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RISK MANAGEMENT FOR AN INTERNATIONAL PROJECT: A CASE STUDY OF AN INFRASTRUCTURE CONSTRUCTION PROJECT FINANCED BY THE ASIAN DEVELOPMENT BANK (ADB) IN THAILAND

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ABSTRACT: More risks are possibly inherent in the international infrastructure construction project since huge investment as well as many parties are involved in the project. With greater attention to the risk management, the project performance may be significantly improved. This paper aims to discuss the risk management process in a multi-party environment entitled the multi-party risk management process (MRMP) and its application to an infrastructure construction project financed by an international lender as a case study. The contributions of the MRMP are discussed. The significant risks and efficient response to the risks were identified according to the result of application in the case studied project.

Key Words : *Risk Management, Infrastructure Project, International Project, International Lender*

1. INTRODUCTION

Typically, international construction projects are related to infrastructure construction, which are large, uncertain, and complex in several aspects. Not only many parties are involved, but also huge investment is required. Generally, risks are inherent in all construction projects. Complexities of the international projects can increase either the number of risks or the degree of risks in terms of frequency and level of impact. In the sophisticated environment governed by the contract and involvement of many parties managing risks through the sole intuition probably inadequate. In order to assure the success of project; therefore, application of the risk management process is useful.

Insufficient infrastructure development is a major factor causes the obstruction of economic development in developing countries. Similarly, Thailand has encountered problems related to infrastructure shortage. Even though infrastructure projects require vast financial investment, they are necessary. Unfortunately, the Private Finance Initiative such as the BOT scheme in Thailand have faced serious problems, especially in contractual aspects and have not been entirely successful[1]. This is one of causation that makes it difficult for further projects to invite private sector investment in this type of contractual scheme in Thailand. Funding from international lenders such as the Asian Development Bank (ADB), the Japan Bank International Corporation (JBIC), and the International Bank for Reconstruction and Development (IBRD) is another way out. In Thailand, the debt borrowing from the international lenders is the largest portion, which is about 56.6% of total external debt outstanding including loans guaranteed by the government as of June 30, 1998[2]. So that this approach seem to be desirable for financing infrastructure projects. This illustrates significance of the construction projects financed by the international lenders. In order to discuss the risk management for international construction project, it is worth to study risk management in the construction project financed by an international lender.

The implementation process of the construction projects financed by an international lender is generally different from typical public construction projects. The international lender is involved and many rules and contractual procedures are determined. The project cycle generally starts from project identification, preparation, appraisals, loan negotiations, commitments, project implementation, project supervision and ends with post evaluation and monitoring after completion.

Incomplete design and detailed engineering, lack of transparency and usage of ambiguous bid evaluation criteria, delayed contract awarding, unfair bidding documents and unequal risk sharing, incapability of lowest bidders, weak supervision and contract administration and lack of quality of contractors are some of problems associated with procurement procedure and construction stages of construction projects financed by the World Bank[3].

In the case of the ADB financed project, serious delays occurring in procurement processes were also mentioned, and more understanding of procurement principles and procedure among participants including bank staff, borrowers, executing agencies, and bidders have to be greater[4]. A post evaluation report of projects financed by the ADB in Thailand in 1999 revealed some risks such as insufficient institutional capability, late land acquisition and right-of-way problems, procurement difficulties and lack of efficient coordination among agencies, which influenced performance of the project in the implementation stage[5].

This paper discusses the risk management process in a multi-party environment, which is referred to as the multi-party risk management process (MRMP) proposed by Pipattanapiwong and Watanabe (2000)[6]. Then, the MRMP is applied to the bridge and elevated road construction project financed by the ADB located in Thailand as a case study.

2. CASE STUDY: INFRASTRUCTURE PROJECT FINANCED BY THE ADB

In particular construction projects financed by an international lender, managing risk at the procurement and construction stages is not straightforward since many parties such as an executing agency, contractors, consultants, and the lender are involved. Such involvement of several parties increases the frequency and impact of risk since each party has different objectives. To apply the MRMP, a bridge and elevated road construction project financed by the ADB was selected. This scheme of infrastructure construction projects has been continuously important in public construction works in Thailand, so it is worth to study this type of project. Among the ongoing 18 public sector loans, 15 have been rated by the ADB, with 13 (86.67 percent) satisfactory and 2 (13.3 percent) partly satisfactory. This case studied project was rated as partly satisfactory by the ADB. Therefore, this project has been selected for application of the MRMP. Furthermore, only this bridge and elevated road construction project financed by the ADB was ongoing in the construction stage in Thailand.

