MULTI-PARTY RISK MANAGEMENT PROCESS (MRMP) FOR A CONSTRUCTION PROJECT FINANCED BY AN INTERNATIONAL LENDER

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In a multi-party environment, conventional risk management processes (RMP) that generally deal with one party may not be applicable. Particularly in a construction project financed by an international lender, managing risks at the procurement and construction stages is not straightforward since several parties (i.e. executing agency, contractors, consultants, lender, and borrower government) are involved. Involvement of a larger number of parties increase the frequency and impact of risks since each party has different objectives. Furthermore, risk responses taken by one party may create other risks to other parties. A systematic process of managing risks in a multi-party environment is thus required. The Multi-party Risk Management Process (MRMP) is proposed to assist decision-makers in systematically and efficiently managing risk in a multi-party environment. In order to demonstrate the applicability of the MRMP, it has been applied to a public bridge and elevated road construction project financed by the Asian Development Bank (ADB) as a case study. The perception of the executing agency, contractor and consultant involved with procurement and construction stages of project are investigated. In accordance to the application, a number of contributions such as multi-party response efficiency, multi-party risk-response-risk, response characteristics, and self-deficiency evaluations are demonstrated.

Keywords: international lender, international project, procurement, risk management, project finance, infrastructure

INTRODUCTION

Risks are inherent in all construction projects. Typically, infrastructure construction project is large, uncertain, and complex in many aspects. This type of project requires huge investment, and several project parties participate. There is a high possibility that more risks are involved than in other types of projects regarding either external risks or internal risks.

Economic development in developing countries is often impeded by insufficient infrastructure development. One way for Government of these countries to mobilize funds for infrastructure development is through borrowing from international financial association. Consequently, infrastructure construction projects financed by an international lender tend to make up a significant part of public construction works in developing countries.

Managing risks at the procurement and construction stages of construction projects financed by an international lender is not straightforward since many parties such as an executing agency, contractors, consultants, and the lender are involved. Involvement of several parties increases the frequency and impact of risk since each

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party has different objectives. Conventional risk management process (RMP) has been employed to assist decision-makers instead of using solely intuition. However, the limitations of the conventional RMP are that only one party is generally considered and the objectives associated with multiple project participants may be overlooked in the analysis. In the conventional RMP, risk identification and response are considered and evaluated by one party. Even when a risk affects several parties, the process of risk and response evaluation by involved parties is probably absent. Since responses to some risks taken by one party may create risks to other parties the risk-response-risk chain may be created. However, such a chain among multiple parties is not generally incorporated in the analysis. In short, the conventional RMP may not be suitable when several parties are involved in a project. A systematic process of managing risks in a multi-party environment is thus required.

To propose a Multi-party Risk Management Process (MRMP) is a major objective of this research. The proposed MRMP has been applied for a construction project financed by an international lender to demonstrate its applicability. A public bridge and elevated construction road project financed by the ADB located in Thailand has been selected as a case study. This paper is divided into three main parts: the MRMP development, the application of the MRMP, and discussion of its applicability. Details of the methodology are accordingly described in the risk identification, structuring, and analysis and response processes in the MRMP development and application of the MRMP.

MULTI-PARTY RISK MANAGEMENT PROCESS (MRMP)

The proposed risk management process, entitled Multi-party Risk Management Process (MRMP) (Pipattanapiwong 2000), provides systematic and logical processes including risk identification, risk structuring, and risk analysis and response. The multiple parties involved in a project and their objectives are incorporated in each process. Priorities based on significance of risks and objectives are considered. The MRMP relies on quantitative measurement and analysis as well as attempts to utilize the decision-makers' experiences and intuition in a systematic and efficient way.

