provided to the subjects. This way, the level of sunk cost became a manipulated factor.

English versions of the scenario were used in Singapore. In Finland and the Netherlands, Finnish and Dutch versions of the scenario were created respectively. In these instances, the scenario was first translated into Finnish or Dutch by a person from the respective cultures. Next, it was back-translated into English by another person from the respective cultures. Based on this double translation process, minor corrections were made to the Finnish and Dutch versions of the scenario to ensure that the meanings of all elements of the scenario had been preserved during translation.

Procedure

Subjects were told that this was an experiment on business decision making and that their answers would remain anonymous. They were reminded that their participation was voluntary and those who did not wish to participate could leave. More than 95% of all subjects from each culture chose to participate. In each culture, participating subjects were randomly assigned to one of four treatment conditions (each representing a different level of sunk cost). The experimental procedure consisted of two parts. In the first part, subjects received a copy of the scenario corresponding to their respective treatment conditions. They were asked to read the scenario and indicate the probability that they would be willing to continue with the project. In the second part, subjects were asked to complete a questionnaire that measured their risk propensity and risk perception, and collected their demographic information (gender, age, and years of work experience).

Subjects

A total of 536 subjects (185 from Finland, 121 from the Netherlands, and 230 from Singapore) completed this study. Subjects were undergraduate and master's students enrolled in an introductory information systems course at a university in their respective countries. Keil et al. (1995a) reported that undergraduate and master's students exhibited no significant differences in their willingness to continue a project. Since this study used the same scenario as Keil et al. (1995a), undergraduate and master's students were used to increase generalizability of the results.

[10]Hofstede's (1991) uncertainty avoidance scores for 53 cultures range from 8 (Singapore) to 112 (Greece). The fact that Finland and the Netherlands have close uncertainty avoidance scores does not warrant the exclusion of either culture from this study because both cultures differ on factors other than uncertainty avoidance (Hofstede 1991; Trompenaars and Hampden-Turner 1998). Current literature has not been conclusive about which cultural factors actually affect decision makers' willingness to continue a project.

T-tests revealed no significant differences between undergraduate and master's students on any construct in the theoretical model. While the use of students as subjects might limit the generalizability of the results to organizational decision makers (Hughes and Gibson 1991), there was some support for using students as surrogates for managers, particularly when the tasks being studied involved human decision making (Ashton and Kramer 1980), which was the case in this study. Table 2 provides descriptive statistics on the demographic information of subjects.[11]

Constructs and Questions

The risk propensity construct was measured using a single question taken from an established portfolio of risk measures developed by MacCrimmon and Wehrung (1985) (see the appendix).[12] The risk perception construct was measured using four questions specifically designed for this study (see the appendix). These questions were grounded in the risk-taking literature. Two questions assessed the level of perceived risks directly. Two other questions assessed perceived probability of success, which contributed indirectly to risk perception (Barki et al. 1993; Mellers and Chang 1994).[13]

The level of sunk cost was a construct manipulated at four different levels (15%, 40%, 65%, and 90% of the total budget) using four versions of the same scenario (Keil et al. 1995a). Willingness to continue a project was a construct measured by asking subjects, after they had read their task, how likely were they to continue with the project (see the appendix). The exact wording of this question was similar to that used in numerous other studies (e.g., Garland 1990; Keil et al. 1995a).

Analyses and Results

Given the large sample of subjects used in this study, a very strict significance level of 0.01 was used for all statistical tests.[14]

Manipulation and Control Checks

The manipulation on uncertainty avoidance was checked based on three questions (see the appendix) from Hofstede (1980). People from high uncertainty avoidance cultures are likely to value security of employment, clearly prescribed (rather than freedom of) job approach, and stable job nature using existing skills (rather than changing job nature requiring new skills). An F-test showed that uncertainty avoidance differed among the three cultures ($F = 305.86$, $p < 0.01$), confirmed by a non-parametric Kruskal-Wallis test ($\chi^2 = 296.49$, $p < 0.01$). Singapore subjects (mean = 1.60, std dev = 0.44) had lower uncertainty avoidance than Dutch subjects (mean = 2.37, std dev = 0.39) and Finnish subjects (mean = 2.60, std dev = 0.44). The subjects from these three cultures appeared to differ on uncertainty avoidance in the direction suggested by Hofstede (1991).

[11]Since the ratio of males to females varied somewhat across subject groups, we first conducted a separate PLS analysis for the combined dataset and for each culture to see whether gender helped to shape the results. In each case, results for male and female subgroups were similar to the overall model, suggesting that gender did not affect the overall results. We conducted similar analyses for age and work experience by splitting the data for the combined dataset and for each culture into two subsets using the median. Again, results for each subset were the same as the overall results. Therefore, we concluded that these demographic variables were not significant factors. Hence, we present the findings without breaking down the samples further by gender, age, or work experience.

[12]At the time our experiments were conducted, we were unable to identify a multi-item measure for risk propensity that had good psychometric properties. Single-item measures may pose theoretical difficulties. However, this does not render results of structural equation modeling analysis invalid (Hair et al. 1998).

[13]Risk is often defined as a combination of the magnitude and probability of loss. Our questions did not directly assess magnitude of loss. However, they did directly assess probability of loss and directly assess perceived risk (which captured both the magnitude and probability components of risk).

