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A Behavioral Model of Software Project Risk Management

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Abstract
Prior research suggests that software project managers do not widely use project risk management prescriptions. This study adopts the view that this situation may be because the assumptions underlying the majority of software project risk management prescriptions diverge from how project managers actually view risk and respond to it. To advance our understanding of project managersâ risk response behavior, the study first applies a problematization methodology to a selection of 55 articles and identifies, articulates, and revises the assumption-ground underlying most of these studies. It then proposes a conceptual model that aims at explaining and predicting software project managersâ risk response behavior and that takes into account the revised assumption-ground. This conceptual model is developed by using the reasoned action approach as a canvas to integrate behavioral decision making under uncertainty research and prior behavioral research in the software project risk management context. Finally, the paper derives several propositions from this conceptual model and provides suggestions for future research.

Keywords: Software project risk management, problematization methodology, behavioral decision making under uncertainty, reasoned action approach

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Introduction

Software projects – whether for the development of commercial software, the custom development of business information systems, or the configuration and implementation of enterprise software – are temporary endeavors to deliver software to users. Software projects have been challenging undertakings since computers were first introduced in business data processing. Indeed, for over half a century, software project managers have had to face the possibility that systems would be delivered late and over budget or fail to meet user needs (Rothfeder, 1988; Standish Group, 2009).

At the same time, efforts have been made to develop software project management practices that could improve the chances of project success (Mignerat and Rivard, 2010). One such practice is software project risk management, which has interested practitioners and researchers alike (Alter and Ginzberg 1978; Bannerman, 2008; Barki et al., 1993; 2001; Boehm 1991; Charette, 2005; de Bakker et al., 2010; Gemino et al., 2008; Keil et al. 2000a, b, c; McFarlan 1981; Wallace et al., 2004). Software project risk management literature commonly refers to the sources of challenge to the success of projects as risk (or uncertainty) factors (Barki et al., 1993). This literature defines software project risk management as "a set of principles and practices aimed at identifying, analyzing and handling risk factors to improve the chances of achieving a successful project outcome and/or avoid project failure" (Bannerman, 2008, p.2120). Past literature usually considers risk management as a two-stage process including risk assessment (i.e., identifying and analyzing risk factors) and risk control (i.e., handling – mitigating and monitoring– risk factors) (Boehm, 1991; Schmidt et al., 2001). Consequently, several relevant studies have sought to offer risk management prescriptions either for the entire risk management process (e.g., Boehm, 1991) or for each of its risk assessment (e.g., Lyytinen et

al., 1998) and risk control (e.g., Barki et al., 2001) stages. Such prescriptions could take the form of general recommendations, or comprehensive principles and practices such as risk management methods.

However, despite such regularity of threats to the success of software projects and the availability of risk management prescriptions, these prescriptions are not widely used (Bannerman, 2008; Kutsch and Hall, 2009; Moynihan, 1997; Ropponen, 1999) or appear to be difficult to use (Taylor et al., 2012). Various explanations for this situation have been offered by past studies; for example, that the project managers' training and experience influences their successful application of project risk management (Ropponen and Lyytinen, 1997). Keeping with the recent studies in the field (Bannerman, 2008; de Bakker et al., 2010; Kutsch and Hall, 2009, 2010; Lauer, 1996; Lyytinen et al., 1998; Taylor, 2005, 2006, 2007; Taylor et al., 2012), our tentative explanation for lack of use of prescriptions concerns the assumption-ground based on which the extant software project risk management studies are conducted and the prescriptions are derived. More specifically, we submit that the assumptions underlying the majority of past literature about the way project managers decide about taking risk response actions lie far from the way project managers typically view risk and respond to it – to the extent that such "... decision-making assumptions are key to understanding why prescriptions from [past studies] appear to be so difficult to apply in IT projects" (Taylor et al., 2012, p.18).

To name a few examples, several past studies assume that project managers will frequently and objectively assess risk factors, calculate the risk exposure, and maintain an updated risk management plan (e.g., Boehm, 1991). These are remote from the observations, for example, suggesting that project managers mainly rely on their "gut feelings" of risk (Ropponen, 1999), focus on a few risk factors and ignore the others (Moynihan, 1997; 2002), objectively

assess risk most likely only once before the project begins (Bannerman, 2008; de Bakker et al., 2010; Taylor 2005) –if they do so at all–, and apply few risk management strategies "to all their projects, regardless of specific risks that had been identified" (Taylor, 2006, p.61).

Following the behavioral studies of managerial risk taking, our objective in this paper is to advance our understanding of how managers "define and react to risk, rather than how they ought to do so" (March and Shapira, 1987, p.1414) in the context of software projects. Therefore, we address the research question of: What are the antecedents of a software project manager's risk response behavior?

To answer this question, we review the past software project risk management literature, develop a revised assumption-ground, and offer a theoretical model consistent with it. We thus contribute by:

1) Extending recent efforts to address the assumptions underlying the software project risk management literature (e.g., de Bakker et al., 2010; Kutsch and Hall, 2010; Taylor et al., 2012) by systematically identifying, articulating, and revising the assumption-ground underlying the majority of extant studies. To do so, we apply the problematization methodology (Alvesson and Sandberg, 2011) to a selection of 55 past relevant articles. We first identify and spell-out each assumption by identifying a theoretical perspective that supports holding that assumption (e.g., classical decision theories). Then, we identify and discuss a theory that supports holding a differing assumption (e.g., behavioral decision theories). Subsequently, we develop the revised assumption-ground.
2) Developing a conceptual model –and a repertoire of propositions— which takes into account the revised assumption-ground and which aims at explaining and predicting

the risk response behavior of software project managers. To do so, we synthesize past relevant software project risk management studies and enrich them using studies pertaining to the behavioral decision theory (Kahneman and Tversky, 1979; March and Shapira, 1987) stream of research. Nevertheless, to facilitate and inform this theory building effort, we use the reasoned action approach (Fishbein and Ajzen, 1975, 2010) as a guide for reconceptualizing the constructs and also as a canvas for building the theory.

3) Providing suggestions for future research, including development of additional propositions and empirical test of them. Especially, we call for further research on project managers' attitude towards responding to risk, an important construct which is understudied in the past literature.

We begin the paper by discussing the assumptions of our theory.

Assumptions

Assumptions refer to those simplifications of the complex phenomena in the world, usually in the form of some propositions, which –over time– their truth is taken-for-granted (Davis, 1971). To implement the abovementioned idea of paying attention to the assumptions underlying software project risk management studies, we used a problematization approach (Alvesson and Sandberg, 2011). This approach provides a systematic way to identify, articulate, and revise the assumptions underlying an existing body of literature. In this study, we are interested in those assumptions that concern software project managers' decision regarding risk management. Such assumptions are referred to as "in-house assumptions" which are "a set of ideas held by a theoretical school about a specific subject matter" (Alvesson and Sandberg, 2011, p.254).

We applied problematization to 55 software project risk management studies conducted between 1978 and 2012. The main task of problematization is to perform a 'dialectic interrogation' of articles –investigating their assumptions in the light of other research carried out on the subject matter, related theories, and one's own position on the subject– in an iterative fashion. We implemented the dialectic interrogation by reading each article in depth, bearing in mind some relevant decision making under uncertainty theories. In doing so, we were attentive to whether assumptions were explicitly stated or were implicit to the study.

Consistent with the observations of past studies (Bannerman, 2008; de Bakker et al., 2010, Kutsch and Hall, 2005; 2009, 2010; Lauer, 1996; Lyytinen et al., 1998; Taylor, 2005, 2006, 2007; Taylor et al., 2012), we observed that software project risk management literature heavily draws upon classical decision theory, especially the expected utility theory (e.g., von Neumann and Morgenstern, 1947). As Lauer (1996, p.288) notes, early studies in the field, (e.g., Boehm, 1991 and Charette, 1989) "explicitly discuss expected utility theory." Later on, however, drawing on expected utility theory (EUT) seems to have become more implicit, for example, through building over such classic studies in the field.

EUT (von Neumann and Morgenstern, 1947) describes people's decision making under uncertainty. EUT assumes people to have an unbounded knowledge of the probability distribution of decision outcomes. EUT models the expected utility of a decision alternative using a combinatorial principle (i.e., a function which sums up the probability-weighted utility of each decision outcome. Later normative applications of EUT suggest decision makers to actually use this combinatorial principle to compute the amount of expected utility of decision outcomes. In EUT, the combinatorial principle is equally sensitive to the probability and utility of each decision outcome. While EUT was originally formulated for positive outcomes, further

applications of EUT have used this combinatorial principle in the same way for positive outcomes (utilities) and negative outcomes (disutilities). The utility function used by EUT implies that people are generally risk-averse; that is, they prefer a certain gain to a gamble which has an expected value equal to that certainty (Arrow, 1965). Finally, EUT postulates that people choose the decision alternative that has the maximum expected utility. As shown in the left-hand side of Table 1, past software project risk management research, to a large extent adopts these assumptions.