Essence and characteristics of MRMP

In a multi-party environment, several project participants are tied with contractual arrangement or interactive communication. The proposed MRMP aims to assure decision-makers that risks are managed systematically and efficiently in a multi-party environment. The underlying essence of the MRMP is based on the risk efficiency concept described by Chapman (1997). Here risk is defined as the deviation of the level of impact from the expected impact of risk associated with the alternative responses. Risk is characterized in terms of impact level and probability of occurrence. To find efficient responses is the key in the conventional RMP. The efficient responses are portrayed on risk efficient boundary, which is plotted by the degree of risk and impact level of risk associated with each response. Risk efficient boundary, which is a bold line connecting response A, response B and response C in Figure 1, presents efficiency condition of each response. The responses, which are portrayed on the risk efficient boundary, provide a minimum level of risk for a given level of impact and a minimum level of impact for a given level of risk. As illustrated in Figure 1, responses A, B, and C are efficient, but response D is not.

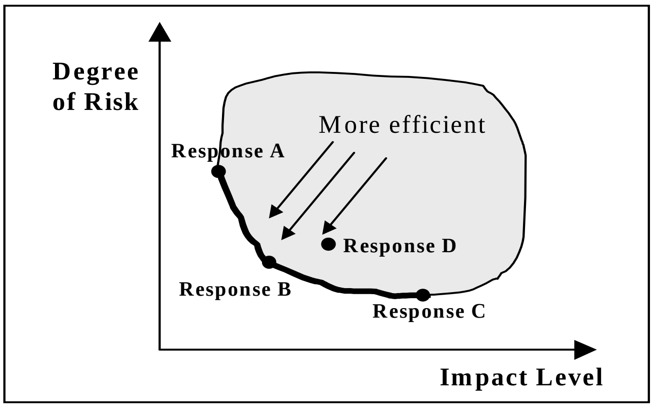

Figure 1: Risk efficient boundary

Based on these underlying concepts, a number of promising characteristics of the MRMP are developed including: multi-party response efficiency, multi-party risk-response-risk, and response characteristics evaluations. These deliveries are consequently discussed in the application of the MRMP. The main processes in the MRMP consist of risk identification, structuring, and analysis and response processes. The outputs of each process are used as inputs of successive processes. Input-process-output is the framework for discussion of each process.

Risk identification process

Risk identification is an important process because identified risks will be considered as inputs of the structuring, and analysis and response processes. The main task in risk identification process is to objectively identify risks affecting involved parties. Risks are identified based on involved parties' objectives. Major and minor risks are initially distinguished in the identification process. The risk identification process diagram is shown in Figure 2.

The description and background of the project would have been prepared. Afterwards, the stages of the project are determined and scoped. The following step deals with the identification of the involved parties. This research focused on the executing agency, contractor, and consultant, who were involved in the procurement and construction stages of a public bridge and elevated road construction project financed by the ADB. Their objectives in each project stage are specified based on the transformation system. The transformation system is described as the process of transforming resource inputs into outputs.

In the first stage of identification process, the preliminary risk checklist was developed from the previous risk checklists (Perry 1985; Al-Bahar 1990; Zhi 1995; Edwards 1995; Fisk 1997; and Laohkongthavorn 1998) to collect the project risks in general. Next, the unstructured interview with preliminary risk checklist was conducted with the fifteen experienced engineers, who have about 15 years experience each, in order to identify possible risks related to bridge and elevated road construction projects either financed or not financed by an international lender in Thailand. These engineers work for the Public Works Department (PWD), the Bangkok Metropolitan Administrative (BMA), the Asian Development Bank (ADB), contractor, and consultant in Thailand, respectively. Afterwards, a new risk checklist was specifically developed for the case studied project according to risks identified from the previous stages. The numbers of risks in the new risk checklist are 51 and 124 in the procurement and construction stages, respectively. This risk checklist is included in the first questionnaire, which is used to identify risks in the case studied project.