[14]When sample sizes are large, statistical tests can be very sensitive and may detect spurious effects. One way to overcome this problem is to use a very strict significance level for data analyses (Hair et al. 1998).

Table 2. Demographic Information of Subjects

Culture	Age in Years Mean (std dev)	Work Experience in Years Mean (std dev)	Gender	
			Males	Females
Combined	21.45 (2.91)	1.26 (2.28)	59.7%	40.3%
Finland	22.46 (4.05)	2.62 (3.18)	40.0%	60.0%
The Netherlands	19.22 (1.71)	0.85 (1.59)	80.2%	19.8%
Singapore	21.81 (1.21)	0.38 (0.57)	64.8%	35.2%

Control checks were carried out on the subject demographics for each culture. Kruskal-Wallis tests showed that the gender ratio of subjects did not differ across the four levels of sunk cost for each culture. F-tests revealed that age, work experience, and risk propensity of subjects did not differ across the four levels of sunk cost for each culture.

PLS Analyses

Partial least squares (PLS) is an advanced statistical method that allows optimal empirical assessment of a structural (theoretical) model together with its measurement model (Wold 1982). The structural model consists of a network of causal relationships linking multiple constructs while the measurement model links each construct with a set of indicators (typically questions) measuring that construct. PLS is superior to traditional statistical methods (e.g., factor analysis, regression, and path analysis) because it assesses the measurement model within the context of the structural model. To do so, PLS first estimates loadings of indicators on constructs and then estimates causal relationships among constructs iteratively (Fornell 1982).

PLS was selected to test the hypotheses for two reasons. First, it is not contingent upon data having multivariate normal distributions and interval nature (Fornell and Bookstein 1982). This makes PLS suitable for handling manipulated constructs such as level of sunk cost. Second, it is appropriate for testing theories in the early stages of development (Fornell and Bookstein 1982). Given that this study is an early attempt to advance a theoretical model on decision makers' willingness to continue a software project, PLS can be used to analyze the data. Many prior studies on information systems have used PLS to test early versions of theoretical models (e.g., Igbaria et al. 1994; Thompson et al. 1991). In this study, PLS-Graph Version 2.91 (Chin 1994) was used.

Measurement Model

The strength of the measurement model can be demonstrated through measures of convergent and discriminant validity (Hair et al. 1998). Convergent validity is normally assessed using three tests: reliability of questions, composite reliability of constructs, and variance extracted by constructs (Fornell and Larcker 1981). Discriminant validity can be assessed by looking at correlations among questions (Fornell and Larcker 1981) as well as variances of and covariances among constructs (Igbaria et al. 1994).

Risk perception was a perceptual construct measured using multiple questions so it had to be assessed for convergent validity. Reliability of these questions was assessed by examining the loading of each question on the risk perception construct. More evidence on reliability could be obtained from the correlation between each question and the risk perception construct. In order for the shared variance between each question and the risk perception construct to exceed the error variance, the reliability score for the question should be at least 0.707. However, a reliability

Table 3. Reliability of Questions for Risk Perception

Culture	Question	Question Loading on Construct	Question-Construct Correlation
Combined	Riskper1	0.88	0.82
	Riskper2	0.86	0.81
	Riskper3	0.71	0.77
	Riskper4	0.69	0.76
Finland	Riskper1	0.91	0.85
	Riskper2	0.90	0.85
	Riskper3	0.57	0.64
	Riskper4	0.72	0.79
The Netherlands	Riskper1	0.75	0.62
	Riskper2	0.57	0.62
	Riskper3	0.79	0.81
	Riskper4	0.76	0.82
Singapore	Riskper1	0.88	0.79
	Riskper2	0.88	0.79
	Riskper3	0.71	0.81
	Riskper4	0.69	0.79

score of at least 0.5 might be acceptable if some other questions measuring the same construct had high reliability scores (Chin 1998). Given that all questions had reliability scores above 0.5, and most questions had reliability scores exceeding 0.707 (see Table 3), the questions measuring risk perception had adequate reliability for the combined dataset and for each culture. Other information systems studies employing PLS had also used 0.5 as an indication of reliability of questions (e.g., Igbaria et al. 1994; Thompson et al. 1991).

PLS took into account relationships among constructs when computing composite reliability scores for the risk perception construct (Chin 1998). Additional evidence on reliability of the risk perception construct was obtained by calculating Cronbach's alpha. A score of 0.7 indicates adequate reliability of constructs, although a slightly lower score might be acceptable for exploratory research (Hair et al. 1998). Based on this criterion, the risk perception construct had adequate reliability for the combined dataset and for each culture (see Table 4). PLS computed the variance extracted by the risk perception construct based on the extent to which its four questions tapped into the same underlying construct (Chin 1998). A score of 0.5 indicates acceptable level of variance extracted (Fornell and Larcker 1981). Based on this criterion, the risk perception construct had an acceptable level of variance extracted for the combined dataset and for each country (see Table 4). Variance extracted was computed as follows (Fornell and Larcker 1981):

$$\text{Variance extracted} = \frac{\Sigma \lambda_i^2}{\Sigma \lambda_i^2 + \Sigma (1 - \lambda_i^2)}$$

where λ_i = loading of question i on the construct

Risk propensity and risk perception were perceptual measures so they had to be assessed for discriminant validity. Correlations between all pairs of