This project is a public works financed by the Thai government and the ADB. The development objective specified by the ADB is to reduce traffic congestion in the western sector of the Bangkok. The main parties involved in this project consist of the executing agency, the Asian Development Bank (ADB), the designer, the consultant and the contractor. The executing agency is the Public Works Department (PWD). The contractor is the joint venture between Thai contractor and Korean contractor. The construction project cost is approximately 1,100 million Baht (included VAT). Loan provided by the ADB is 55% of project cost and the Thai Government provides the rest (45%). Construction project duration is 900 days plus 480 days for the first and second time extension. The expected completion date is on March 11, 2001. Its route is of 6-lane carriageway including approximately 2,700 m. flyover bridge and 800 m. at-grade road. The works also involve four interchange constructions, the removal and relocation of all concerned existing public utilities since the project road is mainly located in densely populated area.

In the case study, the procurement and construction stages have been studied. Three main parties have been investigated: (1) the executing agency, (2) the contractor, and (3) the consultant. The other related parties such as the ADB, the Thai Government, facility public agencies, subcontractors, suppliers, third parties and other stakeholders are not emphasized in the analysis although they are considered as sources of risks that can affect these three main parties.

In the next sections the literature is reviewed on risk management and the overview of the MRMP is discussed. Then, the results of the MRMP application to the case studied project are described.

3. RISK MANAGEMENT PROCESS

Several researchers have variously defined the term 'risk.' Some definitions focus on both down-side (loss) and up-side (gain) of risk, but some only concentrate on the down-side of risk. Definitions that emphasize only down-side may fail to recognize the existence of gain or benefit. Risk definition can be defined differently depending on fields such as insurance, decision theory, and project management. In insurance field, term risk can be defined as follows: the chance of loss, possibility of loss, uncertainty, dispersion of actual from expected results, and probability of any outcome different from the one expected. In decision theory, situations are distinguished by two broad types: (1) risky situation, which is the situation when the probability distribution functions of parameters are known, and (2) uncertain situation, which is the situation when the probability distribution functions are not known. In the context of project management, project risk is defined as the chance of certain occurrences adversely affecting project objectives[7].

In general, risk is characterized in three components i.e. (1) *the risk event*: what might happen to the detriment or in favor of the project; (2) *the uncertainty of the event*: the chance of the event occurring; and (3) *the potential loss/gain*: consequence of the event happening that can be specified as loss or gain[8), 9)]. These characteristics can be summarized in the following equation: Risk = Probability of event (Uncertainty) × Potential or magnitude of loss/gain.

Construction is a process governed by complicated contracts and involving complex relationships in several tiers. Construction project performance may be significantly improved with greater attention to the risk management. Many researchers have defined the meaning of risk management and most of their proposed definitions are defined in a similar context. Generally, the meaning of risk management is described as a systematic approach to deal with risk. A risk management process should establish an appropriate context; set goals and objectives; identify and analyze risks; and review risk responses.

In the conventional risk management process (RMP), only one party is generally incorporated and the objectives associated with multiple project participants may be overlooked in the analysis. Risk identification and responses are considered and evaluated by one party. When a risk affects parties involved, it is important to answer the question of how to properly identify risk and what is the best response that is desirable for all parties. Since responses to some risks taken by one party may create risks to other parties, risk-response-risk chain may be notified. The process of risk and response evaluation by involved parties is probably absent in the conventional RMP. In a multi-party environment like a general construction project, the conventional RMP may not be necessarily sufficient. Pipattanapiwong and Watanabe (2000)[6)] proposed risk management process entitled the multi-party risk management process (MRMP) that considers the several parties' viewpoints in construction projects. The multiple parties involved in a project and their objectives are incorporated in each process of the MRMP.

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).[10] 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 and the MRMP. 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. The responses A, B, and C, which are portrayed on the risk efficient boundary as shown in Figure 1, are risk efficient. These responses provide a minimum level of risk for a given level of impact and a minimum level of impact for a given level of risk.

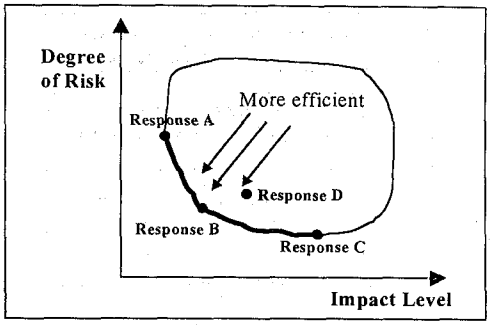

Figure 1 Risk efficiency boundary

The MRMP provides systematic and logical processes including risk identification, risk structuring, and risk analysis and response processes. The process diagram of the MRMP is shown in Figure 2.