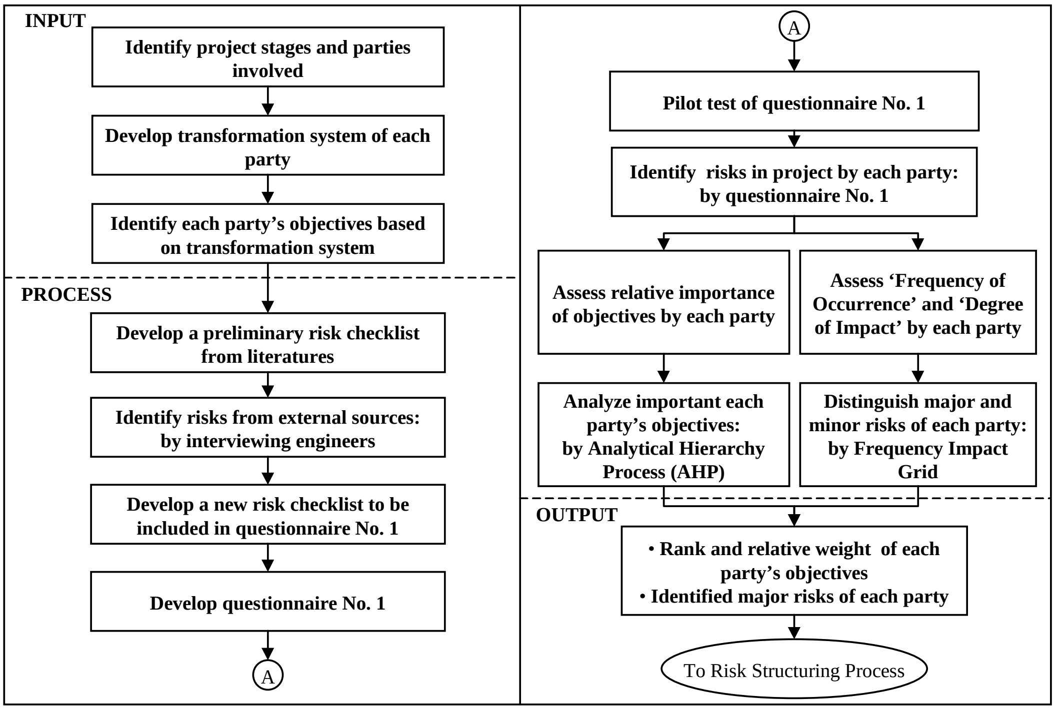

Figure 2: Risk identification process diagram

A structured questionnaire was used to elicit the judgement of each involved party's top management engineers, who were the chief project engineer from the executing agency and project managers from the contractor and consultant. The objective of the first questionnaire is to identify important objectives and risks associated with the involved parties. The first questionnaire was distributed to all parties' top management engineers. It can be generally used in identifying risks. The Analytical Hierarchy Process (AHP) is employed in analyzing each party's important objectives. The relative weights of each objective were obtained from AHP analysis. The frequency impact grid was used to initially distinguish major and minor risks. The grid consists of two dimensions: frequency of occurrence and degree of impact. Indeed, the outputs from the risk identification process are the relative weights of objectives associated with involved parties and the identified major risks. The first three important objectives and risks in order of priority were selected for further analysis.

Risk structuring process

The purpose of risk structuring process is to specify dependencies among risks. The cause and effect relationships among risks associated with specific objectives are also examined. Another task in the structuring process is to identify the most significant risk. This process attempts to improve the understanding of relative importance of different sources of risks. The diagram in Figure 3 shows the risk structuring process.

The MRMP employs influence diagram, which is a useful technique for developing a risk diagram for developing, structuring and discussing complex risk relationship (McNamee 1990). In order to proceed with the structuring process of risks more efficiently, connectivity matrix technique in graph theory was incorporated with the influence diagram when developing a risk structure diagram. This is defined as the matrix whose (i, j) element is one if the i^{th} risk directly causes the j^{th} risk and zero otherwise. The connectivity matrix is used for presenting the existence of relationship among risks and objectives in a systematic form.