Table 4. Reliability of and Variance Extracted by Risk Perception

Culture	Composite Reliability	Cronbach's Alpha	Variance Extracted
Combine	0.87	0.80	0.62
Finland	0.86	0.79	0.62
The Netherlands	0.81	0.70	0.52
Singapore	0.87	0.81	0.63

Table 5. Correlations Between Questions for Risk Propensity and Risk Perception

Culture	Question	Riskper1	Riskper2	Riskper3	Riskper4	Riskprop
Combined	Riskper1	1.00				
	Riskper2	0.79	1.00			
	Riskper3	0.44	0.36	1.00		
	Riskper4	0.36	0.40	0.67	1.00	
	Riskprop	-0.22	-0.17	-0.17	-0.10	1.00
Finland	Riskper1	1.00				
	Riskper2	0.82	1.00			
	Riskper3	0.39	0.26	1.00		
	Riskper4	0.45	0.50	0.50	1.00	
	Riskprop	-0.22	-0.20	-0.06	-0.04	1.00
The Netherlands	Riskper1	1.00				
	Riskper2	0.46	1.00			
	Riskper3	0.28	0.20	1.00		
	Riskper4	0.22	0.24	0.77	1.00	
	Riskprop	-0.03	-0.04	-0.08	-0.03	1.00
Singapore	Riskper1	1.00				
	Riskper2	0.87	1.00			
	Riskper3	0.39	0.37	1.00		
	Riskper4	0.35	0.36	0.78	1.00	
	Riskprop	-0.22	-0.24	-0.20	-0.17	1.00

questions measuring these constructs were computed. As evidence of discriminant reliability, each question should correlate more highly with other questions measuring the same construct than with other questions measuring other constructs (Chin 1998). The risk propensity and risk perception constructs had discriminant validity for the entire dataset and for each culture (see Table 5).

Structural Model

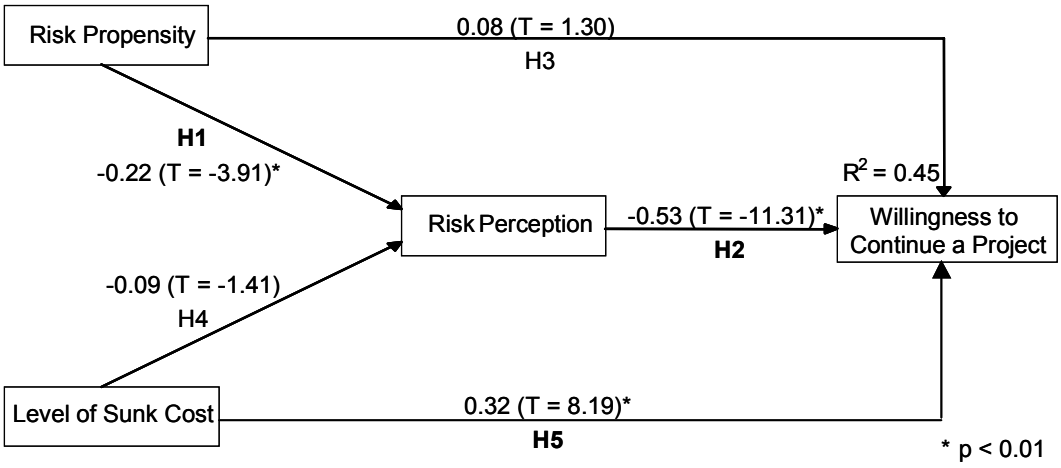
The use of PLS (or any variance-based approach to structural equation modeling) for data analyses tends to bias the results toward higher estimates for indicator loadings in the measurement model at the expense of lower estimates for path coefficients in the structural model (Chin 1998). This tradeoff between measurement and structural models can be avoided by having a large sample size, at least 10 times the largest number of independent constructs affecting a dependent construct (Chin 1998). Since the largest number of independent constructs affecting a dependent construct in the theoretical model was three, the sample size for each culture was large enough to overcome the problem of biased results.

With adequate measurement models, the hypotheses were tested by examining the structural models. The explanatory power of a structural model could be evaluated by looking at the R^2 value (variance accounted for) in the final dependent construct. In this study, the final dependent construct (willingness to continue a project) had R^2 values of 0.45 for the combined dataset, 0.53 for Finland, 0.48 for the Netherlands, and 0.39 for Singapore. Since prior studies could explain no more than 14% of the variance in decision makers' willingness to continue a project, the structural models proposed in this study possessed greater explanatory power than earlier models, making interpretation of path coefficients meaningful. After computing path estimates in the structural model using the entire sample, PLS used a jackknifing technique to obtain the corresponding T-values. Each hypothesis (H1 to H5) corresponded to a path in the structural model for the combined dataset (see Figure 2). Support for each hypothesis could be determined by examining the sign (positive or negative) and statistical significance of the T-value for its corresponding path. With a significance level of 0.01, the acceptable T-value would be 2.326.

