

Analysis of Risk- Response based on Railroad Construction Project

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Abstract

Risk-response is a key component of risk management in railroad construction, for the solution of this problem, certain objectives are designed and realized to contribute this engineering project. During railroad construction risk factors exist in construction project from different aspects; for which all adopted response measures are different. In this paper we begin from theory and choose case studies aspect in risk management that how to adopt response measures. Forty-three risk factors were collected from past research and interviews with railway engineers, and grouped into nine categories. Risk response measures for each risk factor were then analyzed. The measurement is included risk retention, risk reduction, risk transfer, risk elimination or avoidance, and contingency allowances. By interviewing the railroad contractors in one project in the light of case studies, it was found that the most widely used risk response measurements were risk reduction, risk retention, and risk transfer, respectively. The present considerations of railroad contractors used for selecting their risk response measures for each risk factor. These considerations include costs of risk response measures, project procurement, delivery systems and forms of project payment. By questionnaire survey we found that abundant construction management, having nine kinds of crisis, showing that most of crisis are with contractor and relate to designer, only few belong to government agencies, related to sub-contractor and external factors.

Key words: Railway Construction Crisis; response measures; railroad project

Introduction

Railway engineering construction projects generally have large investment, long development cycle, high technical requirements and construction environment is complex, which determines that railway construction project everywhere at risk. Risk response is an important part of the risk management, which not only solve the problem but also help to achieve the goals of engineering project. In order to study the existing risk factors from various aspects and the various measures taken for their solution by different methods, this article deals from the aspects of theory and case study about risk management and responses. At the same time, during railway construction project many risk factors are involved such as economic, political, Law, physical site, scope of work, construction contract, designing, materials, financial and human resource risks. Currently, Thailand railway construction project is improved rapidly with increase construction scale and increase of investment, meanwhile the risk of loss is also increasing. Therefore, for the railway construction engineering projects the process of risk analysis is essential, for risk analysis we choose the perspective of the actual railway engineering construction from Chachoengsao (Thailand) to Lamchabang (Thailand). During analysis the results should focus on risk prevention and specific risk response measures.

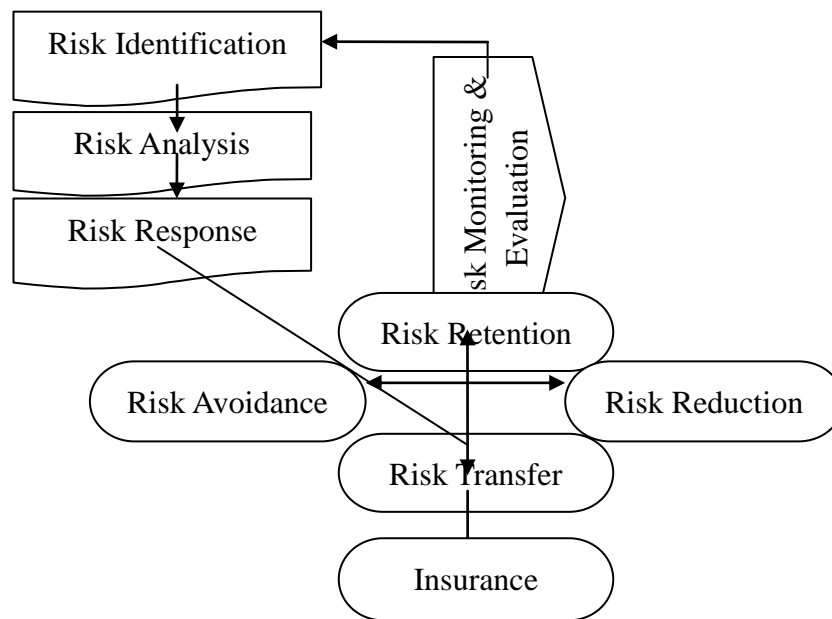


Figure 1. Risk management life cycle

Likhitrungsilp and Photios G. Ioannou (2012)