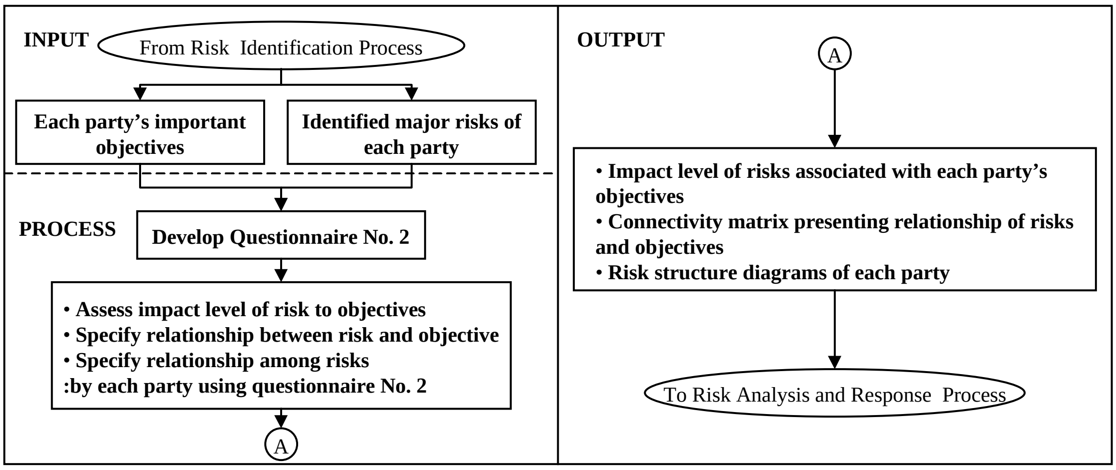

Figure 3: Risk structuring process diagram

The second questionnaire was used to investigate the judgement of each party's top management engineers, who were the same group as in the risk identification process. The second questionnaire was developed based on the distinguished major risks and specified important objectives from the risk identification process to find the relationship among risks and objectives of the case study. It was specifically developed for this case study. The significant risks and risk structure diagram based on connectivity matrix were obtained from the analysis of the second questionnaire.

Risk analysis and response process

In the risk analysis and response process, logical and systematic procedure in evaluating risk response efficiency is provided. The major risks were identified from the risk impact evaluation result in the structuring process by each party. The responses to the major risks were analyzed to find the most efficient response for a particular major risk, which is a main task in the risk analysis and response process. The risk analysis and response process diagram is presented in Figure 4. Response is any action or activity that is implemented to deal with a specific risk or a combination of risks. Responses are categorized into three types (i.e. accept, proactive and reactive) based on timing of implementation. Proactive response is applicable before the major risk occurs. Its main aim is to prepare for efficient risk management in the current project. Reactive response is applicable after the major risk occurs. Its main aim is to better manage the risk for the rest of the current project. The 'accept' response is applicable to both before and after occurrence of the major risk. This scenario is a baseline to be compared with proactive and reactive response scenarios.

After major risk has been selected, the source and consequence risks associated with a major risk are identified. Source risk is defined as the risk that can directly influence and cause the occurrence of the major risk. Consequence risk is defined as the final risk that is directly or indirectly caused by the major risk. The flow of these risks is specified as source risks – major risk – consequence risks as shown in the prototypes of risk response diagram in Figure 5. The 'risk analysis and response interviewing sheet' was used in identifying source and consequence risks, defining probability of risk occurrence and evaluating impact level of a particular major risk in each alternative response by each party.