Risk propensity had an inverse effect on risk perception but had no direct effect on willingness to continue a project. Decision makers with higher risk propensity tended to have lower risk perception. Thus, H1 was supported but H3 was not supported. Risk perception had an inverse effect on willingness to continue a project. Decision makers with lower risk perception tended to be more willing to continue a project in the face of difficulties. Thus, H2 was supported. Level of sunk cost did not affect risk perception but had a direct effect on willingness to continue a project. The higher the level of sunk cost, the greater the willingness of decision makers to continue a project. Hence, H4 was not supported but H5 was supported.

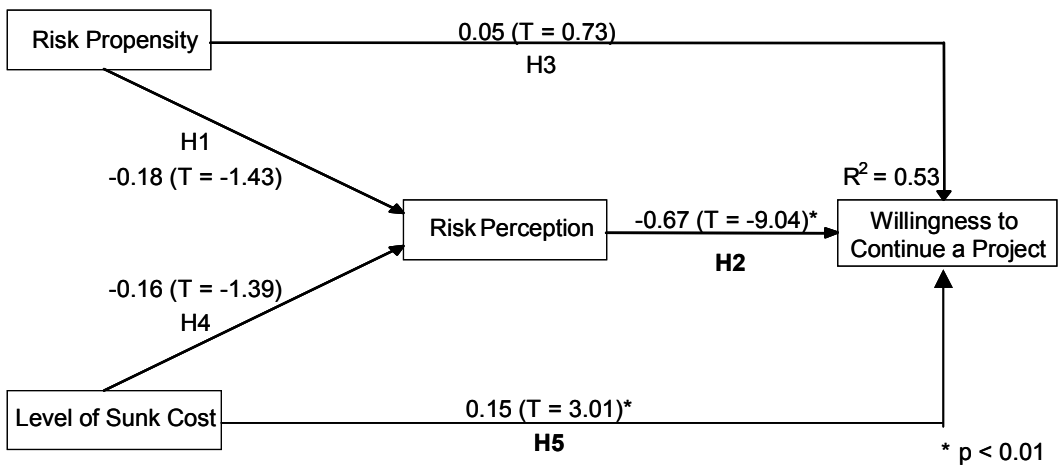
Figures 3, 4, and 5 depict the structural models for Finland, the Netherlands, and Singapore respectively. Hypotheses on cultural differences (H1a and H4a) could be tested by statistically comparing corresponding path coefficients in these structural models. The lack of support for H4 suggested that level of sunk cost did not affect risk perception in general (across various cultures). Thus, there was no support for H4a. Singapore subjects had lower uncertainty avoidance than Finnish and Dutch subjects. Hence, H1a was tested by statistically comparing the path coefficient from risk propensity to risk perception in the structural model for Singapore with the corresponding path coefficients in the structural models for Finland and the Netherlands. This statistical comparison was carried out using the following procedure:[15]

[15]We thank Wynne Chin for suggesting this procedure. We provide the details of this procedure because it has not been documented elsewhere. Earlier studies that compared corresponding paths across structural models had simply looked at the numerical values of path coefficients without conducting a statistical test (e.g., Thompson et al. 1994).



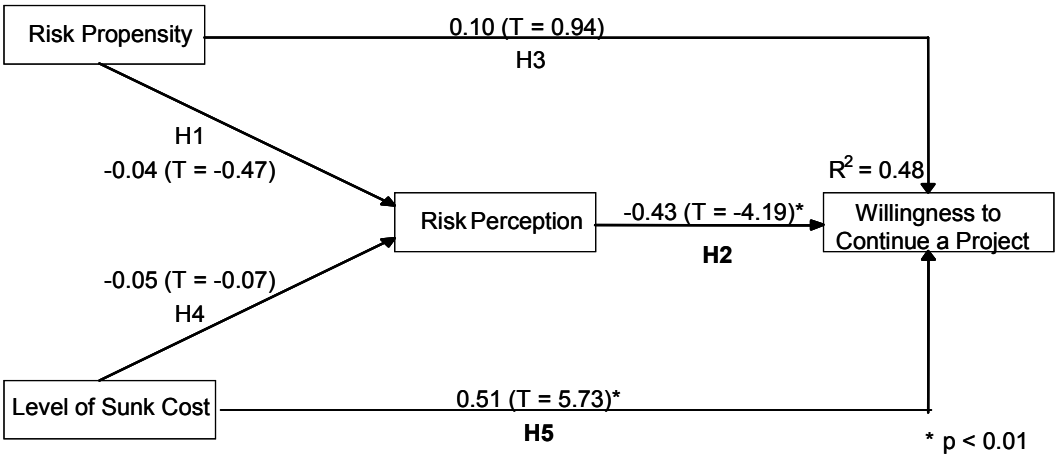
Note: Hypotheses in **bold** were supported.