(1) Risk identification process

The main task of risk identification is to investigate all possible potential sources of project risks and their potential consequences. It is of considerable importance since the processes of risk structuring and risk analysis and response may only be performed on identified potential risks. The risk identification process in the MRMP aims to objectively identify risks that affect parties involved in the project. Each party's objectives are identified based on the transformation system. The transformation system is described as the process of transforming resource inputs into outputs. Each party's important objectives are analyzed by using the Analytical Hierarchy Process (AHP). The output from the AHP analysis is the relative weights of each objective. Risks associated with each party are identified based on their objectives using the risk checklist. Major and minor risks are initially distinguished in the risk identification process by the frequently impact grid, which consists of two dimensions: frequency of occurrence and degree of impact. Specifically, in the application of the MRMP in this case study, before going through the process of risk identification, the preliminary risk checklist and interview have been conducted. The preliminary risk checklist was developed from the previous literatures to collect the project risks in general[8), 11), 12)].

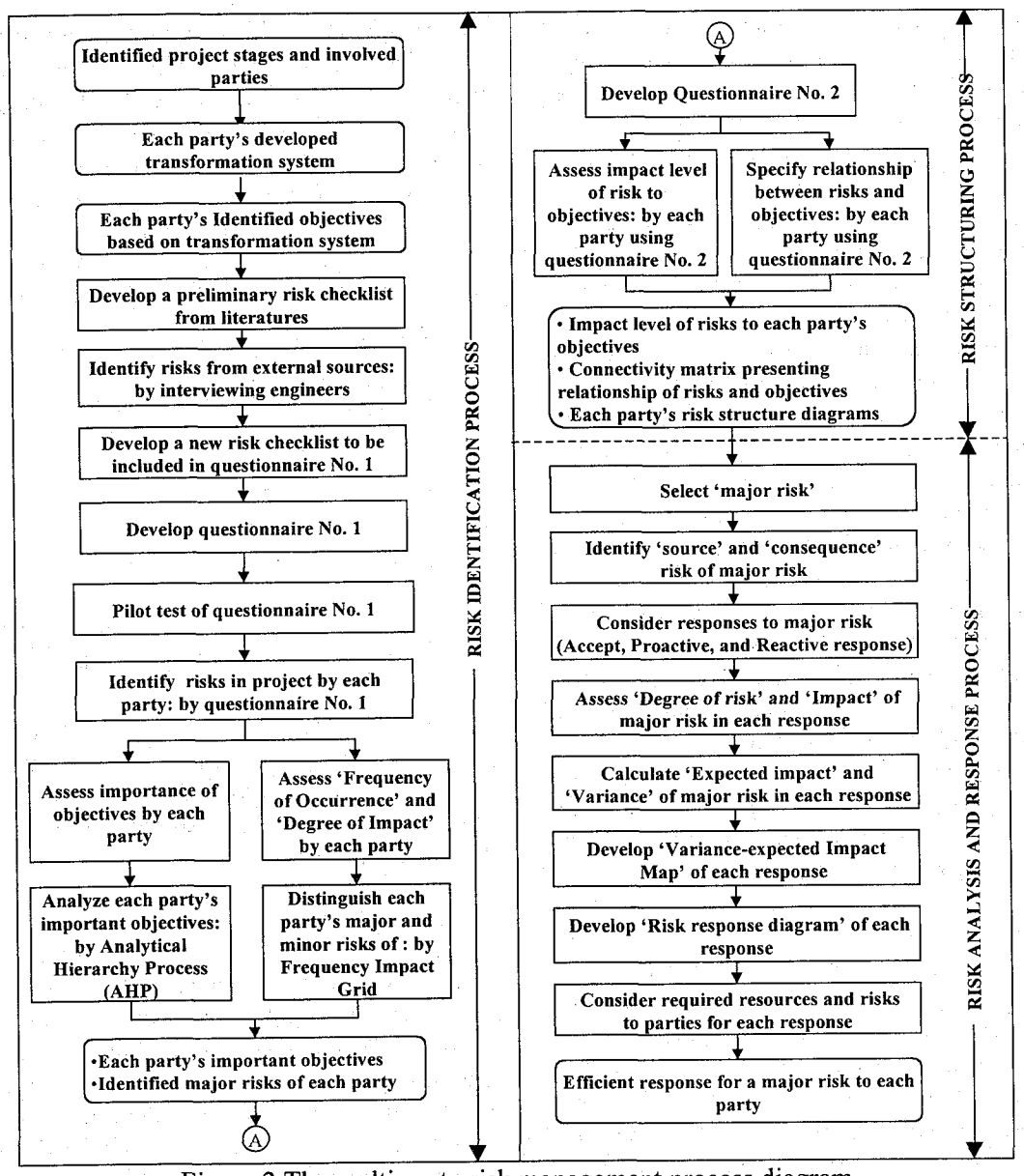

Figure 2 The multi-party risk management process diagram

The unstructured interview with preliminary risk checklist then was conducted with the fifteen experienced engineers 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 interviewees have about 15 years experience each and work for the Public Works Department (PWD), the Bangkok Metropolitan Administrative (BMA), the Asian Development Bank (ADB), contractor, and consultant in Thailand. According to preliminary survey, a new risk checklist was specifically developed for the case studied project. The total numbers of risks in the new risk checklist are 175 consisting of 51 in the procurement stage and 124 in the construction stage. This risk checklist is included in the first questionnaire, which is used to identify risks in the case studied project. Risks specified in the risk checklist are classified in two main categories i.e., external risk and internal risk. Economic risk, political risk, legal risk, weather risk, and public risk are included in the external risk category. The procurement procedure related risk, risk caused by bidders, executing agency, consultant, contractor, and lender, technical risk, contractual risk, personal risk, and construction design and specification risk are included in the internal risk category.

In the case studied project, the respondents for the entire process are the chief project engineer from the executing agency and the project managers from the contractor and consultant. The first structured questionnaire was distributed to investigate the subjective judgement of all parties' respondents. The purpose is to identify important objectives and risks associated with the involved parties. This questionnaire can be generally used in identifying risks. In short, 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, which are in the highest and intermediate priority, were selected for further analysis.

(2) Risk structuring process

Risk structuring process is the successive process from the risk identification. This process relies on the identified risks and objectives. The purpose of the risk structuring process is to specify dependencies among risks. In the MRMP, influence diagram technique is employed to structure the relationship between risks and objectives. In order to conduct the structuring process of risks more efficiently, the connectivity and reachability matrix technique in the graph theory was also used together with the influence diagram. These techniques are used for presenting the existence of relationship among risks and objectives in a systematic form. The connectivity matrix 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 reachability matrix is defined as the matrix whose (i,j) element is one if j^{th} risk is reachable from i^{th} risk and zero otherwise. The raw data from the second questionnaire is collected in the form of reachability matrix, and then the reachability matrix is transformed to the connectivity matrix.