Methodology

In this paper, we analyze about risk managements on railroad construction project, risk response on construction and risk response measures. The collected informations concerning railroad risk-response measures were gathered through questionnaires and interviews from experienced railroad engineers working in large construction companies or government agencies. The six experts who participated in this study included senior engineers, project managers, and site engineers, having railroad experience 10 to 15 years. All experts were involved in large soft-ground railroad projects located in Chachoengsao to Leam Chabang Thailand. The informations obtained from the questionnaire survey were analyzed and summarized. We then conducted detail interviews with all experts to obtain additional informations on the above issues for clarification and verification of their previous answers. Finally, the informations obtained from both survey types were compiled and integrated to obtaine the final results and conclusions.

1 Risk response measurements

Risk response measurements include risk estimation, analysis, and evaluation. On the basis of evaluation of risk factors we determine that how we eliminate or reduce risk about certain factor. Before the happening of accident, it is necessary reduce the accident frequency and minimize the losses due to accidents. Risk response is an important step for risk management, based on several considerations, for each risk factor we can choose risk measurements from different angles. For example, the purpose of risk management, risk decision factors, relevant cost alternative, risk management ability and various related parts are involved certain policy, laws and regulations. According to the result of risk identification, risk assessment and the nature of the specific risks potential impact risk responses are planned. Later on the basis of these response plans, the implementation of plans to deal with risks and to avoid or reduce losses is analyzed for better results. Risk response measures include five parts such as risk retention, risk reduction, risk transfer, risk avoidance and insurance.

1.1 Risk retention

Risk retention which is also called risk acceptance, refers to the risk occurrences, which takes its origin from project principle risk consequences or a countermeasures. Retention can be divided into active and passive risk retention. Active risk retention means the identified risk consciously, in a planned way. While the passive risk retention is risk which managers don't realize during the planning of of project or are not prepared to deal with a

project risk. In the engineering construction risk retention strategy is mostly due to risk identification or analysis of respective errors. Risk management personnel should try to reduce the error of risk identification and risk evaluation. They should also try timely to make a risk decision and implementation of the decisions in time for the completion of significant and large projects.

1.2 Risk reduction

The probability of risk reduction refers to the risk events which affected individuals or reduced to certain acceptable level. The measurement goal is to reduce the possibility of occurrence of a risk or reduce the negative impact of the consequences. Under certain conditions, reduction in the risk intervention might have been better than risk aversion of technical and economic effects. In implementing risk mitigation measures, it is necessary to reduce certain risk to acceptable level. In addition, the time for reducing certain risk is also an important factor. The uncertainty of predictable and unpredictable risks only can be reduced after a period of time. In order to reduce these risks planning are designed as, which are easily implemented both for present as well as for future.

1.3 Risk transfer

Risk transfer along with its results against the rights and responsibility by the insurance (subcontracting, technology transfer, etc.) in the form of transfer to the other party, so as to reduce their risk. For the probabilities and large potential losses the insurance risk transfer countermeasures the risk. The insurance risk transfer includes control, transfer of insurance and financial insurance. Controlling the insurance transfer, transfer is the loss of legal responsibility, by the terms of the contract to eliminate or reduce the loss of the assignor to the assignee liability and responsibility of third party damage. Financial type means transferring by the terms of the contract of insurance involving foreign money compensation which happened or nearly to happen. The insurance risk transfer means the implementation by means of contract transfer; transfer contract object may be related with owner, general contractor, subcontractors and suppliers. During contract both sides carefully identify that both parties bear which kind of responsibility, to prevent unreasonable risk transfer, such as the owner transfer financial risk to the contractor.

