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Research-In-Progress: An Empirical Investigation of the Decision of Whether or Not to Perform Risk Mitigation in Software Projects

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ABSTRACT

Although software project risk management has been found to positively affect project success, research suggests that software project risk management is not widely practiced. Addressing this issue, this research-in-progress paper focuses on the risk-response step of risk management and proposes a model that explains and predicts software project managers' undertaking of risk-response actions. The theoretical model integrates behavioral decision making under uncertainty literature and the reasoned action approach. Especially, the availability heuristic (i.e., people's reliance on the accessible information to make judgments) is used to explain the variation in the project managers' beliefs about the outcomes of continuing-risk-inaction and undertaking risk-response actions. The paper presents the survey methodology that will be adopted to test the model.

Keywords

Software project risk management, risk response actions, availability heuristic, survey methodology.

INTRODUCTION

In today's business world, still a large portion of software projects are challenged. (The Standish Group, 2009). Software project risk management actions are found to positively influence project success (de Bakker et al., 2011). Yet, such actions are not widely practiced (Bannerman, 2008; Kutsch and Hall, 2009, 2010). Consistent with the past literature, we view risk management as having two key steps of assessing and responding to risk (Boehm, 1991). While the extant literature has mainly focused on project managers' undertaking of the risk assessment step, in this study we focus on the risk-response step. According to the Project Management Body of Knowledge (PMBOK Guide, 2004, p.260), risk-response refers to actions (i.e., avoid, transfer, mitigate) that a project manager can adopt to "reduce threats to the project's objectives."

Prior software project risk management literature suggests that the beliefs held by project managers can influence the project managers' undertaking of risk-response actions (e.g., Keil et al., 2000a; Kutsch and Hall, 2009). Based on our review of prior literature, we focus on two key categories of such beliefs. The first category refers to the beliefs about whether the project is risky. This category of beliefs commonly includes project manages' risk perception (Keil et al., 2000a) and could concern multiple aspects of project risk. The second category concerns the beliefs about the efficiency and effectiveness of risk-response actions. This category of beliefs commonly includes beliefs such as beliefs about the cost-justifiability of risk management actions (Kutsch and Hall, 2009) and beliefs about the effectiveness of risk-response actions (Ropponen, 1999). Yet, our knowledge is still limited about the antecedents of such beliefs, how these beliefs are linked to the risk-response actions, and what the relative importance of these beliefs is. The objective of this study is to provide such investigation. Therefore, we address the research questions of: 1) What are the antecedents of software project managers' beliefs about project risk and about risk-response actions, and 2) How these beliefs are related to the intention to undertake risk-response actions in software projects?

To answer these questions, we integrate behavioral decision making literature (e.g., Tversky and Kahneman, 1974) and the reasoned action approach (Fishbein and Ajzen, 1975) to develop a theoretical model of the antecedents and outcomes of beliefs about continuing risk-inaction and also beliefs about taking risk-response actions. Then, we present the survey methodology that will serve to test the model.

THEORETICAL MODEL: CONSTRUCTS AND RELATIONSHIPS

The reasoned action approach in general and its core theories (i.e., the theory of reasoned action and the theory of planned behavior) in particular have been successfully used to explain individual-level behavior across various contexts (Fishbein and Ajzen, 2009). On one hand, this approach suggests that behaviors can be predicted via corresponding behavioral attitudes and these attitudes, in turn, can be predicted using corresponding behavioral beliefs (Ajzen and Fishbein, 1977). On the other hand, behavioral beliefs are suggested to vary based on various sources which include inferring based on other beliefs, information received from external sources, and direct experiences of the person (Fishbein and Ajzen, 1975). Furthermore, recent studies pertaining to this approach suggest that antecedents of multiple behavioral alternatives (e.g., antecedents of not performing the behavior) can be used to strengthen the prediction of performing a particular behavior (Fishbein and Ajzen, 2009).

The model proposed here integrates behavioral decision making literature (e.g., Tversky and Kahneman, 1974) and the reasoned action approach (Fishbein and Ajzen, 2009) to investigate the antecedents and outcomes of beliefs about two essential behaviors related to software project risk management: continuing risk-inaction and beliefs about outcomes of undertaking risk-response actions. Figure 1 illustrates the proposed theoretical model and Table 1 presents the conceptual definitions of the constructs.