In line with the idea of having assumptions that better describe the observed behavior of software project managers, we referred to the behavioral decision theory (BDT). BDT studies provide evidence for the inadequacy of classical decision theory in describing the actual decision making behavior of people; thus, aim at providing a richer explanation (see Einhorn and Hogarth, 1981 and Slovic et al., 1977 for reviews and March and Shapira, 1987, for a discussion in the management context). We draw upon three key BDT studies to revise the assumptions. First, the study of heuristics and biases (Tversky and Kahneman, 1974) assumes people to have bounded knowledge of the probabilities of decision outcomes and suggests that they rely on the heuristics (i.e., mental shortcuts) to estimate such probabilities (see Gigerenzer and Gaismaier, 2011 for a recent review). Second, the prospect theory (Kahneman and Tversky, 1979) describes the people's decision making under uncertainty using a multiplicative combinatorial principle — akin EUT. In prospect theory, however, (1) people are modeled to be sensitive to the deviation of outcomes from a reference point (i.e., gains and losses relative to that point). (2) A person can have unequal sensitivities to probabilities and utilities of outcomes: the combinatorial principle first looks up the probability and value of the decision outcomes in two separate weighting and value functions and then multiplies the results. (3) People are modelled to be more sensitive to

losses than gains. (4) People experience different amounts of utility and disutility for the same amount of gains and losses. (5) People may be risk seeking decision makers (through proposing special curves for the weighing and value functions). Third and finally, the affect heuristic (Slovic et al., 2007) focuses on the affective reactions of people to risky stimuli. Drawing upon the evaluability principle, one key implication of the affect heuristic is that people facing a risky stimulus are generally more sensitive to magnitude of outcomes than to their probability of occurrence. The right-hand side of Table 1 shows our adaptation of these ideas as the revised assumptions for the study of software project managers' decision making behavior regarding project risk.

In sum, the revised assumption-ground goes beyond the 'hyper rational' view of risk management (Kutsch and Hall, 2010) offered by the extant assumption-ground by providing a more behavioral stance. While a few past software project risk management studies actually take into account some of these revised assumptions, such assumptions are yet to be considered as an ensemble in a theoretical model. In the next section, we will introduce the conceptual model of this study which is raised upon the revised assumption-ground.

Table 1 – Juxtaposing the Revised Assumption-Ground and the Extant Assumption-Ground

#	Extant Assumption Ground		Revised Assumption Ground
1	**Assumption**	The only source of information for project managers to make a decision about risk is/ will be an objective assessment of risk.	Project managers perceive risk in more natural ways than only objective assessments.
	Supporting Theory(s)	Normative applications of expected utility theory (von Neumann and Morgenstern, 1947)	Heuristic and biases (Tversky and Kahneman, 1974)
2.a	**Assumption**	Project managers do/will compute the extent of expected disutility due to risk using some formulae or rules of logic.	Project managers feel the extent of expected disutility due to risk.
	Supporting Theory(s)	**Normative applications of** expected utility theory (e.g., Boehm, 1989 in the software project risk management context)	Prospect theory (Kahneman and Tversky, 1979), Risk-as-feeling hypothesis (Loewenstein et al., 2000)
2.b	**Assumption**	The expected disutility is/will be sensitive to the absolute value of outcomes of the project.	Project managers are sensitive to the deviation of outcomes from a reference point (loss or gains).
	Supporting Theory(s)	Expected utility theory (von Neumann and Morgenstern, 1947)	Prospect theory (Kahneman and Tversky, 1979)
2.c	**Assumption**	The expected disutility is/will be linearly and equally sensitive to the components of risk (i.e., probability of and magnitude of loss due to occurrence of undesired outcomes)	The sensitivity of the expected disutility –felt by project managers— to the components of risk (probability of and magnitude of loss due to the occurrence of undesired outcomes) can be non-linear and unequal
	Supporting Theory(s)	Expected utility theory (von Neumann and Morgenstern, 1947)	Prospect theory (Kahneman and Tversky, 1979), the evaluability principle (Slovic et al., 2007), managerial risk perceptions (March and Shapira, 1987)
2.d	**Assumption**	The expected disutility is/will be equally sensitive to losses and gains.	Project managers can have unequal sensitivities to losses and gains.
	Supporting Theory(s)	Later applications of expected utility theory (von Neumann and Morgenstern, 1947) (Original EUT only discusses the gains domain)	Prospect theory (Kahneman and Tversky, 1979)
3	**Assumption**	Project managers are risk-averse.	Project managers can be either risk-averse or risk-seeking (i.e., are loss-averse).
	Supporting Theory(s)	Expected utility theory (von Neumann and Morgenstern, 1947); Risk aversion theory (Arrow, 1965)	Prospect theory (Kahneman and Tversky, 1979)
4	**Assumption**	The only factors influencing a project manager's decision making with respect to risk are an objective assessment of risk, a calculated extent of disutility, and a constant willingness to minimize risk.	Project managers' decision making with respect to risk may be influenced by a variety of factors.
	Supporting Theory(s)	Expected utility theory (von Neumann and Morgenstern, 1947)	Prospect theory (Kahneman and Tversky, 1979); Managerial risk perception (March and Shapira, 1987) Positive outcomes of uncertainty factors (Weber et al., 1992); risk propensity (MacCrimmon and Wehrung, 1990); personal relevance of outcomes (Williams and Wong, 1999); problem framing (Kahneman and Tversky, 1979); and affective states (Slovic et al., 2007).

Conceptual Model and Constructs

Conceptual Model

Figure 1 illustrates our conceptual model and presents the key constructs and relationships that will be studied in this paper. Furthermore, this figure indicates the relationships in which each particular revised assumption will be taken into account.

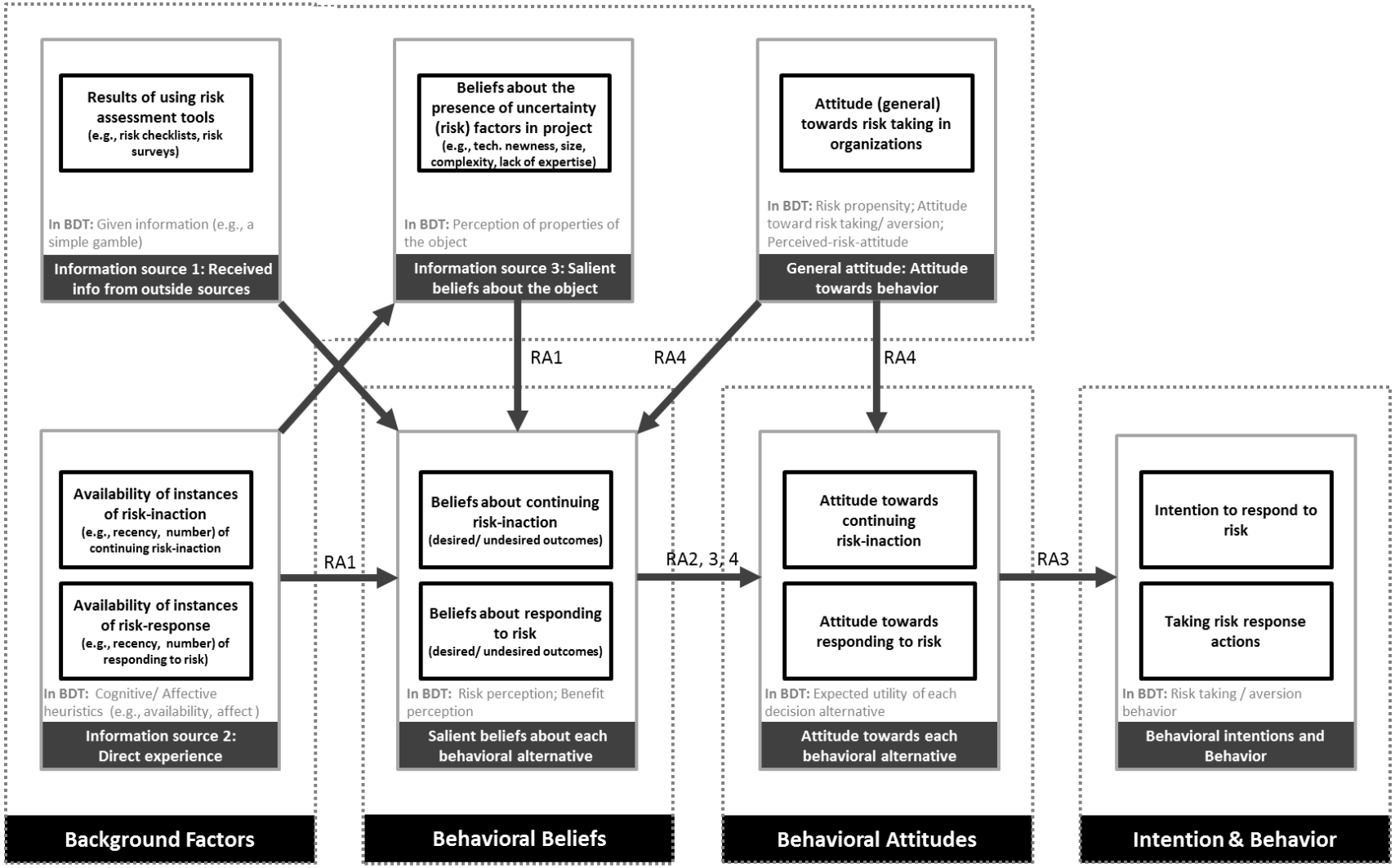
To arrive at this model, first, we identified the relevant constructs and relationships based on a review of previous studies of the risk-related behaviors of software project managers (e.g., Keil et al., 2000a, b, c; Kutsch and Hall, 2010), in addition to the relevant integrative works in the broader managerial risk perception area (e.g., March and Shapira, 1987; Sitkin and Pablo, 1992; Williams and Wong, 1999). Then, we enriched them using both BDT studies and the reasoned action approach (Fishbein and Ajzen, 1975, 2010). In particular, as indicated in Figure 1, we mapped these constructs and relationships onto the reasoned action approach.