1.4 Risk avoidance

Risk avoidance refers to the risk has not yet occurred, take the initiative to give up or refuse to implement may lead to risk loss. Risk aversion in the project management is a system, for that probability, loss of process or project mandatory avoidance countermeasures. In wide terms risk aversion means losing profit opportunities, which is a kind of negative and preventive measures. In addition, from the perspective of risk management, risk avoidance is refusing to take risks; it is one of the ways to eliminate the risk. Although the construction project can't eliminate all risks, but by the method of risk aversion, to a certain risk, eliminate before it occurrences, so it reduce the opportunity of risk or reduce causes of damage. In general, the following several ways, usually risk avoidance strategy should be considered: (1). The probability of risk events happening a lot of loss in big projects and the consequences; (2). The probability of the loss is not large but when the risk of incident loss is severe (3). Risk aversion objectively don't must for projects but just need for the better set up of project.

1.5 Insurance

Insurance means is a kind of important measures for construction of engineering projects for the welfare of persons involved in certain project. Insurance required that owner or contractor must pay a fee, once the risk event occurs, which may cause economic loss, or for other losses, the fee is a compensation for the loss. For those who have a speculative accident risks the loss can be solved through insurance. When the owner after the implementation of the insurance, reduce the pressure of risk management, and facilitate the payments of funds after the incident, this result that worker soon return to work as soon as possible, which is achievement of project goals. Insurance can be divided into compulsory insurance and voluntary insurance. At present, the Thai construction engineering insurance coverage of a single, the high cost of insurance, for owners, contractors and risk awareness is not strong, which cannot make the engineering insurance profitable, therefore it is suggested that for better management of construction project the existing method of insurance must be improved.

2 Analysis of risk response methods for each rail road construction project risk factor

Impact of railway construction project risk through every link of the construction of the project, through summing up and summarizing risk factors can be divided into the following nine categories: scope of work and terms of contract, the construction sites, natural environment factors, design factors, construction and operation technology, material and equipment factors, human factors, economic factors, political law, force measurement factors. Table 1 is encountered in the railway construction contractor in construction projects of various kinds of risk factors, suggest a risk response measurements.

Table 1. Risk response methods for each railroad construction project risk factor

Risk code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P1: Economic, Politics and Law											
P11	Variation of construction material prices	⊙					⊙				
P12	Fluctuation of currency exchange rates	⊗							⊗		
P13	Changes in salary	⊗									
P14	Changes in policy and regulation	⊙								○	
P2: Physical and Construction Site											
P21	Project condition unable forecast			⊗						○	
P22	Project condition difference			⊗						○	
P23	Veracity of soil survey and construction			⊗						○	
P24	Owner offer construction information error			⊙							⊙

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

Rd4: Risk reduction by work adjustment

T1: Risk transfer by subcontracting

T2: Risk transfer by construction insurance

E: Risk elimination (avoidance)

C: Contingency allowance

N: Risk not considered by Contractor

○ Adopted by 1-4 experts

⊙ Adopted by 5-8 experts

⊗ Adopted by 9-12 experts

Table 2. Risk response methods for each rail road construction project risk factor

Risk code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P25	Construction delivery delay	⊙									⊗
P26	Public utility transportation	⊙		○							
P27	Construction problems	○									⊙
P28	Land supply arrangement and requisition of land	⊗									
P3	Force Majeure										

P31	Bad weather	⊙					⊗				
P32	Natural environment	⊗					⊗				
P33	Personnel crisis (strikes of workers)	⊗					⊗				
P34	Failure complete projects within scope of owner's budget	⊙					⊗				
P4	Scope of work and Construction Contract										

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

Rd4: Risk reduction by work adjustment

T1: Risk transfer by subcontracting

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Table 3. Risk response methods for each railroad construction Project risk factor

Risk code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P41	Work scope changes			⊙		○					
P42	Delay in negotiation of change			⊙		○					
P43	Delay in contract amendment and dispute resolution			○			⊙				
P44	Scope of work contract actual difference						⊗				○
P5	Design										
P51	Design errors and omissions	⊗			⊗						
P52	Operation technology poverty lead to structure of potential defect	⊗			⊗						
P53	Plane and specs incomplete or in conflict	⊙					⊙				
P54	Delays in design and design change						○				⊙
P6	Material and Equipment										