Another task in the structuring process is to identify the most significant risk by analysis of impact level to important objectives. Specifically, the impact level is the influential consequence of risks to each important objective when risk is realized.

The respondents, who were the same group as in the risk identification process, have been investigated their judgement by using the second questionnaire. The second questionnaire was developed based on the distinguished major risks and specified important objectives from the risk identification process. The first part of this questionnaire asks executing agency's, contractor's, and consultant's respondents to rate the impact level of major risks to important objectives. Then, they have been questioned to specify the relationship of risks in the second part. The results from the second questionnaire are the relationship among risks and objectives and also impact level of risks. The significant risks and risk structure diagram associated with the executing agency, contractor and consultant in the procurement and construction stages were obtained from the analysis of the risk structuring process.

(3) Risk analysis and response process

In the risk analysis and response process, logical and systematic procedure in evaluating risk response efficiency for a particular major risk is provided. In the MRMP, the analysis and response are combined. To analyze major risk and evaluate efficient response to a major risk, the probability of occurrence and impact level of major risk are two important variables used in the analysis and response process.

Response is any action or activity that is implemented to deal with a specific risk or a combination of risks. Responses can be categorized into five different types: which are accept, reduce, avoid, transfer, and add contingency. However, it is usually more useful to consider the timing of implementation of the response rather than being concerned too much about the type of response by deciding whether the response is to be implemented before or after the risk occurs. In the MRMP, the alternative responses are classified into three main categories: accept, proactive, and reactive responses depend on when it is implemented. 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. The 'accept' response is a baseline to be compared with proactive and reactive response scenarios.

The selected major risk is the most significant risk based on the impact level assessment and the respondents' judgement in the case studied project. In some cases, the results of calculation of impact levels of risks in the top rank groups are very close. The first rank risks may not be the most significant. Therefore, risks falling into high ranked group are put into evaluation. The most significant risk in this group is selected based on respondent's final judgement.

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. Then, the probability of occurrence and level of impact to objectives of major risk are assessed. The probability of occurrence and impact level are two variables used in calculating the variance and expected impact.

The probability assessment in this research is relied on subjectivity because the possibility of recurrence of the same event under substantially identical conditions is small in the real-world situations and to obtain a large set of relative

frequency data is often hardly possible. 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 impact level of major, source and consequence risks in each alternative response is evaluated. Then, the total impact level of major risk is evaluated and used in calculating the expected impact and variance of the major risk in each alternative response.