The reasoned action approach is widely known to explain the individual level behavior across contexts. In the context of the present study, assuming that "the project manager is the main risk actor" (Kutsch and Hall, 2005, p.593), the reasoned action approach can be used to guide the study of a software project manager's risk-response behavior. Generally speaking, the reasoned action approach suggests that behaviors will reasonably follow the related attitudes and beliefs (Fishbein and Ajzen, 2010). More specifically, as the principle of compatibility in this approach suggests, "A single behavior can be viewed as involving an action directed at a target, performed in a given context, at a certain point in time [...] The principle of compatibility [...] requires that measures of attitude and behavior involve exactly the same action, target, context, and time elements, whether defined at a very specific or at a more general level" (Ajzen and Fishbein, 2005, pp.182-183). Therefore, we pay extra attention to the compatibility of the

predictors of the risk response behavior to it. As this approach has been relevant to behavioral decision making under risk (e.g., Mukherji and Wright, 2002; Park and Blenkinsopp, 2008), we are confident in its relevance to explain software project managers' behaviors in response to project risk.

It is noteworthy that we have distinguished two behavioral alternatives of continuing risk-inaction and responding to risk in our model. We view these behavioral alternatives as separate constructs for two reasons. First, their antecedents are qualitatively different: Beliefs about risk-inaction concern the information about projects that were troubled when no action was taken to redirect them. Beliefs about risk response, however, concern the information about projects in which risk response actions were taken, the efficiency/effectiveness of those actions and alike. Second, attitudes towards these behavioral alternatives might equivocally coexist. That is, these attitudes are not necessarily simple opposites and can be positive or negative at the same time. For example, a project manager who does not evaluate continuing risk-inaction as positive might at the same time evaluate undertaking the available risk-response actions as negative.

Table 2 summarizes our definitions of the constructs of the conceptual model. In the following section, we will derive some propositions from this model. Finally, in the Future Research section we will discuss how further propositions can be developed based on this model.



Legend: RA: Revised Assumption; BDT: Behavioral Decision Theory

Figure 1 - Conceptual Model

Table 2 – Definitions of Key Constructs

Relevant Construct in the Reasoned Action Approach	Construct	Definition	Relevant Constructs in the Software Project Risk Management Context	Relevant Constructs in BDT
Object of behavior	Software project	A temporary endeavor to deliver software (and the accompanying hardware) to users in organizations.	"IT projects" de Bakker et al. (2010, p.494); "IT projects" Kutsch and Hall, (2009, p.72); "software development" Lyytinen et al., (1998, p.234)	"A prospect" (Kahneman and Tversky, 1979)
Behavioral alternatives	Continuing risk-inaction	The extent to which a project manager carries-on undertaking the software project in its existing condition – without taking any pre-emptive actions about the potential undesired outcomes.	"decisions not to pursue any active management of risk" Kutsch and Hall (2009, p.78); "deliberate ignoring" Kutsch and Hall, (2010, p.247); "escalation" Keil (1995, p.428); "escalation" Keil et al. (2000b, p.634)	Risk taking behavior
			"Decision to continue the project" Huff and Prybutok (2008, p.39); "the choice to apply project risk management to mitigate project risk or may choose not to manage it" Kutsch and Hall (2005, p. 592); "a decision … either to continue with or delay the previously scheduled launch" Keil et al. (2008, p.912); "Continue with the project as is [vs. making a change in the project]" Lauer (1996, p.291); "Decision of whether or not to continue with the project" Keil et al. (2000a, p.151); "whether to continue or abandon a troubled project" Keil et al. (2000c, p.299)	
	Responding to risk	The extent to which a project manager takes actions in a software project aiming at reducing potential undesired outcomes.	"risk response action" Taylor et al. (2012, p.19); "*management* approach of risk management … *how* to deal with risks in order to prevent a project from failing" de Bakker et al. (2010, p.495); "actions that project managers use in practice to address risks identified for their projects" Taylor (2006, p.50); "'recipes' that experienced PMs use to cope with project risk" Moynihan (2002, p.379); "whistle-blowing" Keil et al. (2007, p.59)	Risk aversion behavior
Behavioral intentions	Intention to respond to risk	The subjective probability that a software project manager takes actions in the software project aiming at reducing the probability of or impact due to occurrence of undesired outcomes.	"Decision maker's willingness to continue a project under conditions of sunk cost" (Keil et al., 2000c, p.300)	N/A

Beliefs about object	Beliefs about characteristics of the software project	A software project manager's subjective probability that some exciting/ unexciting uncertainty factors are associated with a particular software project.	"uncertainty and risk … both terms used to describe project characteristics that tend to increase the probability of project failure" Barki et al. (2001, p.43); "uncertainty factors" Barki et al. (1993, p.207); "project risk factors" Wallace et al. (2004, p.291)	N/A
Behavioral beliefs	Perceived risk/benefit of continuing risk-inaction	A set of salient beliefs held by a software project manager about the undesired/desired outcomes of carrying-on the project– without taking any pre-emptive actions about the potential undesired outcomes, with each belief being accounted for by a subjective probability (SP-/SP+) of and an estimated loss (X-)/ gain(X+) due to occurrence of the corresponding undesired/desired outcome.	"Risk interpretation" Pablo (1999, p.99); "Risk perception" Keil et al. (2000a, p.146); "Risk perception" Du et al. (2007, 272)	"Risk perception" Slovic (1987, p.236); "Risk perception" Sitkin and Weingart (1995, p.1575)
	Perceived risk/benefits of responding to risk	A set of salient beliefs held by a software project manager about the undesired/ desired outcomes of taking pre-emptive actions about the potential undesired outcomes of the project, with each belief being accounted for by a subjective probability (SP+/SP+) of and an estimated gain (X+)/ loss due to occurrence of the corresponding undesired/desired outcome.	"opportunity [vs. risk]" Fairley (1994, p.58)	"Attractiveness" Weber et al. (1992)
Behavioral attitudes	Attitude towards continuing risk-inaction	A software project manager's overall favorable or unfavorable evaluation of carrying-on undertaking the software project in its existing condition –without taking any pre-emptive actions about the potential undesired outcomes.	N/A	A risk-taking attitude
	Attitude towards responding to risk	A software project manager's overall favorable or unfavorable evaluation of taking actions in the software project aiming at reducing the probability of or impact due to occurrence of undesired outcomes.	"attitude towards risk management" Nyfjord and Kajko-Mattsson (2008, p.66)	A risk-averse attitude
Background factors	Risk propensity (i.e., attitude (general) towards risk taking in organizational contexts	A project manager's favourable or unfavourable evaluation of performing actions which have mixed desired and undesired potential outcomes, in the general context of software projects –but not about a particular software project.	"Risk propensity" Keil et al. (2000a, p.146); "the project manager's attitudes toward risk" Lauer (1996, p.287) ; "Risk propensity" Huff and Prybutok (2008, p.36)	"risk propensity" MacCrimmon and Wehrung (1990); "Risk propensity" Nicholson, et al. (2005, p.160);

				Risk taking propensity" Sitkin and Pablo (1992, p.12)
	Availability	The ease with which instances or examples of the event may be retrieved from memory.	N/A	
	Availability of instances of continuing risk-inaction	The ease with which a software project manager may retrieve from memory the (successful/ unsuccessful) cases of moving projects ahead without taking actions which aim at reducing the undesired project outcomes.	N/A	"Availability" Tversky and Kahneman (1974) "Judgment of availability" Billings and Schaalman, 1980, p.98)
	Availability of instances of risk response	The ease with which a software project manager may retrieve from memory the (successful/ unsuccessful) cases of taking actions which aim at reducing the undesired project outcomes.		
	Results of using risk assessment tools	The output generated by a project manager's use of a risk assessment tool which provides risk information such as the extent of risk analyzed to exist in the project risk (probability, exposure, etc.), the risk factors identified to be relevant to the project, etc.	"risk identification" [by a list of risk items] Lyytinen et al. (1998); "[use of checklist is to] provide a comprehensive risk profile" Keil et al. (2008, p.911) "the way they encourage managers to view risks" Du et al. (2007, p.271)	N/A

Propositions

In order to derive propositions from the conceptual model in a manageable fashion, we present them within three subsections. First, we will investigate the antecedents of attitude towards continuing risk-inaction. Then, we will focus on the antecedents of attitude towards responding to risk. Finally, we will propose how these two attitudes influence a software project manager's risk response behavior.

Predicting Attitude towards Continuing Risk-Inaction

Figure 2 illustrates the relationships that we will investigate in this subsection.