Figure 2. Structural Model for Combined Dataset



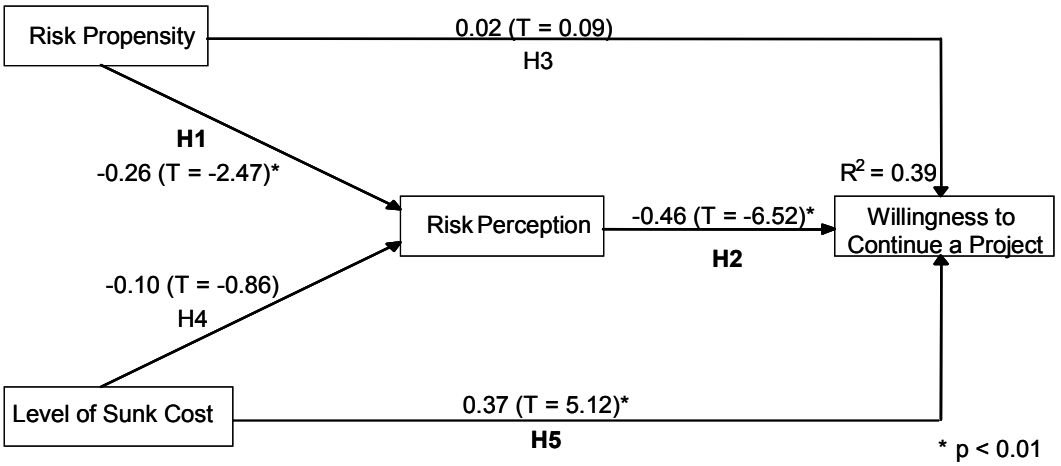
Note: Hypotheses in **bold** were supported.

Figure 3. Structural Model for Finland



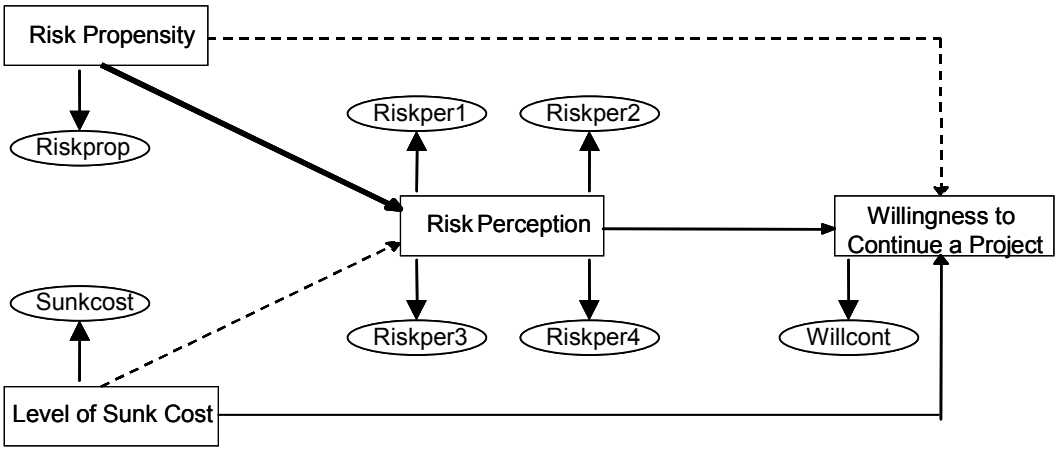
Note: Hypotheses in **bold** were supported.

Figure 4. Structural Model for the Netherlands



Note: Hypotheses in **bold** were supported.

Figure 5. Structural Model for Singapore



Note: Paths in dash are unsupported, path in **bold** is culturally sensitive, and ovals are Indicators for constructs (see the appendix).

Figure 6. Summary of Results

$$S_{pooled} = \sqrt{\{[(N_1 - 1) / (N_1 + N_2 - 2)] \times SE_1^2 + [(N_2 - 1) / (N_1 + N_2 - 2)] \times SE_2^2\}}$$

$$t = (PC_1 - PC_2) / [S_{pooled} \times \sqrt{(1/N_1 + 1/N_2)}]$$

where S_{pooled} = pooled estimator for the variance
t = t-statistic with $N_1 + N_2 - 2$ degrees of freedom
N_i = sample size of dataset for culture i
SE_i = standard error of path in structural model of culture i
PC_i = path coefficient in structural model of culture i

Results showed that the path coefficient from risk propensity to risk perception in the structural model for Singapore was significantly stronger than the corresponding path coefficients in the structural models for Finland ($t = 11.57$, $p < 0.01$) and the Netherlands ($t = 27.45$, $p < 0.01$). As hypothesized, cultures lower on uncertainty avoidance yielded a significantly stronger inverse relationship between risk propensity and risk perception than cultures higher on uncertainty avoidance. Thus, H1a was supported.

Discussion and Implications

By integrating both situational (level of sunk cost) and individual factors (risk propensity and risk perception) into a theoretical model, this study has accounted for a substantial portion of the variance in decision makers' willingness to continue a project. Moreover, it illustrates how cross-cultural differences (on uncertainty avoidance) may moderate the relationship between risk propensity and risk perception, and adds a cultural dimension to the theoretical model. Figure 6 summarizes the results of this study.

Discussion of Findings

In a previous study using U.S. subjects, Sitkin and Weingart (1995) reported that risk propensity affected risk behavior of decision makers through their risk perception. Specifically, decision makers high on risk propensity tended to have low risk perception, causing them to be more willing to take risk. The results of this study support such a relationship by showing that the

effect of risk propensity on decision makers' willingness to continue a project was mediated by risk perception. The strong relationship between risk propensity and risk perception, reported by Sitkin and Weingart, also ties in with the cross-cultural finding of this study. Based on Hofstede (1991), the U.S. is higher on uncertainty avoidance than Singapore but lower on uncertainty avoidance than the Netherlands and Finland. Collectively, both sets of results point to the fact that lower uncertainty avoidance cultures (e.g., Singapore and the U.S.) may have stronger relationships between risk propensity and risk perception than higher uncertainty avoidance cultures (e.g., the Netherlands and Finland).