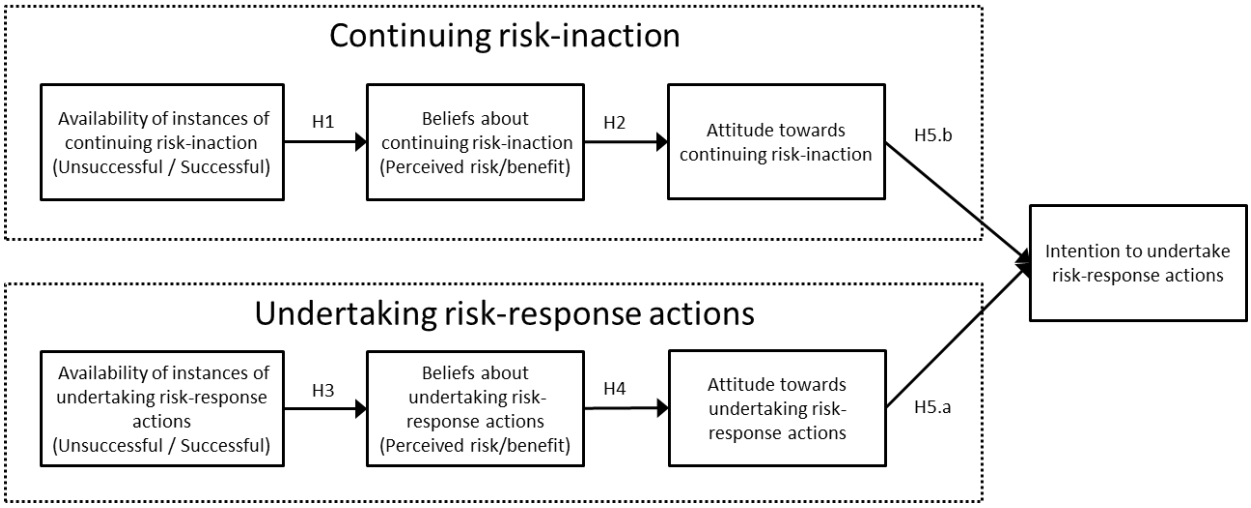

Figure 5. Theoretical Model

In brief, the model posits that continuing risk-inaction and undertaking risk-response actions are two behavioral alternatives. On one hand, it suggests that the influence of the beliefs about each of these two behavioral alternatives on intention to undertake risk-response actions will be mediated through the corresponding behavioral attitude. On the other hand, by drawing upon the availability heuristic (Tversky and Kahneman, 1974), it emphasizes the role of a project manager's direct experience with such behaviors in explaining the variation in the corresponding behavioral beliefs.

Construct	Definition
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.
Availability of instances of undertaking risk-response actions	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.
Beliefs about behavior: Perceived risks and perceived benefits	Perceived risk/benefit of continuing risk-inaction is a set of salient beliefs held by a software project manager about the undesired/desired outcomes of carrying-on undertaking the software project in its existing condition –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/gain (X^-/X^+) due to occurrence of the corresponding undesired/desired outcome.
	Perceived risk/benefit of undertaking risk-response actions is a set of salient beliefs held by a software project manager about the undesired/desired outcomes of taking pre-emptive actions regarding the potential undesired outcomes of the project, with each belief being accounted for by a subjective probability (SP^-/SP^+) of and an estimated loss/gain (X^-/X^+) due to occurrence of the corresponding undesired/desired outcome.
Attitude towards behavior: Attitude towards continuing risk inaction and attitude towards undertaking risk-response actions	Attitude towards continuing risk-inaction is 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.
	Attitude towards undertaking risk-response actions is 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.
Behavioral intentions: Intention to undertake risk-response	Intention to undertake risk-response is 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.
Behavioral alternatives: Continuing risk inaction and undertaking risk-response actions	Continuing risk inaction is 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.
	Undertaking risk-response actions is the extent to which a project manager takes actions in a software project aiming at reducing potential undesired outcomes.