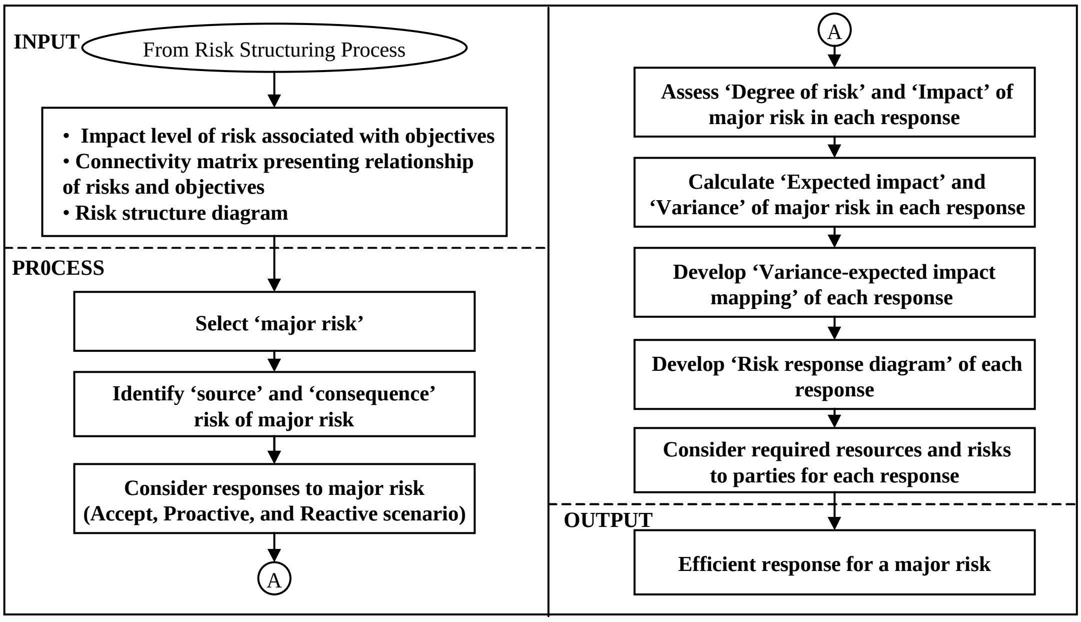

Figure 4: Risk analysis and response diagram

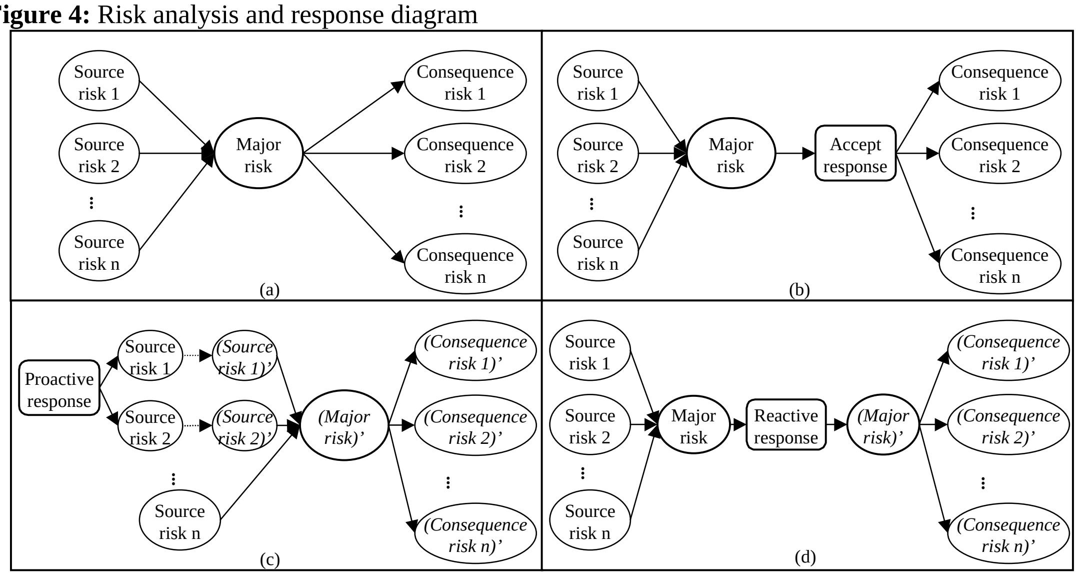

Figure 5: Prototypes of risk response diagram

The probability of occurrence is a component to characterize risk. This research uses subjective probability in evaluating probability of occurrence of risks because of two reasons. Firstly, most real-world situations are unique, and possibility of recurrence of the same event under substantially identical conditions is small. Secondly, there is often little possibility of obtaining a large set of relative frequency data. To elicit subjective probability, the direct method was employed. The direct method assumes the existence of a rational decision-maker well aware of the rudiments of probability. Then, the method merely consists of asking the subject to assign a number to their opinion about the outcome in question.

Another component of risk characteristics is impact level of risk. The next step is to evaluate the impact level of major, source and consequence risk in each alternative response. Then, the total impact level of major risk is calculated and used in calculating the expected impact and variance of the major risk in each alternative response.

The variance of impact is used to measure the degree of risks. Using variance to represent risk is also stated by Raftery (1994). The expected impact is used to discuss the impact level of risk. The calculations of the expected impact and variance rely on the assumption that there are two possibilities of the major risk in each response scenario, i.e., ‘occur’ or ‘not occur.’ If the major risk occurs, the probability of occurrence is assigned. On the other hand, if the risk does not occur, the probability of occurrence is zero. After the expected impact and variance of major risk in each response scenario have been calculated, they are plotted in a variance–expected impact map. This map is used to discuss the risk response efficiency and characteristics of response in quantitative and graphical format.

APPLICATION OF MRMP