To further explore how cross-cultural differences may impact decision makers' willingness to continue a project, an F-test using culture as the independent variable was carried out. The result showed that the three cultures had significant differences in terms of decision makers' willingness to continue a project ($F = 15.40$, $p < 0.01$), confirmed by a non-parametric Kruskal-Wallis test ($\chi^2 = 27.15$, $p < 0.01$). A multiple comparison procedure revealed that Singapore subjects (mean = 66.04, std dev = 21.73) were more willing to continue with the project than Dutch (mean = 56.03, std dev = 26.25) and Finnish subjects (mean = 53.62, std dev = 25.05). Thus, the stronger relationship between risk propensity and risk perception in a low uncertainty avoidance culture appears to be translated into greater decision makers' willingness to continue a project.

The effect of the level of sunk cost on willingness to continue a project (the sunk cost effect) was direct and not mediated by risk perception. This lack of mediated impact (H4 not supported) suggests that decision makers were unlikely to have equated level of sunk cost with level of project completion. A likely explanation for this result, consistent with prospect theory (Kahneman and Tversky 1979; Tversky and Kahneman 1981), is that the level of sunk cost creates a cognitive bias at a subconscious level, prompting decision makers to take risk. This subconscious cognitive bias may be manifested in the form of emotional attachment that decision makers commonly display for projects in which they have invested substantial resources. A prior study by Keil et al. (1995a) found that the sunk cost effect existed in both the U.S. and Finland. Results of the study reported here show that the sunk cost effect also exists in the Netherlands and Singapore.

Implications for Future Research

One direction for future research would be to replicate this study across a broader range of cultures. While Singapore is on the low end of Hofstede's (1991) uncertainty avoidance index, the Netherlands and Finland are closer to the middle. Thus, an obvious extension would be to replicate this study in very high uncertainty avoidance cultures (e.g., Greece, Portugal, or Guatemala) (Hofstede 1991) to determine whether the results observed for the Netherlands and Finland would still hold. Likewise, this study could be conducted in other low uncertainty avoidance cultures (e.g., Jamaica, Denmark, or Sweden) (Hofstede 1991) to see if the results obtained for Singapore would still apply.

Another avenue for future research would be to extend decision making from an individual to a group level. Cohesive groups that operate with a "groupthink" attitude tend to be more committed to their current courses of action (Street and Anthony 1997). It would be interesting to study how group factors (e.g., group cohesion) may interact with individual factors (e.g., risk propensity and risk perception) to affect groups' willingness to continue a project. Given that groups in some cultures may be more cohesive and prone to groupthink than groups in other cultures (Tan et al. 1998), it would be interesting to observe whether multi-cultural groups could be used to reduce escalation of commitment tendencies at a group level. This research area is important because groups, rather than individuals, are usually responsible for critical organizational decisions. Hence, knowing the circumstances under which groups may yield to escalation of commitment tendencies could help organizations to alleviate such problems.

A third possible direction for future research would be to study how escalation of commitment

tendencies could be alleviated so as to reduce wasteful commitment of money to failing projects. The results of this study suggest that risk identification techniques (Barki et al. 1993; Ropponen and Lyytinen 2000) may help decision makers to develop more conservative assessments of the situation by increasing their risk perception and making them more conscious of software risk. Since project information tends to be ambiguous or even contradictory, a critical role of risk identification techniques is to improve the quality of feedback available to decision makers. Such techniques may reduce decision makers' willingness to continue a project (Lyytinen et al. 1996). Awareness of software risk may also prompt decision makers to develop strategies (Ropponen and Lyytinen 1997) to deal with unavoidable risk. Such issues have not been adequately studied but some scholars have initiated efforts in this direction by putting together various types of software risk with appropriate risk management strategies (e.g., Keil et al. 1998; Lyytinen et al. 1998; Ropponen and Lyytinen 2000).

Fourth, it would be useful to identify additional situational or individual factors that may influence decision makers' willingness to continue a project. Examples of situational factors are the availability of an alternative project (Keil et al. 1995a) and foreseeability of the negative feedback (Conlon and Wolf 1980). Examples of individual factors are the responsibility level (Staw et al. 1997) and the education and experience of the decision maker (Ropponen and Lyytinen 2000). Empirical studies have reported that decision makers were more willing to continue a project when there were no alternative projects, when the negative feedback was foreseeable, when they were responsible for initiating the project, and when they were lacking in education and experience with similar projects. However, it is plausible that these factors affected decision makers by altering their risk perception. Future versions of this study could incorporate these factors into the theoretical model to see whether it could account for even more of the variance in decision makers' willingness to continue a project.