The variance is employed to represent the degree of risk and the expected impact is employed to discuss the impact level of risk in this research. 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. The expected impact and variance of major risk in each response scenario are plotted in a variance–expected impact map. The variance-expected impact map, which consists of two dimension i.e., variance in the vertical axis and expected impact in the horizontal axis, is used to present the efficiency condition of responses and discuss characteristics of response in a quantitative and graphical format.

As discussed in previous sections, due to absence of objective data, the subjective data is mainly used in this process. Thus, the structured interview has been conducted to elicit probability of occurrence and impact level of analyzed major risk in each possible response. The 'risk analysis and response interviewing sheet' was used in investigate the respondent's judgement. The aims of this interviewing sheet are to identify source and consequence risks, define probability of risk occurrence and evaluate impact level of a particular major risk in each alternative response.

4. RESULT OF THE MRMP APPLICATION IN THE CASE STUDY

The proposed MRMP was applied to a public bridge and elevated road construction project financed by the ADB located in Thailand. 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.

The following sections describe the result of the MRMP application. The findings are explained according to the processes of the MRMP.

(1) Identification of risks

From the important objective analysis in the AHP analysis, it was found that the executing agency's and contractor's important objectives in the procurement stage are identified differently. The executing agency's most important objective is to select the capable contractor who has financial capability, technical capability in terms of site management, personnel, and equipment, and works experience. On the other hand, contractor perceives that the feasibility and profitability of the awarded contract price is the most important objective.

However, respondents similarly identified the important objectives in the construction stage. The project completed on schedule is the most important objective associated with contractor and consultant. For the executing agency, project schedule, cost and quality are considered equally important. The important objectives of each party are summarized in Table 1.

Table 1 Important objectives of each party in case study

Party	Procurement stage	Construction stage
Executing agency	Capable contractor	Schedule, Budget, Quality
Contractor	Contract price	Schedule
Consultant	-	Schedule

Risks identified by each party as the highest and intermediate priority in the frequency impact grid are distinguished as initial major risks. From the frequency impact grid analysis, the numbers of initial major risks are shown in Table 2.

Table 2 Number of major risks in the highest and intermediate priorities from frequency impact grid

Party	Procurement Stage		
	Highest	Intermediate	Total
Executing agency	6	15	21
Contractor	6	3	9
Party	**Construction Stage**		
	Highest	**Intermediate**	**Total**
Executing agency	-	25	25
Contractor	15	20	35
Consultant	26	-	26

In the procurement stage, the executing agency identified most of risks in the highest priority category are risks related to bidding and prequalification process. On the other hand, the contractor identified risks related to the executing agency. In the construction stage, there were not any risks identified by the executing agency in the highest priority. Almost all risks in the intermediate priority are risks caused by the contractor, subcontractor and supplier. Risks caused by the contractor, material risks and economic risks are the majority of risks identified by the contractor in the highest priority. For the consultant, risks caused by the contractor were mostly identified as the highest priority. Risks in the highest and intermediate priority are further analyzed in the risks structuring process.

(2) Structuring risks

From the analysis of risk structuring process, the relationships between risks and objectives were specified. This paper presents only the risks structure diagrams associated with all parties in the construction stage as shown in Figure 3. These risk structure diagrams show the relationship between high ranked risks and first three important objectives.

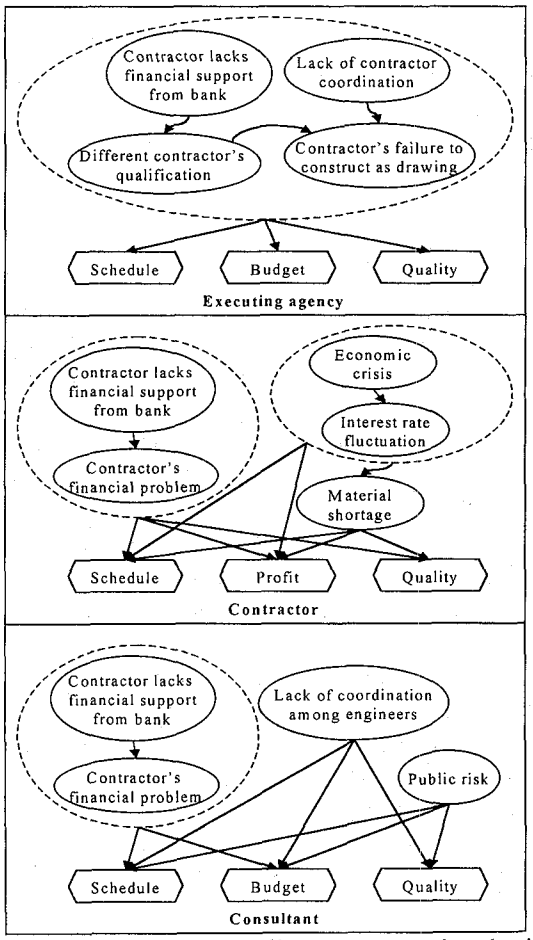

Figure 3 Risk structure diagrams associated with each party in construction stage

(3) Analysis and response evaluation of risk

The significant major risks, which were evaluated by the executing agency's, the contractor's, and the consultant's respondents from the impact evaluation result in risk structuring process, are summarized in Table 3.