Table 1. Definitions of Constructs

Determinants of attitude towards continuing risk-inaction

Self-evidently, if a software project manager continues risk-inaction in a project, he/she consciously/unconsciously allows the potential outcomes of the present uncertainty factors to materialize. Nevertheless, project managers' beliefs about what potential outcomes might happen due to presence of uncertainty factors vary (Keil et al., 2008; Lauer, 1996). Traditional software project risk management studies (Barki et al., 1993; Keil et al., 1998) suggest that uncertainty factor such as project size or complexity might lead to undesired outcomes. Thus, such view offers a negative take on the presence of uncertainty factors. However, Sauer and Reich (2009, p.186) find that software project managers may consider high risk aspects of software projects such as "transforming a major system" as "exciting". Thus, they offer the possibility of a positive take on the presence of uncertainty factors. Therefore, project managers can be expected to focus on either desired or undesired outcomes associated with continuing risk-inaction with regard to the uncertainty factors present in the projects.

One way in which such beliefs about behaviors are formed, as the reasoned action approach suggests, is through the direct experience of people with the similar situations in the past. More precisely, the availability heuristic (Tversky and Kahneman, 1974) proposes that the availability of relevant instances in mind influences one's currently held beliefs. Thus, the extent to which instances of continuing risk-inaction are available to a project manager can be

expected to influence his/her currently held beliefs about outcomes of continuing risk-inaction. Therefore, it is hypothesized that:

H1.a The greater the availability of unsuccessful instances of continuing risk-inaction, the stronger a software project manager's perceived risk of continuing risk-inaction.

H1.b The greater the availability of successful instances of continuing risk-inaction, the stronger a software project manager's perceived benefit of continuing risk-inaction.

Following the reasoned action approach, such beliefs in presence of uncertainty factors can be expected to influence the attitude (i.e., overall affective evaluation) towards continuing risk-inaction. Therefore, it is hypothesized that:

H2.a Beliefs about undesired outcomes of continuing risk-inaction negatively influence attitude towards continuing risk-inaction.

H2.b Beliefs about desired outcomes of continuing risk-inaction positively influence attitude towards continuing risk-inaction.

Determinants of attitude towards undertaking risk-response actions

Similarly, beliefs about the outcomes of undertaking risk-response actions (in similar projects) vary across managers. Prior studies find that, on one hand, most of those project managers who practice risk management "reported good or relatively positive experiences: they saw that projects using risk management methods fared better" (Ropponen, 1999, p.255). Among the reasons they provided were that "use of risk management methods provided a more consistent view of the development situation, led to better use of available information, helped to identify project assumptions, improved credibility of plans, and created proactive management and contingency planning" (Ropponen, 1999, p.255). On the other hand, those project managers who do not practice risk management believe it to be time consuming, costly, hard to do (for different reasons including the number of stakeholders), and ineffective (Kutsch and Hall, 2009).

Again, based on insights from the reasoned action approach and the availability heuristic, such beliefs can root in the direct experience of a project manager with risk-response actions. That is, whether the available instances performing risk management in the past had successful or unsuccessful outcomes can be expected to impact the currently held beliefs about outcomes of performing risk management. Therefore, it is hypothesized that:

H3.a The greater the availability of unsuccessful instances of undertaking risk-response actions, the stronger a software project manager's perceived risk of undertaking risk-response actions.

H3.b. The greater the availability of successful instances of undertaking risk-response actions, the stronger a software project manager's perceived benefit of undertaking risk-response actions.

Furthermore, following the reasoned action approach, such belief about undertaking risk-response actions can be expected to influence the attitude towards doing risk management in a project. Therefore, it is hypothesized that:

H4.a Beliefs about undesired outcomes of undertaking risk-response actions negatively influence attitude towards undertaking risk-response actions.

H4.b Beliefs about desired outcomes of undertaking risk-response actions positively influence attitude towards undertaking risk-response actions.