The proposed MRMP was applied to a public bridge and elevated road construction project financed by the ADB in order to demonstrate the applicability. It should be noted that results of the MRMP have different implications depending on when it is applied. In this case study, although the procurement stage has been completed already, it is assumed that the analysis was conducted at a later part of the procurement stage. The objectives of this analysis are to study whether major risk could have been managed more efficiently or not and to draw lessons for a similar project in future. For the construction stage, the analysis was assumed to be conducted when major risks were occurring.

After going through several steps in the risk identification, structuring, and analysis and response processes, it was found that the contractor identified ‘executing agency lacks experience in procurement process’ risk as the major risk in the procurement stage. This major risk is related to executing agency’s self-deficiency. Associated with this result, the self-deficiency evaluation is one of the features in the MRMP.

In the construction stage, the executing agency, the contractor, and the consultant perceived the ‘contractor’s liquidity and financial problem’ risk as the major risk in the construction stage. Four reactive responses have been proposed to deal with the ‘contractor’s liquidity and financial problem’ risk. The first response is ‘accept’ this situation after the major risk occurs. The three remaining responses are ‘new capable contractor joins or takes over the current contractor,’ ‘bank provides financial assistance to the contractor,’ and ‘the executing agency terminates the contract.’ The findings of the MRMP application in the case study are summarized in Table 1

When a major risk influences multiple parties, the response to the risk should be desirably efficient for the all parties. The most desirable response in this case study seems the ‘new capable contractor joins or takes over current contractor’ response as shown in the variance-expected impact map in Figure 6. This illustrates ‘the multi-party response efficiency evaluation,’ which is a direct extension of the risk efficiency concept in the conventional RMP. The risk response diagram of the efficient response, ‘new capable contractor joins or takes over current contractor’ response, is presented in Figure 7.