Table 3 Major risks of each party in the case study

Party	Procurement stage	Construction stage
Executing agency	Delay in awarding contract	Contractor's financial problems
Contractor	Inexperienced executing agency	Contractor's financial problems
Consultant	-	Contractor's financial problems

In the procurement stage, it was found that delay in awarding contract risk is perceived significant by the executing agency. Bidders' complaint, unclear bid documents, late land acquisition, and late executing agency approval are identified as source risks. The consequence risk associated with delay in awarding risk is delay in signing contract. Preparing clear bid document is most efficient proactive response evaluated by the executing agency.

For the contractor, the lack of executing agency's experience in the procurement process is the most significant risk in the procurement stage. The only one proactive response, which is capable and experienced consultant assists the executing agency in the procurement process is suggested by the contractor. This inexperienced executing agency in the procurement process risk also create other risks such as unfair prequalification criteria, unclear bid documents, bidders complaint, delay in awarding and signing contract. Therefore, for this type of projects in future, the executing agency is recommended to improve procurement process by concerning the proposed efficient proactive responses that the bid document should be clearly prepared and capable and experienced consultant should be employed in assisting the executing agency.

In the construction stage, 'contractor's liquidity and financial problems' risk is the most significant risk for all parties. The "economic crisis and bank does not support loan to contractor" are source risks that are identified by the all parties. Interest rate fluctuation, material price fluctuation and late payment by the executing agency are additional source risks identified by only the contractor. 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 occurred. 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.'