Determinants of intention to undertake risk-response actions

The reasoned action approach suggests that the antecedents of various behavioral alternatives can be used to predict the intention to perform a behavior (Fishbein and Ajzen, 2009). Therefore, on one hand, it can be expected that intention to undertake risk-response actions will be consistent with the project manager's attitude towards performing such behavior. Therefore, it is hypothesized that:

H5.a The more positive a software project manager's attitude towards undertaking risk-response actions, the stronger his/her intention to undertake risk-response actions (and vice versa).

On the other hand, it can be expected that a positive attitude towards continuing risk-inaction inhibits undertaking risk-response actions. Therefore, it is hypothesized that:

H5.b The more positive a software project manager's attitude towards continuing risk-inaction, the weaker his/her intention to undertake risk-response actions (and vice versa).

METHOD

To test the advanced hypotheses, we propose to conduct a cross-sectional survey.

Measures

In this section we explain the operationalization of the constructs. An initial version of the survey instrument is provided in the Appendix.

Availability We borrow the measures for the two availability constructs from Billings and Schaalman (1980) and adapt them to the software project risk management context. The availability constructs are multidimensional; thus, a change in one dimension (e.g., recency of instances) will not necessarily cause a change in another one (e.g., number of instances). Therefore, these constructs will be modeled as formative constructs (Petter et al., 2007).

Beliefs Measures for the two behavioral beliefs constructs are adapted from the available operationalizations of the risk perception construct (Keil et al., 2008).

Attitudes To measure the two behavioral attitude constructs, we adapt the items developed by Ajzen and Fishbein (1980) to the software project risk management context. Thus, the behavioral attitudes will be measured using five semantic differential items of good-bad, wise-foolish, favorable-unfavorable, beneficial-harmful, and positive-negative, all with the 'neutral' in the middle of a 7-point scale.

Intention A measure of behavioral intention will be borrowed and adapted from Ajzen and Fishbein (1980).

Control variables In this study, we will control for the risk propensity of the project managers. To measure risk propensity, we borrow the items from Keil et al. (2000) with some modifications. We also control for organizational control systems which enforce practicing risk management. We develop a measure for this control variable based on past relevant literature (e.g. Wiseman and Gomez-Mejia, 1998).

Target population

This study targets the entire population of software project managers. Our focus on software project managers as our respondents is based on the assumption that project managers are key risk actors in the projects (Kutsch and Hall, 2005).

Sampling frame and reducing non-response

Sampling frame We will consider two options to reach software project managers. In option 1, we will obtain a directory of software project managers from institutions such as PMI. Then, we will directly contact the individuals on the list. In option 2, we will ask a survey company to contact project managers on our behalf and gather a particular number of responses. In either of the options, the respondents will be directed to a Web survey.

Reducing non-response Prior to contact respondents, we will use some a priori strategies to minimize the non-response (Sivo et al., 2006). We will make the questionnaire short and convenient to answer. First, an invitation email will be emailed to project managers. In the following week, an email including the link to the survey will be emailed to the project managers. Second, after a week, a follow up email will be sent to all project managers contacted earlier. We will also give the respondents the opportunity to enter a draw for some prizes. After collecting data, we will test for the non-response bias.

Validation

To validate our measurement, first, we will conduct a panel of experts for a pilot verification of face and content validity of each of the measures. We will do so by conducting interviews with experts in software project management, including professionals as well as academics. Second, we will perform a card sorting exercise for validating and purifying items as well as improving their wording. Third, we will run a pre-test of the model using a small sample. In doing so, we pay a special attention to validating the formative constructs (Petter et al., 2007).

Data analysis approach

As mentioned above, the two availability-based constructs are second-order constructs. Therefore, to be able to handle these formative constructs, we will adopt the Multi Indicators, Multi Causes (MIMIC) approach by adding a few reflective items to each formative constructs. We will use EQS or LISREL to analyze the collected data.

Required sample size

For either EQS or LISREL, a sample size of minimum 200 will be targeted. We will estimate the exact number of required sample size when we have a better estimate of the number of our measurement items.

Common method variance

Because both dependent and independent variables will be tested in one instrument, we pay a special attention to the common method variance (CMV). Before collecting data, we will use a priori strategies to prevent the CMV (Podsakoff et al., 2003; Sharma et al., 2009). After collecting data we will benefit from the available a posteriori methods to account for the CMV such as the single factor method.