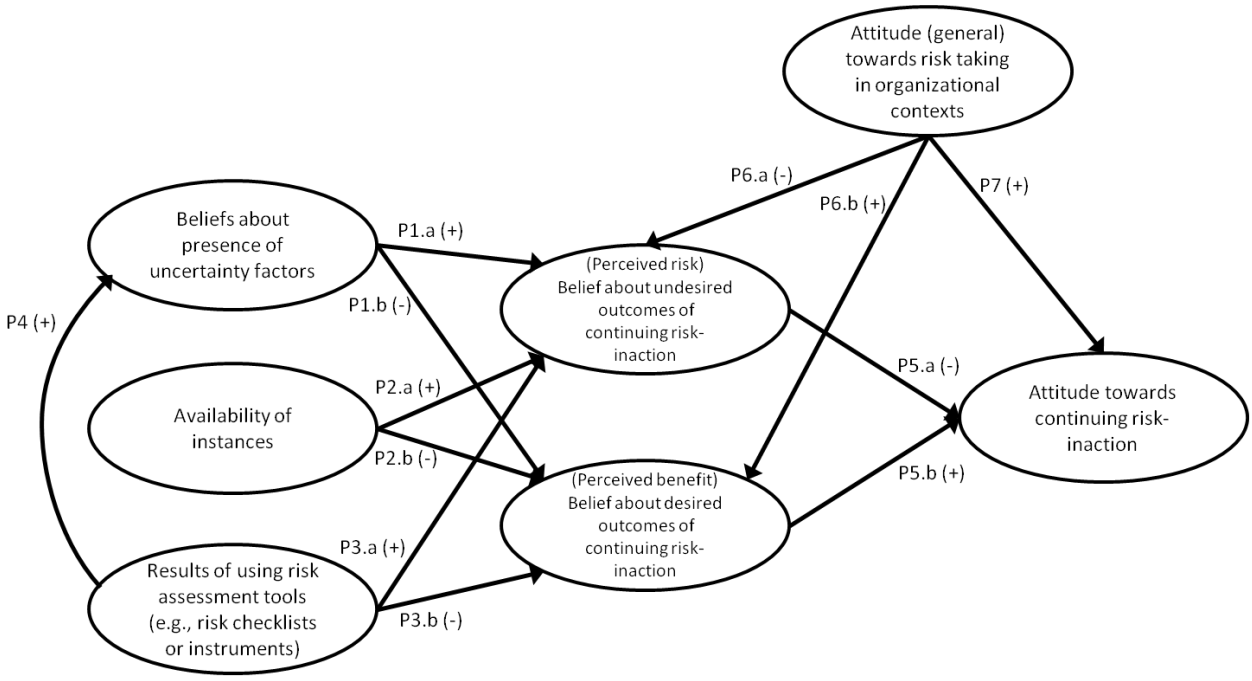


Figure 2 - Explaining and Predicting Attitude towards Continuing Risk-Inaction

Beliefs formation. A software project manager's perceived risk and benefit of continuing risk-inaction are suggested to vary based on a cognitive analysis of risk factors and their potential undesired outcomes (e.g., Moynihan, 1997), gut feelings (e.g., Ropponen, 1999), and use of attention shaping tools (e.g., Lyytinen et al., 1998). As such, these factors map onto the three sources of variation in beliefs suggested by the reasoned action approach:

> On the basis of direct observation or information received from outside sources or by way of various inference processes, a person learns or forms a number of beliefs about an object. That is, he associates the object with various attributes. (Fishbein and Ajzen, 1975, p.14)

In the following, we develop Propositions 1 to 4 to investigate such variation in beliefs.

P1: Several uncertainty factors of software projects are identified in past research (e.g., Schmidt et al., 2001). Identifying uncertainty factors is based on idea that in future projects, a project manager's awareness of presence of such factors will alert him/her that the project might end up with some undesired outcomes (de Bakker et al., 2010; Moynihan, 2002).

Such inference of beliefs about project outcomes based on the beliefs about the presence of causes of uncertainty factors (causes of variation in outcomes) maps onto the reasoned action approach's suggestions that "beliefs formed on the basis of an observation lead to the formation of new beliefs" (Fishbein and Ajzen, 1975, p.14). In particular, beliefs about outcomes can be influenced by beliefs in causes. Supporting this idea, BDT studies suggest that the "ease of cognitively constructing an event" is influenced by the number of "reasons or causes" one believes to exist for its occurrence (Levi and Pryor, 1987, pp.220-221).

Consequently, a project manager's belief in presence of some uncertainty factors in a project can be expected to influence his/her beliefs about the outcomes of carrying the project on while having such uncertainty factors.

Therefore, it is proposed that

Proposition 1: *A project manager's salient beliefs about presence of uncertainty factors in a software project will impact his/her salient beliefs about outcomes of continuing risk-inaction in that project.*

Proposition 1.a: *Salient beliefs about presence of uncertainty factors positively influence salient beliefs about the undesired outcomes (i.e., perceived risk) of continuing risk-inaction.*

Proposition 1.b: *Salient beliefs about presence of uncertainty factors negatively influence salient beliefs about the desired outcomes (i.e., perceived benefits) of continuing risk-inaction.*

Moynihan (2002) provides project managers with list of constructs –resembling uncertainty factors— and asks them to identify how much risk is perceived for presence of each of the constructs in a hypothetical project. He observes that for a project manager, perception of risk varies across the constructs; thus, provides basic support for Proposition 1.

P2: A software project manager's perception of risk is suggested to vary based on his/her "gut feelings" (Ropponen, 1999) or situational awareness (Taylor, 2007) with such feelings or awareness being a result of the direct involvement of the project manager with a project.

Such sources of belief variation coincide with the notion of heuristics in the BDT literature. Heuristics are mental shortcuts which people use to easily and quickly arrive at a judgment with respect to the object of judgement (Tversky and Kahneman, 1974). In formal terms, a heuristic is "a strategy that ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods" (Gigerenzer and Gaissmaier, 2011, p.454). For simplicity, here we suffice to discuss the availability heuristic (Tversky and Kahneman, 1974) —the most widely discussed cognitive heuristic (Kahneman, 2003).

The availability heuristic refers to the people's reliance on the readily available information to judge the attributes of the object of judgement (Tversky and Kahneman, 1974). For example, the availability heuristic suggests that "estimations of the likelihood of an event are influenced by the ease with which instances or examples of the event may be retrieved from memory" (Billings and Schaalman, 1980, p.98). Availability has multiple dimensions including the number of recalled instances, relative frequency of similar instances, similarity of the current situation and remembered instances, familiarity of the person with the situation, and recency of a similar instance (Billings and Schaalman, 1980). Availability can be mapped onto the reasoned action approach as an antecedent of beliefs since salient beliefs are suggested to be the ones which are "readily accessible" in memory" (Ajzen, 2011, p.1118).

Consequently, availability of instances of successful/ unsuccessful similar projects in which risk were not respond to can be expected to cause a variation in a software project manager's perception of the desired/undesired outcomes of continuing risk-inaction in a project.

Therefore, it is proposed that

Proposition 2: *Availability of similar instances will impact a software project manager's salient beliefs about outcomes of continuing risk-inaction in that project.*
Proposition 2.a: *Availability of unsuccessful instances of continuing risk-inaction (e.g., number, recency) will positively influence the perceived risk of continuing risk-inaction (and vice versa).*
Proposition 2.b: *Availability of unsuccessful instances of continuing risk-inaction (e.g., number, recency) will negatively influence the perceived benefit of continuing risk-inaction (and vice versa).*

In the context of IS pre-implementation decision making, Jamieson and Hyland (2006) find that "Many decision makers relied on gut feel and simple heuristics to simplify decision making … Gut feel is often a tangible application of expertise but encompassed the need for a solution to 'feel right'" (para.18).

P3 and P4: Risk assessment tools, whether for risk analysis or risk identification purposes (Boehm, 1991), influence a project manager's perceived risk (Du et al., 2007; Lyytinen et al. 1998). A variation in one's beliefs based on the received information from tools is is in accordance with the reasoned action approach's idea that "information received from outside sources" may influence one's beliefs (Fishbein and Ajzen, 1975, p.14).

On one hand, tools for risk analysis such as risk measurement instruments (e.g., Barki et al., 2001) provide an estimate the extent of 'riskiness' or exposure to risk. Consequently, results of using such tools can be expected to impact the strength of beliefs about potential desired/ undesired outcomes of a carrying a project on.

Therefore, it is proposed that

Proposition 3 *Results of the risk assessment tools used by a project manager will impact his/her beliefs about outcomes of continuing risk-inaction in that project.*

Proposition 3.a: *Those results of risk assessment tools that suggest undesired outcomes positively influence perceived risk of continuing risk-inaction (and vice versa).*

Proposition 3.b: *Those results of risk assessment tools that suggest undesired outcomes negatively influence perceived benefit of continuing risk-inaction (and vice versa).*

On the other hand, tools for risk identification, such as risk checklists (e.g., Lyytinen et al., 1998; Moynihan, 1997; Schmidt et al., 2001), provide insight about the presence of certain risk factors in a project. Because different tools focus on different uncertainty factors (Lyytinen et al., 1998), "different assessment tools will contribute to shaping managerial attention in different ways" (Du et al., 2007, p.271); accordingly, they are also known as attention shaping tools. Consequently, results of using such tools can be expected to influence the saliency of beliefs about existence of different uncertainty factors in a project.