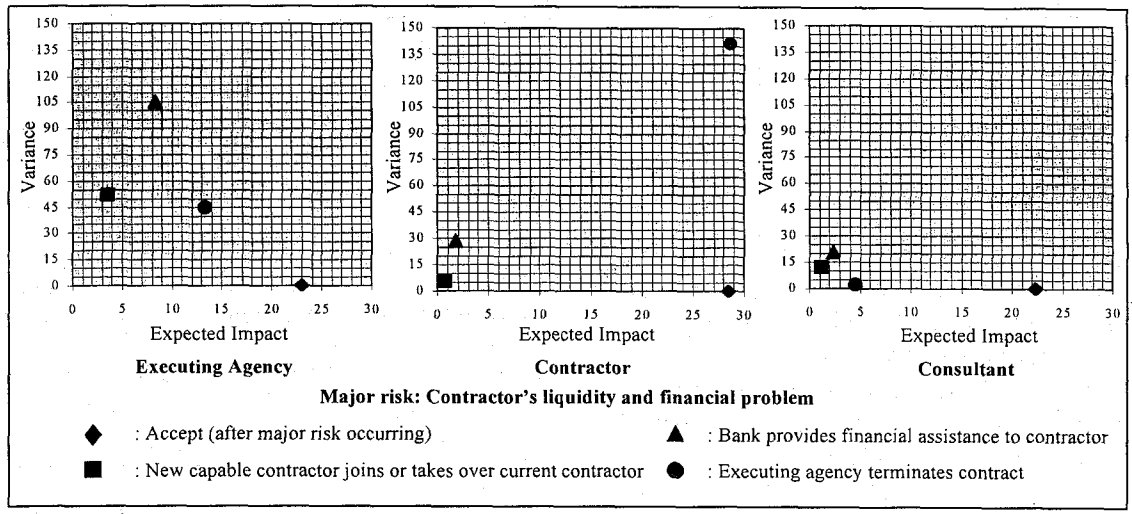

Figure 4 Variance-expected impact map for the major risk in construction stage

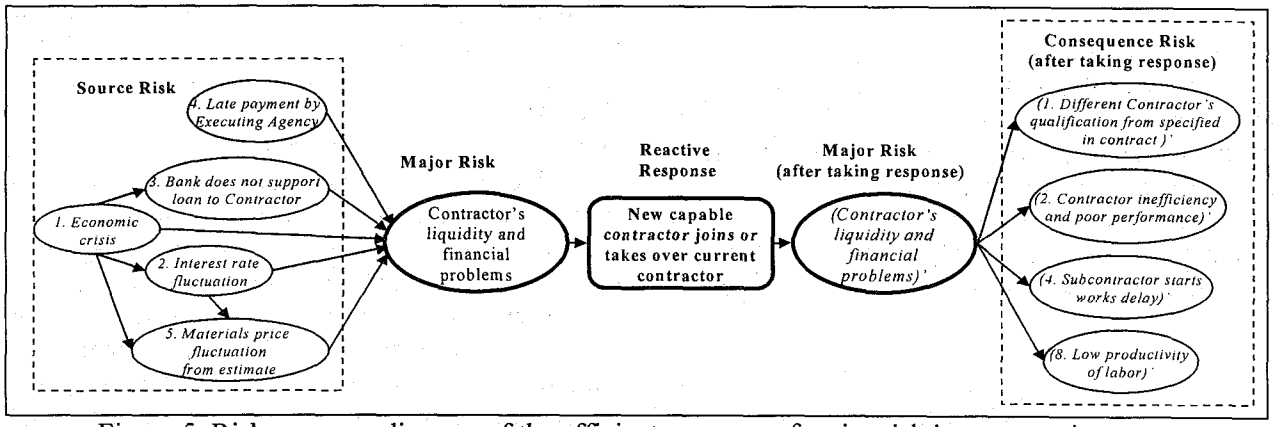

Figure 5 Risk response diagram of the efficient response of major risk in construction stage

Since the all parties similarly identified the contractor's liquidity and financial problem risk in the construction stage, this paper will discuss the result of response evaluation by using this example. The variance-expected impact map of this major risk is shown in Figure 4. When a major risk influences multiple parties, the response to the risk should be desirably efficient for the all parties. From this map, the 'new capable contractor joins or takes the current contractor' response seems to be desirable response for the all related parties. The risk response diagram of this efficient response is presented in Figure 5.

5. DISCUSSION OF THE MRMP APPLICATION

From the MRMP application, the contractor identified 'the executing agency lacks experience in the procurement process' risk as the major risk in the procurement stage. This major risk is related to the executing agency's self-deficiency. This result presents one of the benefits of incorporating multi-party in the risk management process. The self-deficiency evaluation is one of the characteristics in the MRMP.

The response evaluation results of 'the contractor's liquidity and financial problem' risk in the construction stage show that the most desirable response for all parties seems the 'the new capable contractor joins or takes over the current contractor' response. This illustrates the multi-party response efficiency evaluation. This characteristic of the MRMP is direct extension of the risk efficiency concept in the conventional RMP.

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. With the same response evaluation of the major risk in the construction stage, if the 'executing agency terminates contract' response is taken by the executing agency, this creates another risk i.e. financial risk to the contractor as shown in Figure 6. This result reveals the multi-party risk-response-risk evaluation, which is another feature of the MRMP.

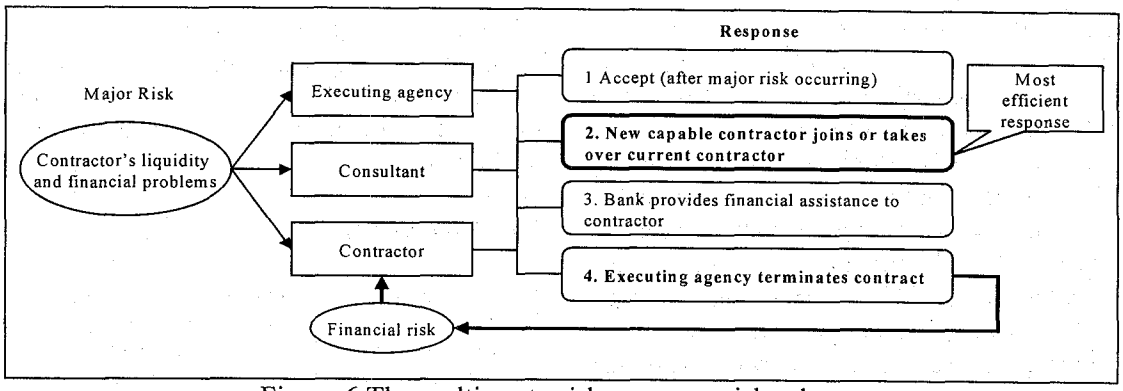

Figure 6 The multi-party risk-response-risk scheme

Table 4 Findings of the MRMP application in the case study

Party	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 RMP)
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
Contractor	Schedule			- Multi-party risk-response-risk evaluation
Consultant	Schedule			- Response characteristics evaluation

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. It is useful to study whether all parties' preferred perception and characteristics of each response are matched or not. From the MRMP application in this case study, the response characteristics associated with the multiple parties' perceptions can be presented by the variance-expected impact map. In Figure 4, 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. The findings of the MRMP application in the case study are summarized in Table 4.

6. CONCLUSIONS

This paper discusses the risk management process for an international infrastructure construction project, and the application result of the MRMP. The MRMP is a risk management process that may be more applicable than the conventional risk management process in managing risks in a multi-party environment.