CONCULDING REMARKS

The core argument for the research is that the two beliefs held by software project managers are influential on their choice of risk-response actions: a) the belief about whether the project is risky 2) the belief about the efficiency and effectiveness of risk-response actions. On one hand, these beliefs are influenced by the instances available to project managers. On the other hand, the impact of these beliefs on the choice of risk-response actions is mediated by the corresponding attitudes: attitude towards risk-inaction and attitude towards undertaking risk-response actions.

Potentially, if the model is supported by the data, there are multiple implications. The first implication is that the knowledge of the level of risk is not the only factor determining risk-response behavior. In order to decide to undertake risk-response actions, first, project managers should feel negative about ignoring the present risks. Also, they should have a positive attitude towards risk-response actions. The second implication is the importance of the availability of similar instances for both project risk and project risk-response actions. To train a better nose for risk, training programs should include vivid images of failed projects due to risk. To promote risk response actions, their efficiency and effectiveness should be vividly illustrated for managers. The third implication would be focusing on the most influential beliefs. The relative importance of beliefs on the decision to respond to risk will be determined through the test of the model.

At the International Research Workshop on IT Project Management (IRWITPM 2012), we will present the construct definitions and the theoretical model, as well as our approach to operationalizing the constructs. We will seek feedback on whether they make sense and on how we can improve them.

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Appendix – The preliminary instrument [UNDER DEVELOPMENT]

Instructions

The following questions concern some aspects of software project management.

Screening question

1- Are you currently managing a software/IT/IS project? (yes/no)

Please think about the project (or pick one of the projects) that you currently manage.

Project description and perceived project characteristics

2- Please describe the project using the following items
   a. The project budget is (less than $10K, $10K-$100K, $100K-$1M, more than $1M)
   b. The project duration is (less than 6 months, 6 to 12 months, more than 12 months)
   c. The type of project is (rollout, …)
   d. The project is currently in the (initiation, development, implementation) phase.
   e. The project is complex (not at all/ to a large extent)
   f. The software application is complex (not at all/ to a large extent)
   g. The technologies used in the project are (very old, very new)
   h. The project team has the expertise required to finish the project (not at all, completely)

Outcomes (of continuing risk-inaction)

3- Generally speaking, how beneficial/risky you think this project is? (very high risk / very high benefit).
4- Assuming that you continue the project in its existing condition,
   a. This project will be a (very high risk /very high benefit).
   b. I believe that with --- % probability the ---- % of the value of project will be lost.
   c. I believe that with --- % probability ---- % extra value will be added to the project.

Availability - Number

5- How many instances of troubled or failed projects (which were similar in nature to the present project) can you think of (none, a few, etc.)?
6- The number of troubled or failed projects (which were similar in nature to the present project) is (negligible, small, etc.)

Availability - Relative frequency

7- Similar projects are troubled or failed (never, once in a while, etc.)
8- What percentage of similar software projects experiences trouble or failure? ----%

Availability - Relevance

9- Most of the projects which are troubled or failed are (very, somewhat, etc.) different from this project.
10- Project managers who undertake similar projects have troubled or failed projects (never, rarely, etc.)

Availability - Familiarity

11- Have you experienced instances of troubled or failed projects in the prior projects you have managed (never, rarely, etc.)?
12- Have other project managers in your organization experienced troubled or failed projects (never, rarely, etc.)?
13- Have other project managers in other organizations experienced troubled or failed projects (never, rarely, etc.)?

Availability - Drama

14- In past instances of similar projects which were troubled, the trouble has been (a severe problem/ a great benefit).
15- When a similar project is troubled, that trouble has been (quite harmful/ very desirable)

Availability - Recency

16- The most recent episode of trouble or failure in a similar project occurred --- years and --- month ago, as far as you can recall.
17- How long ago were there instances of troubled or failed similar projects (never, long time ago, etc.)?