Table 1: Findings of the MRMP application in the case study

Party	Important Objective	Identified Major Risk	Efficient Response	MRMP Contributions
Procurement stage				
Executing agency	Selecting capable contractor	- Delay in awarding contract	- Preparing clear bid document	- Response efficiency evaluation (same as conventional risk management process)
Contractor	Contract price	- Executing agency lacks experience in procurement process	- Capable and experienced consultant assists executing agency in procurement process	- Self-deficiency evaluation
Construction stage				
Executing agency	Schedule, Budget, Quality	- Contractor's liquidity and financial problem	- New capable contractor joins or takes over the current contractor	- Multi-party response efficiency evaluation - Multi-party risk-response-risk evaluation - Response characteristics evaluation
Contractor	Schedule			
Consultant	Schedule			

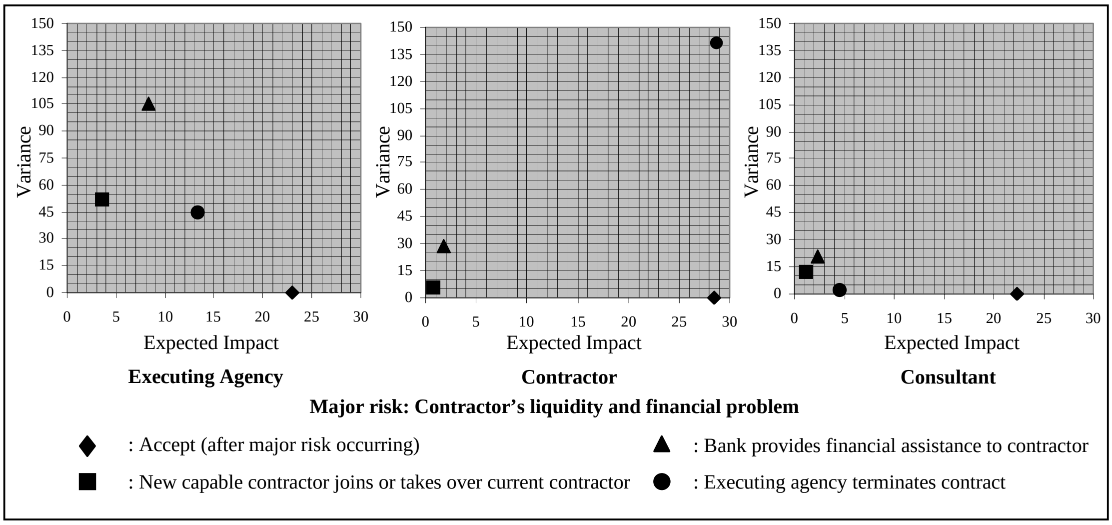

Figure 6: Variance-expected impact map for the major risk in construction stage

When a primary risk is responded to, secondary risks may occur. This risk-response-risk chain, which is discussed by Isaac (1995) and Chapman (1997), generally involves only one party. In many situations, there may be a major risk affecting several parties in a project. When one party takes a response to a major risk, this may create risks to other parties. The multi-party risk-response-risk evaluation is another feature of the MRMP. In this case study, if the 'executing agency terminates contract' response is taken by the executing agency, this create another risk to contractor as shown in Figure 8.

Additionally, each party may have his/her preferred perception toward a particular risk. The characteristics of perception include risk averse, risk neutral, and risk seeking (Flanagan, 1993 and Raftery, 1994). It is useful to study whether all parties' preferred perception and characteristics of each response are matched or not. From the MRMP application, the response characteristics associated with the multiple parties' perceptions can be presented by the variance-expected impact map. In Figure 6, for example, the second response of 'new capable contractor joins or takes over current contractor' was evaluated to be a little more risk seeking response than the first response of 'acceptance' by all parties. If the all parties are willing to take this risk, the second response would be the best response. Understanding the characteristics of response to a risk perceived by parties is significant in the multi-party environment, which can be easily achieved with the response characteristics evaluation, another feature of the MRMP.