Finally, this study can be replicated in organizational settings to see if the findings would still apply. For example, the results showed that there was an inverse relationship between risk perception and willingness to continue a project. However, this relationship may be moderated by organizational factors. If the level of sunk cost is considered low by the standard of the organization and decision makers can abandon the project with no adverse consequences (e.g., losing his or her job), decisions to continue the project would be considered risk-seeking. Thus, decision makers with low risk perception may be more willing to continue the project. But if the level of sunk cost is considered high by the standard of the organization and decision makers cannot abandon the project without any adverse consequences, decisions to continue the project would be considered risk-averse. Therefore, decision makers with high risk perception may be more willing to continue the project. Another organizational issue is the availability of slack resources. Decision makers who have the luxury of such resources tend to demonstrate higher risk propensity. These issues can be tested in field studies.

The theoretical model proposed in this study could be refined for future research. Specifically, the two paths that were not supported by the results may be omitted. Other constructs that may contribute to decision makers' willingness to continue a project or moderate certain paths in the model may be added. Figure 7 consolidates all of the research ideas discussed above into a theoretical model to guide future research efforts (the bold lines are culturally-sensitive paths). While this study focuses on cultural factors affecting decision makers, future studies could also examine organizational culture.

Implications for Practice

The strength of the escalation of commitment behavior appears to vary from one culture to another. While prior work has tentatively attributed such variations to cultural factors (Chow et al. 1997; Keil et al. 1995a; Sharp and Salter 1997), this study is the first to incorporate a manipulation check to show that uncertainty avoidance (a cultural factor) affects escalation of commitment behavior. This finding is useful for managers undertaking global software projects.

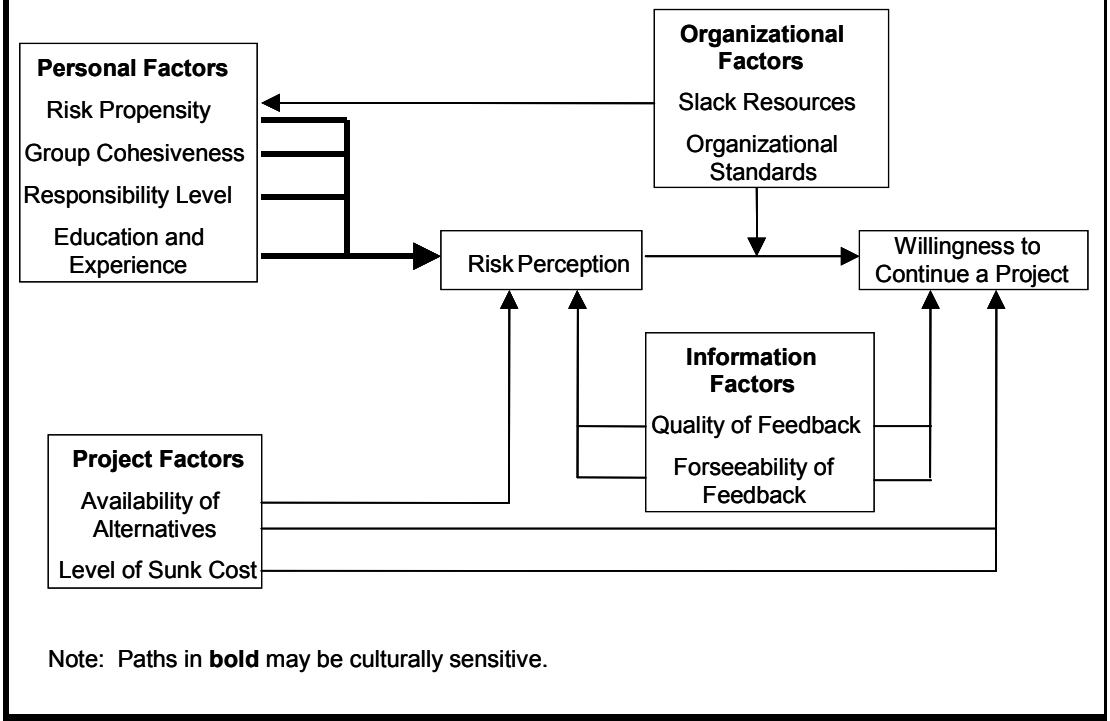


Figure 7. Theoretical Model for Future Research

In particular, managers need to take into account such cultural differences when outsourcing software projects to development teams from different cultures. Teams from low uncertainty avoidance cultures may be more risk-seeking and more susceptible to escalation of commitment behavior than teams from high uncertainty avoidance cultures. If managers want to alleviate such differences in behavior among all the development teams, they need to establish common policies to guide teams on when to continue working on projects with questionable prospects for success.

Risk propensity appears to influence decision makers' willingness to continue a project through risk perception. This result, consistent with Sitkin and Weingart (1995), has two practically useful implications. First, it may be possible to match managerial characteristics to project nature. Managers with high risk propensity (common in low uncertainty avoidance cultures) can be assigned to software projects involving advanced or new technologies. Since successful completion of such projects usually depends on overcoming (rather than avoiding) risk, appointing managers with high risk propensity reduces the likelihood of such projects being terminated prematurely. Conversely, managers with low risk propensity (common in high uncertainty avoidance cultures) can be assigned to software projects that use familiar technologies or development methods. Since such projects can be completed with minimal risk, having managers with low risk propensity reduces the possibility that such projects would be allowed to continue when prospects for success are questionable. Matching managers to projects can enhance the probability of project success (Lyytinen et al. 1998).