Availability - Valence

18- For your organization, an increase in the number of troubled or failed projects would be (a crisis, a problem, etc.)
19- Would an increase in the number of troubled projects be of positive or negative value to your organization (very negative value, slight advantage, etc.)?

Availability - Competence

20- Do you feel competent to deal with troubled projects (not at all, somewhat inadequate, etc.)?
21- Do you feel that your organization is competent to deal with troubled projects (not at all, somewhat inadequate, etc.)?

Attitude towards continuing risk-inaction

Here by risk-response, we general mean actions aiming at reducing risk.

22- Overall, I think that continuing this project without undertaking risk-response actions is
    a. Good/bad
    b. Wise/foolish
    c. Favorable/unfavorable
    d. Beneficial/harmful
    e. Positive/negative

Risk-response

23- Please indicate which of the following risk response actions could be relevant to this project.
    a. Run a pilot test
    b. Communicate dangers with higher management
    c. Communicate dangers with team members
    d. Transfer risk into a more controllable one
    e. [under development]
    f. Other. Please specify ...

Risk/benefits of continuing risk-inaction

24- Generally speaking, how beneficial/risky you think undertaking risk-response actions in this project is? (very high risk / very high benefit).
25- Assuming that you will perform risk response in this project,
    a. The project will be (very risky/highly beneficial)
    b. I believe that with --- % probability the ---- % of the value of project will be lost.
    c. I believe that with --- % probability ---- % extra value will be added to the project.

Availability - Number

26- How many instances of successful undertaking of risk response actions in projects can you think of (none, a few, etc.)?
27- The number of successful projects because of taking risk response actions is (negligible, small, etc.)

Availability - Relative frequency

28- Successful undertaking of risk response actions occurs (never, once in a while, etc.)
29- What percentage of software projects successfully undertakes risk response actions? ----%

Availability - Relevance

30- Most of the projects which took risk response actions in a successful way are (very, somewhat, etc.) different from this project.

31- Organizations having projects which undertake risk response actions have successful projects (never, rarely, etc.)

Availability - Familiarity

32- Have you experienced instances of successful undertaking of risk response actions in the projects you have managed (never, rarely, etc.)?
33- Have other project managers in your organization experienced successful implementation of risk response actions (never, rarely, etc.)?
34- Have other project managers in other organizations experienced successful implementation of risk response actions (never, rarely, etc.)?

Availability - Drama

35- In past instances of projects benefiting from undertaking risk-response actions, the benefit has been (bipolar – a severe problem to a great benefit).
36- When a project is troubled by performing a risk response action, that trouble has been (bipolar – quite harmful to very desirable)

Availability - Recency

37- The most recent case of undertaking risk-response actions occurred --- years and --- month ago, as far as you can recall.
38- How long ago were there instances of a project benefiting performance of risk response actions (never, long time ago, etc.)?

Availability - Valence

39- For your organization, a decrease in the extent of undertaking risk-response actions would be (a crisis, a problem, etc.)
40- Would an increase in undertaking risk-response actions in projects be of positive or negative value to your organization (very negative value, slight advantage, etc.)?

Availability - Competence

41- Do you feel competent in undertaking risk-response actions (not at all, somewhat inadequate, etc.)?
42- Do you feel that your organization is competent in undertaking risk-response actions (not at all, somewhat inadequate, etc.)?

Attitude towards undertaking risk-response actions

43- Overall, I think that undertaking risk-response actions in this project is
    d. Good/bad
    e. Wise/foolish
    f. Favorable/unfavorable
    g. Beneficial/harmful
    h. Positive/negative

Behavioral intention

44- I will take risk response actions in this project (very likely/ very unlikely)
45- I have plans to adopt some changes in my current project/project management style in order to reduce potential negative outcomes of the project.

Control variables – Risk propensity

The measure of risk propensity will be adopted from Keil et al. (2000)

Control variables - Organizational control systems

46- Your wealth is tied to undertaking risk-response actions (not at all, to a large extent)
47- In your organization, incentives for undertaking risk-response actions are (rare/many)
48- Top management expects you to perform risk response (not at all, to a large extent)
49- If the project gets troubled, you will be blamed for not undertaking risk-response actions (not at all, to a large extent)