Therefore, it is proposed that

Proposition 4: *Results of the risk assessment tools used by a project manager will impact his/her salient beliefs about existence of uncertainty (risk) factors in a software project.*

Proposition 4.a: *The more a risk assessment tool highlights the presence of an uncertainty factor, the more likely it appears in a project manager's set of salient beliefs about the presence of uncertainty factors in the project.*

Keil et al. (2000a) find a significant positive influence from the given risk information on the perceived risk of software project managers, providing support for Proposition 3.a. Moreover, Keil et al. (2008, p.915) found that use of a risk checklist (a risk identification tool) heightens risk perception through increasing the number of the identified risk factors, supporting Proposition 4.a. However, Du et al. (2007, p.279) found that "the attention-shaping tool [a risk checklist] did significantly impact risk perception for individuals with low expertise" but not for experienced IT project managers. As such, this finding provides a challenge for generalizability of Proposition 4.a.

Attitudes formation. In the following, we develop Propositions 5 to explain the beliefs-attitude relationships.

P5: A software project manager's attitude towards continuing risk-inaction without responding to risks is so far understudied. Nevertheless, according to March and Shapira (1987), managers have mixed affective evaluations of intentional risk taking: "Managers recognize the emotional pleasures and pains of risk taking, the affective delights and thrills of danger. Risk taking involves emotions of anxiety, fear, stimulation and joy" (p.1409). In a similar vein, Sjöberg (2007) notes that risk is commonly associated with "dread and worry [...] Yet, the reason that people are active with something is usually that they are interested and feel positive about doing it, in one sense or another [...]"(p.232).

Such evaluation of a decision alternative with potential outcomes of mixed valence is modelled in BDT using the notion of expected utility or choice preference criteria. Expected utility is traditionally known to model a rather cognitive integration of the information about potential outcomes. However, it is now increasingly suggested that the notion of expected utility–to large extent– represents people's affective evaluation of the potential outcomes. According to Kahneman (2003),

> Utility cannot be divorced from emotion ... A theory of choice that completely ignores feelings such as the pain of losses and the regret of mistakes is not just descriptively unrealistic. It also leads to prescriptions that do not maximize the utility of outcomes as they are actually experienced [...]. (p.706)

Such affective evaluation related to one's beliefs can be mapped onto the reasoned action's suggestion that one's beliefs about potential outcomes of behavior combined with

evaluations of them leads to formation of an affective evaluation (i.e., attitude) towards that behavior (Fishbein and Ajzen, 1975).

Consequently, a project manager's attitude towards continuing risk-inaction can be expected to be influenced by his/her salient beliefs about outcomes of doing so.

Therefore, it is proposed that

Proposition 5: *Because people evaluate their beliefs, beliefs about the outcomes of continuing risk-inaction will influence a project manager's attitude towards such behavior.*
Proposition 5.a: *Perceived risk of continuing risk-inaction negatively influences attitude towards continuing risk-inaction.*
Proposition 5.b: *Perceived benefit of continuing risk-inaction positively influence attitude towards continuing risk-inaction.*

As mentioned above, at the abstract level, this relationship maps onto the belief-attitude relationship of the reasoned action approach. We should note, however, that the combinatorial principle used to *model* the belief-by the reasoned action approach is tightly linked to the subjective expected utility theory. That is, Fishbein and Ajzen (1975, p.27) explicitly refer to the subjective expected utility theory in the BDT literature (e.g., Edwards, 1954) by making an analogy of attitudes to subjective expected utilities, beliefs to subjective probabilities, evaluation to values, and then by using the same principle to combine them. Such correspondence to the SEU implies that several assumptions are shared with the EUT. Therefore, in order to be consistent with the revised assumption ground, we suggest to use the combinatorial principle of prospect theory (Kahneman and Tversky, 1979) than that of the attitude theory (Fishbein, 1963) to model this relationship. Note that such update is does not violate the Ajzen and Fishbein's (2008) recommendation that the combinatorial principle should have a multiplicative nature.

Biasing factors. Biasing factors might influence the people's gathered information (over/under-estimation) and their sensitivity (over/under-weighing) to such information (Kahneman and Tversky, 1979). We develop Propositions 6 and 7 to explain the impact of an

instance of such biasing factors, namely risk propensity, on the beliefs and attitude about outcomes of continuing risk-inaction in a project.

P6: Risk propensity is suggested to influence a decision maker's behavior in the software project management decision making context (Huff and Prybutok, 2008; Keil et al., 2000a; Lauer, 1996). A project manager who is a risk taker (i.e., has a positive attitude –general– towards risk taking) in the organizational contexts perceives less undesired outcomes and more desired outcomes for continuing risk-inaction.

Consistently, risk propensity is a key factor studied by BDT (Sitkin and Pablo, 1992). For example, a risk taking attitude is suggested to cause the underestimation of probabilities of undesired outcomes (Kahneman and Tversky, 1979). The general attitude towards risk taking is represented by the shape of evaluation functions in the prospect theory; however, we capture it through a separate construct in order to study its influence on the related beliefs and attitudes. The reasoned action approach recognizes general attitudes as background factors which influence one's behavioral beliefs (Fishbein and Ajzen, 2010).

Consequently, a software project manager with positive attitude (general) toward taking risk in the organizational contexts can be expected to attend more to the positive aspects of the decision making object and less to the negative aspects, thus making related beliefs salient.

Therefore, it is proposed that

Proposition 6: *Attitude (general) towards risk taking in organizational contexts causes over/under estimation of outcomes of continuing risk-inaction in the project.*

Proposition 6.a: *The more positive the attitude (general) towards risk taking in organizational contexts, the lower the perceived risk (and vice versa).*

Proposition 6.b: *The more positive the attitude (general) towards risk taking in organizational contexts, the higher the perceived benefit (and vice versa).*

A significant negative relationship between the risk propensity and risk perception constructs (Huff and Prybutok, 2008; Keil et al., 2000a) has been found in past software project

risk management research, providing support for Proposition 9. Furthermore, Kutsch and Maylor (2011, p.122) observe an "apparent tendency towards underestimation of risk in IT projects by project managers" which might be in part, because of that most software project managers have risk taking propensity.

P7: As studies in BDT suggest, people's attitude towards risk influences their evaluation of decision alternatives through over/under-weighing of evaluations (e.g., Kahneman and Tversky, 1979). For example, insights from the prospect theory (Kahneman and Tversky, 1979) suggest that risk propensity of favoring risk leads to overweighing the probability of gains, underweighting probability of losses, getting higher than normal utility from gains, and being hurt less than normal from losses. Such relationship can be mapped onto the reasoned action approach as the influence of an external factor on the related attitude (Fishbein and Ajzen, 1975).

Consequently, a project manager who is a risk taker (i.e., has a positive attitude – general— towards risk taking) in the organizational contexts is expected to be less sensitive to information about undesired outcomes of the project than to the information about the desired ones. Therefore, we expect that the project managers who is a risk taker has more positive attitude towards continuing risk-inaction in a project than who is a risk averse.

Therefore, it is proposed that

Proposition 7: *Attitude (general) towards risk taking in organizational contexts leads to over/under weighting of the outcomes of the continuing risk-inaction in the project; thus impacts a project manager's attitude towards continuing risk-inaction.*

Proposition 7.a: *The more positive the attitude (general) towards risk taking in organizational contexts, the more positive the attitude towards continuing risk-inaction.*

Some support for the influence of risk propensity on the attitude towards carrying the project on as-is is can be found in the March and Shapira's (1987) observation that:

In general, the managers studied by Shapira (1986) expect the choice of an alternative to be justified if large potential losses are balanced by similarly large potential gains, but they do not seem to think that they would require the expected value of a riskier alternative to be greater than that of the less risky in order to justify choice. (p.1409)

Predicting Attitude towards Responding to Risk

Figure 3 illustrates the relationships that we will investigate in this subsection.

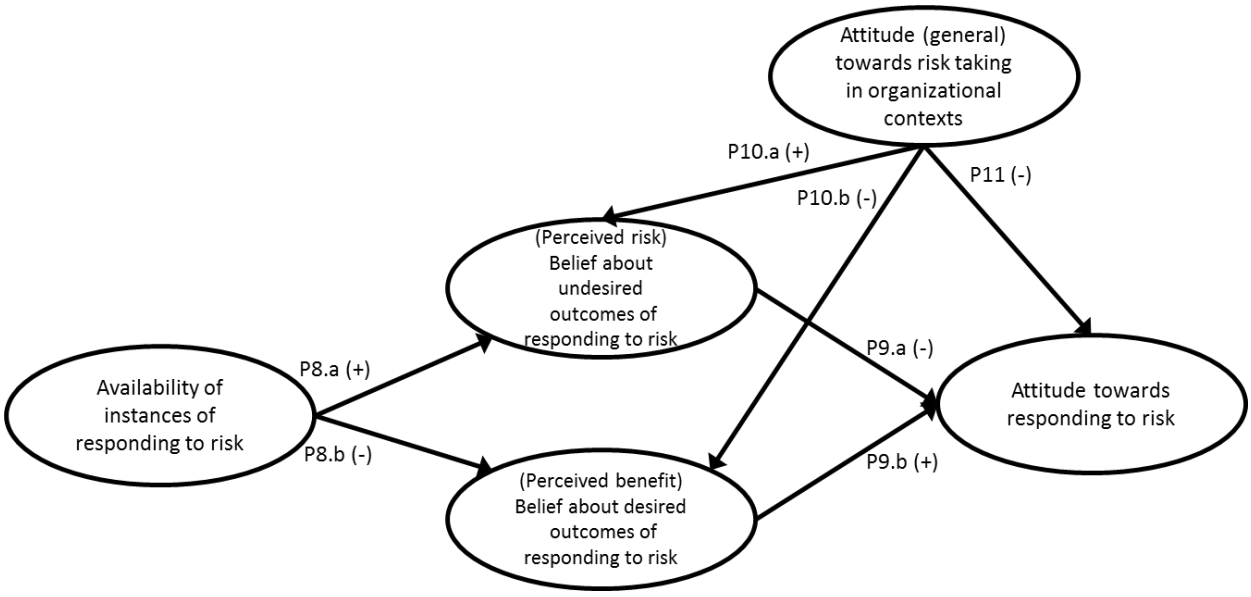


Figure 3 - Explaining and Predicting Attitude towards Responding to Risk

Beliefs formation. We develop Proposition 8 to provide an explanation for the variation in project managers' beliefs about outcomes of responding to risk. In doing so, we suffice to discuss the role of availability of instances of risk response.