Second, it may be possible to modify managerial behavior by manipulating risk perception. For managers with very high risk propensity, which can translate into very low risk perception (especially in low uncertainty avoidance cultures), measures can be employed to alter their risk perception. These include promoting open

discussion to get perceptions of people outside the project team (Lyytinen et al. 1998), reminding them about the availability of alternative projects (Keil et al. 1995a), advising them to focus on the decision process rather than outcomes (Simonson and Staw 1992), and assuring them that the decision outcomes do not reflect their managerial abilities (Simonson and Staw 1992). These measures can help managers to form a more realistic risk perception and possibly avoid delaying decisions to discontinue or redirect troubled projects.

A finding that is consistent across cultures is that decision makers tend to be more willing to continue a project when the level of sunk cost is high. Thus, when the level of sunk cost is very high, some "de-escalation" tactics (Keil and Robey 1999) can be used to help managers avoid escalation of commitment behavior or at least minimize its impact when it does occur. Promising tactics include making costs of continuing a project salient to decision makers (Brockner et al. 1979), encouraging decision makers to set absolute spending limits (Brockner et al. 1979), asking decision makers to set target levels of completion at specific time intervals (Simonson and Staw 1992), and advising decision makers to disregard level of sunk cost when deciding whether or not to continue a project (Howe and McCabe 1983). Another tactic is to reduce project size by breaking large projects into smaller chunks, so that total sunk cost is minimized, while the relative sunk cost on a specific deliverable rises quickly, thus pushing people to complete various segments of the project (Keil and Robey 1999). Together, these tactics are organizational safeguards against the sunk cost effect.

Limitations of This Study

As is the case with all laboratory experiments, we need to be cautious when generalizing the results of this study for several reasons. First, results obtained using student subjects may be somewhat different from results obtained using actual managers, who have been victims of the escalation of commitment phenomenon and who may be more sensitive to such a phenomenon. Second, the experiments conducted in this study took a necessarily narrow focus so as to achieve a high degree of control over extraneous variables. There are organizational and political factors that may also influence decision makers' willingness to continue a project. These factors have not been investigated here and may not lend themselves to experiments.

Third, the scenario used in this study represented an over-simplification of options available to managers who face the decision of how to handle a project with uncertain prospects for success. In this study, the decision was framed as a choice of whether or not to continue the project. Clearly, managers can make other choices such as redirecting the project by replacing key individuals involved or changing the requirement specifications of the project (Keil and Robey 1999). Fourth, this study used a single-item measure for the risk propensity construct. Although such a measure does not render the results of structural equation modeling analysis invalid (Hair et al. 1998), it does weaken the measurement models and can pose theoretical difficulties. The similar finding on risk propensity, reported by Sitkin and Weingart (1995), provides support for the findings of this study. Nevertheless, findings pertaining to the risk propensity construct should be validated in future studies using multiple-item measures for this construct.

Conclusion

This study makes some novel contributions to software project management knowledge. First, it advances a theoretical model to explain decision makers' willingness to continue a software project. By incorporating concepts from risk-taking theory, in addition to the commonly-tested level of sunk cost, this theoretical model has greater explanatory power than earlier models. Second, it illustrates how uncertainty avoidance (a cultural factor) can impact decision makers' willingness to continue a software project. While earlier studies have speculated on the importance of cultural factors, this study pinpoints the moderating impact of a cultural factor with the aid of a theoretical model. In doing so, it adds a cultural dimension to existing knowledge on the escalation of commitment phenomenon.

As organizations become more computerized, software projects will consume an ever increasing amount of organizational resources. Useful theories on escalation of commitment behavior can potentially lead us to "de-escalation" tactics (Keil and Robey 1999) that may help organizations to save millions of dollars in unnecessary expenses. And as multicultural teams are increasingly being deployed for large software projects, these theories need to be evaluated for cross-cultural applicability. This study is an initial attempt to develop a theory on escalation of commitment behavior with a cultural dimension.

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APPENDIX

Question	Exact Wording of Question
Risk propensity	Scale: 1 “much less willing” to 5 “much more willing”
Riskprop	How would you rate your own willingness to undertake risky business propositions compared to other individuals?
Risk perception	Scale: 1 “strongly disagree” to 5 “strongly agree”
Riskper1	I believe the CONFIG project has a high probability of success (reverse scale).
Riskper2	I believe the CONFIG project has a low probability of success.
Riskper3	I believe there are very little risks in continuing to fund the CONFIG project (reverse scale).
Riskper4	I believe there are substantial risks in continuing to fund the CONFIG project.
Willingness to continue a project	Scale: 0% “definitely would not continue” to 100% “definitely would continue”
Willcont	How likely is it that you personally would choose to continue with the CONFIG project?
Level of sunk cost	Provided to the subjects as part of the scenario
Sunkcost	Manipulated at 15%, 40%, 65%, or 90% of the total budget.
Uncertainty avoidance	Scale: 1 “extremely unimportant” to 5 “extremely important” In choosing an ideal job, how important do you rate the following issues?
Unavoid1	Have security of employment.
Unavoid2	Have considerable freedom to adopt your own approach to the job (reverse scale).
Unavoid3	Have training opportunities to learn new skills (reverse scale).