The bridge and elevated road construction project financed by the ADB was selected as a case study in applying the MRMP. The project financed by an international lender tends to be more important in public sector in Thailand. The study concentrated on the executing agency, the contractor and the consultant, who are involved in the procurement and construction stages in the case studied project. The results reveal the significant risks associated with each party in the procurement and construction stages as well as the efficient responses to each significant risk. The summary of results is previously shown in Table 4. The recommended proactive responses of major risk in procurement stage can be used as proactive actions for similar projects in future. For the construction stage, the recommended reactive response of major risk in the construction stage can be recently implemented to this case study.

Analyzing the MRMP application, it was found that a number of contributions of the MRMP were extensively developed from the conventional RMP. First, the multi-party response efficiency evaluation is to find a desirable response, which is risk efficient to the all related parties in order to manage risk more efficiently. 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 more preferable response for all parties. Fourth, 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.

The multi-party response efficiency, response characteristics, multi-party risk-response-risk, and self-deficiency evaluations can beneficially assist a decision-maker to better make a decision and manage risks in a multi-party environment. Understanding how to reduce risky situation, impact level, required resources and effects to all related parties when implementing a risk response is important in the MRMP.

Finally, more risks possibly influence the international infrastructure construction projects than other types of project since many complexities such as several parties and huge investment are involved. The more attention of risk management should be put in management of this type of project in order to reduce impact of risks to project performance e.g. cost, time and quality. Not only the main parties, who directly participate in execution of project, but also other stakeholders such as taxpayers and users of that infrastructure project will gain the benefits from improving project performance. Applying the MRMP will not remove all risks, however, it will enable explicit decisions to be made, which will mitigate the potential effect of certain risks, and provide the efficient response.

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REFERENCES

1) Ogunlana, S. O.: Build-Operate-Transfer Procurement Traps: Examples from Transportation Project in Thailand, Proceedings of the CIB W92 Symposium on Procurement, May, 1997.
2) Overseas Economic Cooperation Fund, Japan: Projects Under the 23rd OECF Loan To Thailand, OECF, Japan Newsletter, Bangkok Office. September, 1998.
3) Godavitarne, C.: World Bank Concerns, Policies and Practices Related to Procurement and Contract Management, International Conference on Contract Management in Construction Industry, New Delhi, India, pp. 55-59, 1995.
4) Hayashi, L. A.: Handbook on Problems in Procurement for Projects Financed by the Asian Development Bank, Central Projects Services Office, ADB, October, 1986.
5) Asian Development Bank: Post Evaluation Report for Thailand (1999), Asian Development Bank, 1999.
6) Pipattanapiwong, J. and Watanabe, T.: Multi-party Risk Management Process (MRMP) for a Construction Project Financed by an International Lender. Proceedings of the 16th ARCOM conference, Glasgow Caledonian University, Glasgow, 1: 219-228, 2000.
7) Niwa, K.: Knowledge-Based Risk Management in Engineering: A Case Study in Human-Computer Cooperative Systems, John Wiley & Sons, Inc., Canada, 1989.
8) Al-Bahar, J. F. and Crandall, K. C.: Systematic Risk Management Approach for Construction Projects, Journal of Construction Engineering and Management, Vol. 106, No. 3, September: 533-546, 1990.
9) Raftery, J.: Risk Analysis in Project Management, E & FN SPON, An Imprint of Chapman & Hall, London SE1 8HN, UK, 1994.
10) Chapman, C. and Ward, S.: Project Risk Management: Process, Techniques and Insights, John Wiley & Sons, Inc., Canada, 1997.
11) Zhi, H.: Risk Management for Overseas Construction Projects, International Journal of Project Management, Vol. 13, No. 4, pp. 231-237, 1995.
12) Edwards, L.: Practical Risk Management in the Construction Industry, Thomas Telford Publications, Thomas Telford Services Ltd., London, 1995.

国際建設事業におけるリスクマネジメント
-タイ国におけるアジア開発銀行融資建設事業のケーススタディ-

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国際建設事業では、投資額が巨額であること、多数の関係者が関与することなどから、その事業リスクは必然的に大きくなる場合が多い。
リスクマネジメント手法は、事業を円滑に執行するための有力な手法の一つである。しかし従来の手法では、単一主体の視点に基づいて分析が行われる場合が多く、複数の主体の視点を 十分に考慮することは必ずしも容易ではなかった。
本稿は、複数の主体の視点を考慮できる「複数主体リスクマネジメントプロセス手法の国際建設事業のリスクマネジメントへの適応性を検討することを目的とする。
ケーススタディを通して新手法の特長を考察するとともに、当該事業の主要リスク並びにそれらへの効率的対応策を検討することを試みた。