P8: Software project managers hold a wide range of beliefs about the outcomes of performing project risk management (Kutsch and Hall, 2010; Ropponen and Lyytinen, 1997). For example, on one hand, project managers might believe that performing risk management can

improve project performance (Ropponen and Lyytinen, 1997). On the other hand, project managers might believe that risk management "creates anxiety among shareholders" and leads to disagreement between them (Kutsch and Hall, 2010, p.248). Such beliefs are suggested to be linked to a project manager's experience (de Bakker et al, 2010; Du et al., 2007; Moynihan, 1997). Likewise, in the management context, March and Shapira (1987) state that "Managerial confidence in the possibilities for post-decision reduction in risk comes from an interpretation of managerial experience. Most executives feel that they have been able to better the odds in their previous decisions" (p.1410).

In BDT research, the availability heuristic —introduced above— offers a link between the memories of past experiences to one's current beliefs (Tversky and Kahneman, 1974). Similarly, the reasoned action approach suggests that accessibility of memories leads to making corresponding beliefs salient (Ajzen, 2011).

In the software project risk management context, for example, a project manager's beliefs about outcomes of responding to risk will be influenced by outcomes of recent experiences with risk response, especially in the last project in which risk response has been practiced. Consequently, a project manager's availability of instances of successful or unsuccessful experience with risk response in the past can be expected to influence his/her beliefs about the outcomes of responding to risk in a project.

Therefore, it is proposed that

Proposition 8: *Availability of similar instances of responding to risk will impact a project manager's beliefs about outcomes of risk response in that project.*

Proposition 8.a: *Availability of unsuccessful instances of responding to risk (e.g., number, recency) will positively influence the perceived risk of risk response (and vice versa).*

Proposition 8.b: *Availability of unsuccessful instances of responding to risk (e.g., number, recency) will negatively influence the perceived benefit of risk response (and vice versa).*

Ropponen and Lyytinen (1997) observe that software project managers generally believe risk management methods to have "a positive impact both on the development process and its outcomes" (p.43). Nevertheless, they find that such perception of positive outcomes of performing risk management is related to the "number" of previously managed projects, providing some support for Proposition 8.

Attitude formation. We develop Proposition 9 to offer an explanation for the variation in the software project managers' attitude towards responding to risk.

P9: Some project managers believe that costs of risk management are not justified (Kutsch and Hall, 2009); this, implicitly suggests the possibility of a negative attitude towards responding to risk for them.

In the general management context, March and Shapira (1987) suggest that although managers describe a negative attitude towards individual risk taking in the organizations, they individually feel positive about taking controlled risks. That is, managers have a positive attitude towards complementing risk taking with actions aimed at reducing danger and retain benefits.

The relationship between beliefs about outcomes of risk response and the attitude towards doing so can be mapped onto the belief-attitude relationship in the reason action approach (Fishbein and Ajzen, 1975).

Consequently, a software project manager's belief in the positive or negative outcomes of risk response can be expected to influence his/her attitude towards doing so.

Therefore, it is proposed that

Proposition 9: *Because people evaluate their beliefs, a project manager's attitude towards responding to risk will be influenced by his/her beliefs about the outcomes of such behavior.*

Proposition 9.a: *Perceived risk of risk response negatively influences the attitude towards responding to risk.*

Proposition 9.b: *Perceived benefit of performing risk response positively influences the attitude towards responding to risk.*

A direct empirical study of attitude towards *responding to risk* is yet to be conducted in the software project management context. Nevertheless, past studies provide few instances of why project managers believe that 'risk management does not worth it'; thus imply a negative attitude towards risk management based on such beliefs (Kutsch and Hall, 2009).

Biasing factors. From a behavioral perspective, one might expect the beliefs about outcomes of *responding to risk* in a project and attitude towards performing such behavior to be biased by other factors. In the following, Proposition 10 focuses on the bias on the people's gathered information and Proposition 11 discusses the bias on their sensitivity to such information.

P10 and P11: Given the high perceived costs of performing risk management (Kutsch and Hall, 2009), a software project manager who is a risk taker (i.e., has a positive attitude – general— towards risk taking in organizational contexts) can be expected to prefer to passively wait for problems to occur and then find a solution for them; rather than to spend costs to prevent the problems before they occur. Thus, such project manager will have relatively strong beliefs in the undesired outcomes of *responding to risk.*

Consequently, a software project manager who is a risk taker can be expected to have stronger beliefs about downsides of risk response than one who is risk averse.

Therefore, it is proposed that

Proposition 10: *A software project manager's attitude (general) towards risk taking in organizational contexts causes over/under estimation; thus, biases his/her perceived outcomes of responding to risk.*

Proposition 10.a: *The more positive the attitude towards risk taking, the higher the perceived risk of responding to risk (and vice versa).*

Proposition 10.b: *The more positive the attitude towards risk taking, the lower the perceived benefit of responding to risk (and vice versa)*

As BDT studies suggest, risk propensity leads to over/under-weighing information when making decisions (Kahneman and Tversky, 1979). This can be mapped onto the influence of an external factor on an attitude in the reasoned action approach (Ajzen and Fishbein, 2000).

Consequently, a project manager who is a risk taker (i.e., has a positive attitude –general– towards risk taking) in the organizational contexts is expected to be less sensitive to information about desired outcomes of the project risk response than to the information about the undesired outcomes; thus, he/she will have a relatively negative attitude towards responding to risk in a project.

Therefore, it is proposed that

Proposition 11: *A software project manager's attitude (general) towards risk taking in organizational contexts causes over/under weighting of outcomes of responding to risk in the project; thus, impacts the project manager's attitude towards responding to risk.*

Proposition 11.a: *Attitude towards risk taking in the organizational contexts negatively influences attitude towards responding to risk.*

This relationship is not explored in the software project risk management context yet.

Predicting Risk Response Behavior

Figure 4 illustrates the relationships that we will investigate in this subsection.

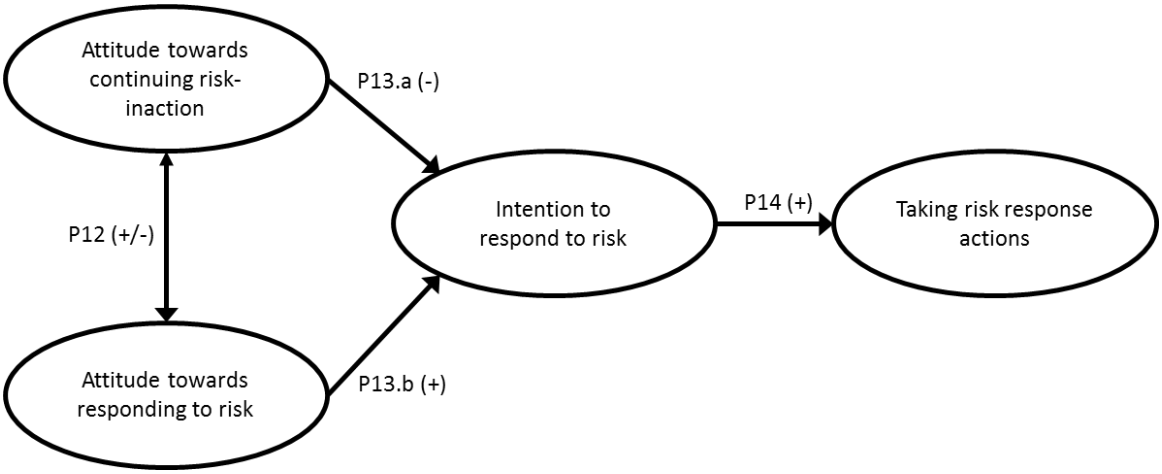


Figure 4 - Explaining and Predicting the Risk Response Behavior

Behavior formation from attitudes and intention. We develop Proposition 12 to explain the mutual relationship of a software project manager's attitude towards responding to risk and his/her attitude towards continuing risk-inaction in a project. Then, we advance Proposition 13 and 14 to explain how these two attitudes influence a software project manager's behavioral intention and behavior.