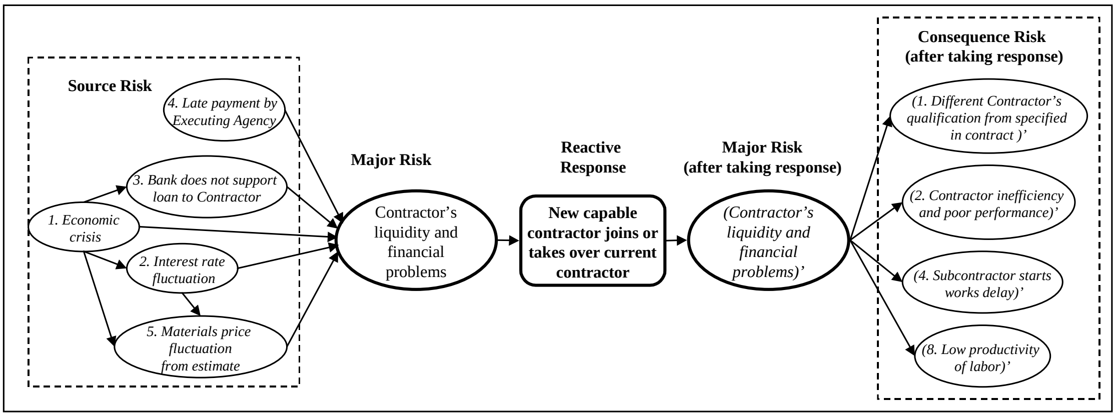

Figure 7: Risk response diagram of the efficient response

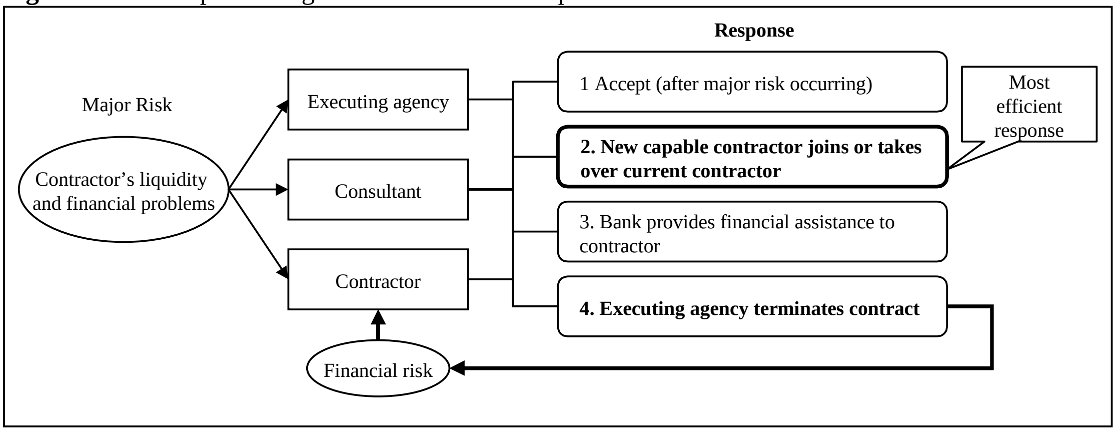

Figure 8: The multi-party risk-response-risk scheme

CONCLUSIONS

The core concept of the MRMP is to understand how to reduce risky situation, impact level, required resources and effects to all related parties when implementing a risk response. A number of contributions of the MRMP, which is drawn from the application, were developed from the conventional RMP to assist a decision-maker to better make a decision and manage risks in a multi-party environment. These are multi-party response efficiency, response characteristics, multi-party risk-response-risk, and self-deficiency evaluations.

First, the multi-party response efficiency evaluation is provided. From this premise, in order to manage risk more efficiently, it is desirable to find a response, which is risk efficient to all related parties. Second, risks to one party occurring from a response taken by another party can be notified, which is the multi-party risk-response-risk chain. Third, the response characteristics (i.e. risk avoiding, risk neutral, and risk seeking) associated with a major risk can be specified from the presentation of variance-expected impact map. This feature could assist decision-makers to find and select the most preferable response for all parties. Finally, the chance of self-deficiency evaluation is offered. A party can notify the deficiency regarding the experience, technical or managerial skill, etc, of other parties involved in the project during the identification of risks. These illustrate advantages of incorporating multiple parties in the risk management process.

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