P12: While attitude towards continuing risk-inaction and attitude towards responding to risk are not simple opposites –because they are qualitatively distinct and also have differing antecedents— they appear to be interrelated (Fischhoff et al., 1978). On one hand, one might expect that if a project manager does not like to continue risk-inaction, he/she might like to respond to risk.

Therefore, it is proposed that

Proposition 12.a: *A software project manager's attitude toward continuing risk-inaction and attitude toward responding to risk are negatively correlated.*

One the other hand, one might argue that since these two behavioral alternatives are distinct, contradicting attitudes could coexist. That is, a software project manager who has a negative attitude towards continuing risk-inaction might not necessarily have a positive attitude towards responding to risk (and vice versa). Deliberate ignorance of risk when risk management is a "taboo" is an example of such case (Kutsch and Hall, 2010). In such situation, a project manager might feel uncomfortable because he/she is aware of presence of risk; however, he/she might not favor responding to risk and deliberately ignore risk because talking about risk is a "taboo".

Therefore, as a rival proposition:

Proposition 12.b: *A software project manager's attitude toward continuing risk-inaction and attitude toward responding to risk are independent.*

Further research is required to investigate such relationship.

P13: While some past studies find a significant relationship between risk perception and risk behavior (Keil et al., 2000) other studies (Keil et al., 2008) did not find one. One potential reason for such inconsistency could be that risk response in software projects is usually more complex than avoiding risk (Fairley, 1994).

In the BDT research, Sjöberg (2007) suggests that "Even if a hazard is regarded as a threat, we may feel positive about acting on it, feeling hope that something may be done to mitigate the risk ..." (p.232). In a similar vein and in the general management context, taking good risk is believed to be equal to accompanying risk taking by efforts to keep risk under control (March and Shapira, 1987).

Therefore, a software project manager's decision to mitigate risk is not an obvious choice and depends on the particularities of the project. For example, "a project manager would act sensibly by, for example, not applying project risk management because he or she rates the utility of not using project risk management as higher than the utility of confronting stakeholders with discomforting information" (Kutsch and Hall, 2009, p.78). As such, a project manager can be expected to compare the utility of responding and not responding to risk when making such decision.

Such consideration of multiple behavioral alternatives in predicting a behavior maps onto the recent recommendation by the reasoned action approach to include the attitude towards each behavioral alternative in predicting a behavior (Fishbein and Ajzen, 2009; Richetin et al., 2011). In this case, the person can be expected to choose and perform "the one with the most positive attitude" (Sheppard et al., 1988, p.327). Nevertheless, we adopt the reasoned action approach's suggestion that the impact of attitudes on behavior is mediated through corresponding behavioral intention (Fishbein and Ajzen, 1975).

Consequently, a software project manager's attitude towards each behavioral alternative can be expected to influence his/her intention to respond to risk.

Therefore, it is proposed that

Proposition 13: *A software project manager's behavioral intention is consistent with his/her relevant behavioral attitudes.*
Proposition 13.a: *The attitude towards continuing risk-inaction will negatively impact the intention to respond to risk.*
Proposition 13.b: *The attitude towards responding to risk will positively impact the intention to respond to risk.*

Researchers find that software project manager who did not practice risk management believed that it imposes unjustified costs (Kutsch and Hall, 2009); however, those who practiced risk management believed that its "benefits were achieved with a reasonable costs" (Ropponen, 1999, p.255). Considering that the role of beliefs will be mediated by their corresponding attitudes, this provides some support for Proposition 13.

P14: In the BDT context, researchers note that the decision to take risk is closely tied to exhibiting risk taking behaviors (Sitkin and Pablo, 1992; Sitkin and Weingart, 1995). Likewise, the reasoned action approach suggests that "Each intention is viewed as being related to the corresponding behavior" (Fishbein and Ajzen, 1975, p.15). Consequently, a software project manager who plans to respond to risk can be expected to carry-out such activity in the project.

Therefore, it is proposed that

Proposition 14: *A software project manager's risk response behaviors will follow his/her intention to perform such behavior.*
Proposition 14.a: *The intention to respond to risk will positively impact taking risk response actions.*

Proposition 14 is yet to be explored in the software project risk management context.

Future Research and Concluding Remarks

In this paper, we sought to increase our understanding of software project managers' risk response behavior. While prior software project risk management studies have mainly adopted a rationalistic view of risk management, this paper contributes to this literature by leveraging on the few existing behavioral studies in the field and providing a theoretical basis for future behavioral studies of risk management. To this end, we identified and articulated four important assumptions that underlie the majority of software project risk management studies and revised them. Furthermore, we developed a conceptual model which facilitates explaining and predicting software project managers' risk response behavior. In particular, the model distinguishes between two essential behaviors of software project managers related to project risk management, namely continuing risk-inaction and responding to risk. Then, it postulates the sources of beliefs, beliefs, and attitudes about each of these behavioral alternatives.

This work has several implications and suggestions for future research. First, future studies aimed at developing software project risk management prescriptions can benefit from the revised assumption-ground, for instance, to investigate how difficult it will be for project managers to practice their prescriptions. The rationale for this suggestion is that the farther the assumptions underlying the prescriptions from such revised assumptions, the harder the application of such prescriptions in practice (Taylor et al., 2012). Second, different parts of the conceptual model have not been empirically investigated before and are subject to further investigations. Especially, the attitude towards responding to risk construct, which plays a key role in determining the subsequent behavior, is understudied. Finally, the model offers a baseline theory for the study of decision making about responding to project risk. However, as the risk propensity construct and the related propositions (i.e., P6, P7, P10, and P11) illustrate, various

parts of such decision making can be influenced by different biasing factors. Examples of such factors which were named in the Revised Assumption 4 are personal relevance of outcomes (Williams and Wong, 1999, problem framing (Kahneman and Tversky, 1979), and affective states of project managers (Slovic et al., 2007). While the impact of some these factors have been investigated in a small number of software project risk management studies before, further propositions can be develop to specify their impact with a finer grain using the conceptual model.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179–211.

Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and social psychology review*, *6*(2), 107–122.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin; Psychological Bulletin*, *84*(5), 888–918.

Ajzen, I., & Fishbein, M. (2000). Attitudes and the attitude-behavior relation: Reasoned and automatic processes. *European review of social psychology*, *11*(1), 1–33.

Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior. In D. Albarracín, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (pp. 173–221). Mahwah, NJ: Erlbaum.

Ajzen, I., & Fishbein, M. (2008). Scaling and testing multiplicative combinations in the expectancy–value model of attitudes. *Journal of Applied Social Psychology*, *38*(9), 2222–2247.

Ajzen, Icek. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health*, *26*(9), 1113–1127.

Alhakami, A. S., & Slovic, P. (1994). A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit. *Risk Analysis*, *14*(6), 1085–1096.

Alter, S., & Ginzberg, M. (1978). Managing uncertainty in MIS implementation. *Sloan Management Review*, *20*(1), 23–31.

Alvesson, M., & Sandberg, J. (2011). Generating research questions through problematization. *The Academy of Management Review*, *36*(2), 247–271.

Arrow, K. J. (1965). The theory of risk aversion. *Aspects of the theory of risk-bearing*. Helsinki: Yrjö Jahnssonin Säätiö.

Bannerman, P. L. (2008). Risk and risk management in software projects: A reassessment. *Journal of Systems and Software*, *81*(12), 2118–2133.

Barki, H., Rivard, S., & Talbot, J. (2001). An integrative contingency model of software project risk management. *Journal of Management Information Systems*, *17*(4), 37–69.

Barki, Henri, Rivard, S., & Talbot, J. (1993). Toward an Assessment of Software Development Risk. *Journal of Management Information Systems*, *10*(2), 203–225.

Billings, R. S., & Schaalman, M. L. (1980). Administrators' estimations of the probability of outcomes of school desegregation: A field test of the availability heuristic. *Organizational Behavior and Human Performance*, *26*(1), 97–114.

Boehm, B. W. (1991). Software risk management: principles and practices. *IEEE Software*, *8*(1), 32–41.

Boehm, Barry W. (1989). *Software Risk Management*. IEEE Computer Society Press.

Charette, R. N. (2005). Why software fails. *IEEE Spectrum*, *42*(9), 42–49.

Charette, Robert N. (1989). *Software Engineering Risk Analysis and Management*. New York: Mcgraw-Hill.

Davis, M. S. (1971). That's Interesting! Towards a Phenomenology of Sociology and a Sociology of Phenomenology. *Philosophy of the Social Sciences*, *1*(2), 309–344.

de Bakker, K., Boonstra, A., & Wortmann, H. (2010). Does risk management contribute to IT project success? A meta-analysis of empirical evidence. *International Journal of Project Management*, *28*(5), 493–503.

Du, S., Keil, M., Mathiassen, L., Shen, Y., & Tiwana, A. (2007). Attention-shaping tools, expertise, and perceived control in IT project risk assessment. *Decision Support Systems*, *43*(1), 269–283.

Dunegan, K. J., Duchon, D., & Barton, S. L. (1992). Affect, risk, and decision criticality: Replication and extension in a business setting. *Organizational Behavior and Human Decision Processes*, *53*(3), 335–351.

Edwards, W. (1954). The theory of decision making. *Psychological bulletin*, *51*(4), 380–417.

Einhorn, H. J., & Hogarth, R. M. (1981). Behavioral Decision Theory: Processes of Judgment and Choice. *Journal of Accounting Research*, *19*(1), 1–31.

Fairley, R. (1994). Risk management for software projects. *IEEE Software*, *11*(3), 57–67.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How Safe Is Safe Enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits. *Policy Sciences*, *9*(2), 127–152.

Fishbein, M. (1963). An investigation of the relationship between beliefs about an object and the attitude toward that object. *Human Relations*, *16*(3), 233–239.

Fishbein, & Ajzen. (1975). Attitude, Intention and Behavior: An Introduction to Theory and Research (p. xi, 578). Reading, Mass: Addison-Wesley Pub. Co.

Fishbein, M., & Ajzen, I. (2010). *Predicting and Changing Behavior*. Taylor & Francis.

Gemino, A., Reich, B. H., & Sauer, C. (2008). A Temporal Model of Information Technology Project Performance. *Journal of Management Information Systems*, *24*(3), 9–44.

Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. *Annual review of psychology*, *62*, 451–482.

Huff, R. A., & Prybutok, V. R. (2008). Information systems project management decision making: The influence of experience and risk propensity. *Project Management Journal*, *39*(2), 34–47.

Jaccard, J. (2012). The Reasoned Action Model Directions for Future Research. *The ANNALS of the American Academy of Political and Social Science*, *640*(1), 58–80. doi:10.1177/0002716211426097

Jamieson, K., & Hyland, P. (2006). Factors that influence Information Systems decisions and outcomes: A summary of key themes from four case studies. *ACIS 2006 Proceedings*. Retrieved from http://aisel.aisnet.org/acis2006/43

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American psychologist*, *58*(9), 697–720.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society*, *47*(2), 263–291.

Keil, M., Li, L., Mathiassen, L., & Zheng, G. (2008). The influence of checklists and roles on software practitioner risk perception and decision-making. *Journal of Systems and Software*, *81*(6), 908–919.

Keil, M., Wallace, L., Turk, D., Dixon-Randall, G., & Nulden, U. (2000a). An investigation of risk perception and risk propensity on the decision to continue a software development project. *Journal of Systems and Software*, *53*(2), 145–157.

Keil, Mark, Mann, J., & Rai, A. (2000b). Why Software Projects Escalate: An Empirical Analysis and Test of Four Theoretical Models. *MIS Quarterly*, *24*(4), 631–664.

Keil, Mark, Tan, B. C. Y., Wei, K.-K., Saarinen, T., Tuunainen, V., & Wassenaar, A. (2000c). A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects. *MIS Quarterly*, *24*(2), 299–325.

Kutsch, E., & Hall, M. (2005). Intervening conditions on the management of project risk: dealing with uncertainty in information technology projects. *International Journal of Project Management*, *23*(8), 591–599.

Kutsch, E., & Hall, M. (2010). Deliberate ignorance in project risk management. *International Journal of Project Management*, *28*(3), 245–255.

Kutsch, E., & Maylor, H. (2011). Risk and error in IS/IT projects: going beyond process. *International Journal of Project Organisation and Management*, *3*(2), 107–126.

Kutsch, Elmar, & Hall, M. (2009). The rational choice of not applying project risk management in information technology projects. *Project Management Journal*, *40*(3), 72–81.

Lauer, T. W. (1996). Software project managers risk preferences. *Journal of Information Technology*, *11*(4), 287–295.

Levi, A. S., & Pryor, J. B. (1987). Use of the availability heuristic in probability estimates of future events: The effects of imagining outcomes versus imagining reasons. *Organizational Behavior and Human Decision Processes*, *40*(2), 219–234.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological bulletin*, *127*(2), 267–286.

Lyytinen, K., Mathiassen, L., & Ropponen, J. (1998). Attention shaping and software risk-A categorical analysis of four classical risk management approaches. *Information Systems Research*, *9*, 233–255.

MacCrimmon, K. R., & Wehrung, D. A. (1990). Characteristics of Risk Taking Executives. *Management Science*, *36*(4), 422–435.

March, J. G., & Shapira, Z. (1987). Managerial Perspectives on Risk and Risk Taking. *Management Science*, *33*(11), 1404–1418.

McFarlan, F. W. (1981). Portfolio approach to information systems. *Harvard Business Review*, *59*(5), 142–150.

Mignerat, M., & Rivard, S. (2010). Entre Acquiescence Et Manipulation: Réponses Des Gestionnaires De Projet De SI Aux Pratiques Institutionnalisées. *Systèmes d'Information et Management*, *15*(2), 9–44,134.

Moynihan, T. (1997). How experienced project managers assess risk. *IEEE Software*, *14*(3), 35–41.

Moynihan, T. (2002). Coping with client-based "people-problems": the theories-of-action of experienced IS/software project managers. *Information & management*, *39*(5), 377–390.

Mukherji, A., & Wright, P. (2002). Reexamining The Relationship Between Action Preferences And Managerial Risk Behaviors. *Journal of Managerial Issues*, *14*(3), 314–330.

Pablo, A. L. (1999). Managerial risk interpretations: does industry make a difference? *Journal of Managerial Psychology*, *14*(2), 92–108.

Park, H., & Blenkinsopp, J. (2009). Whistleblowing as Planned Behavior – A Survey of South Korean Police Officers. *Journal of Business Ethics*, *85*(4), 545–556. doi:10.1007/s10551-008-9788-y

Procaccino, J. D., & Verner, J. M. (2006). Software project managers and project success: An exploratory study. *Journal of Systems and Software*, *79*(11), 1541–1551.

Richetin, J., Conner, M., & Perugini, M. (2011). Not Doing Is Not the Opposite of Doing: Implications for Attitudinal Models of Behavioral Prediction. *Personality and Social Psychology Bulletin*, *37*(1), 40–54.

Ropponen, J. (1999). Risk assessment and management practices in software development. In L. P. Willcocks & S. Lester (Eds.), *Beyond the Productivity Paradox* (pp. 247–266). Chichester: John Wiley & Sons.

Ropponen, J., & Lyytinen, K. (1997). Can software risk management improve system development: an exploratory study. *European Journal of Information Systems*, *6*(1), 41–50.

Rothfeder, J. (1988, November 7). It's late, costly, incompetent--but try firing a computer system. *Business Week*, 164–165.

Sauer, C., & Reich, B. H. (2009). Rethinking IT project management: Evidence of a new mindset and its implications. *International Journal of Project Management*, *27*(2), 182–193.

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: An international Delphi study. *Journal of Management Information Systems*, *17*(4), 5–36.

Sheppard, B. H., Jon Hartwick, & Warshaw, P. R. (1988). The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research. *Journal of Consumer Research*, *15*(3), 325–343.

Sitkin, S. B., & Pablo, A. L. (1992). Reconceptualizing the Determinants of Risk Behavior. *The Academy of Management Review*, *17*(1), 9–38.

Sitkin, S. B., & Weingart, L. R. (1995). Determinants of Risky Decision-Making Behavior: A Test of the Mediating Role of Risk Perceptions and Propensity. *The Academy of Management Journal*, *38*(6), 1573–1592.

Sjöberg, L. (2007). Emotions and Risk Perception. *Risk Management*, *9*(4), 223–237.

Slovic, P. (1987). Perception of risk. *Science*, *236*(4799), 280–285.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, *177*(3), 1333–1352.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1977). Behavioral Decision Theory. *Annual Review of Psychology*, *28*(1), 1–39.

Taylor, H. (2005). Congruence between risk management theory and practice in Hong Kong vendor-driven IT projects. *International Journal of Project Management*, *23*(6), 437–444.

Taylor, H. (2006). Risk management and problem resolution strategies for IT projects: Prescription and practice. *Project Management Journal*, *37*(5), 49–63.

Taylor, H. (2007). An Examination of Decision-Making in IT Projects from Rational and Naturalistic Perspectives. *ICIS 2007 Proceedings*, Paper 30.

Taylor, Hazel, Artman, E., & Woelfer, J. P. (2012). Information technology project risk management: bridging the gap between research and practice. *Journal of Information Technology*, *27*(1), 17–34.

The Standish Group. (2009). *CHAOS Summary 2009*.

Tversky, A., & Kahneman, D. (1974). Judgment Under Uncertainty: Heuristics and Biases. *Science*, *185*(4157), 1124–1131.

Von Neumann, J., & Morgenstern, O. (1947). *Theory of games and economic behavior* (2nd ed.). Princeton: Princeton University Press.

Wallace, L., Keil, M., & Rai, A. (2004). How software project risk affects project performance: an investigation of the dimensions of risk and an exploratory model. *Decision Sciences*, *35*(2), 289–321.

Weber, E. U., Anderson, C. J., & Birnbaum, M. H. (1992). A theory of perceived risk and attractiveness. *Organizational Behavior and Human Decision Processes*, *52*(3), 492–523.

Williams, S., & Wong, Y. W. (1999). The effects of mood on managerial risk perceptions: Exploring affect and the dimensions of risk. *The Journal of social psychology*, *139*(3), 268–287.

Wiseman, R. M., & Gomez-Mejia, L. R. (1998). A Behavioral Agency Model of Managerial Risk Taking. *The Academy of Management Review*, *23*(1), 133–153.

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