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

T1: Risk transfer by subcontracting

T2: Risk transfer by construction insurance

E: Risk elimination (avoidance)

C: Contingency allowance

○ Adopted by 1-4 experts

⊙ Adopted by 5-8 experts

⊗ Adopted by 9-12 experts

Rd4: Risk reduction by work adjustment

N: Risk not considered by Contractor

Table 4. Risk response methods for each railroad Construction Project risk factor

Risk Code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P61	Material Scarcity	○									⊙
P62	Delays in material and equipment delivery	⊙					⊙				
P63	Unavailable material and equipment					⊙					
P64	Material fluctuation										⊙
P7	Construction Operations and Techniques										
P71	Inappropriate construction planning									⊙	⊙
P72	Inappropriate construction method			○		⊙					○
P73	Site working accident			○							⊙
P74	Supervision of construction deficiency			○							⊙
P75	Safety in construction					⊙					⊙

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

Rd4: Risk reduction by work adjustment

T1: Risk transfer by subcontracting

T2: Risk transfer by construction insurance

E: Risk elimination (avoidance)

C: Contingency allowances

N: Risk not considered by Contractor

○ Adopted by 1-4 experts

⊙ Adopted by 5-8 experts

⊙ Adopted by 9-12 experts

Table 5. Risk response methods for each rail road construction project risk factor

Risk code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P7	Construction Operations and Techniques										
P76	Construction affect natural environment	○									⊙
P8	Human Resource Risk										
P81	Contractor management and experience	⊙			⊙						

P82	Contractor financial problem									⊙			
P83	Sub-Contractor breach of contract	⊙											⊙
P84	Sub-Contractor management ability		⊙		⊙								⊙
P85	Sub-Contractor financial problem		⊙										⊙
P86	Staff quality problem												⊙
P87	Brain drain												⊙

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

Rd4: Risk reduction by work adjustment

T1: Risk transfer by subcontracting

T2: Risk transfer by construction insurance

E: Risk elimination (avoidance)

C: Contingency allowance

N: Risk not considered by Contractor

○ Adopted by 1-4 experts

⊙ Adopted by 5-8 experts

⊗ Adopted by 9-12 experts

Table 6. Risk response methods for each railroad construction project risk factor

Risk code	Risk factor	Alternative risk response methods									
		Rt	Rd1	Rd2	Rd3	Rd4	T1	T2	E	C	N
P9	Financing and Economic										
P91	Capital tension supply	○									⊙
P92	Cost control no good	⊗									⊙
P93	Financial crisis										⊗
P94	Owner deferred payment										⊗
P95	Expenses of overspend	⊗									○

Note:

Rt: Risk retention

Rd1: Risk reduction addition

Rd2: Risk reduction by physical protection

Rd3: Risk reduction by personnel management

T1: Risk transfer by subcontracting

T2: Risk transfer by construction insurance

E: Risk elimination (avoidance)

C: Contingency allowance

○ Adopted by 1-4 experts

⊙ Adopted by 5-8 experts

⊗ Adopted by 9-12 experts

Rd4: Risk reduction by work adjustment

N: Risk not considered by Contractor

3. Summarized risk response measures with each risk factor

In dealing with all kinds of risk factors, the contractors consider many measures to deal with risks. In addition, the contractor should consider other risks, such as, contract conditions, various organizations, construction methods, construction contractor risk management strategy and so on. Based on considering the specified risk response, this article is accordance with literature, Flanagan and Norman (1993) Eskesen, Tengborg, Kampmann, and Veicherts (2004). In this work since then experts of railway engineering construction projects were interviewed and the result of interview is summarized. As we have mentioned that risk-response measures adopted by the nine experts for each tunneling risk factor were quite diverse. This resulted from several internal and external criteria that the respondents took into account while choosing their measurements. The detailed person to person interviews with the respondents were identified by eight criteria, which are considered important when making such decisions. These can be summarized as follows: Cost associated with the risk-response measures, project delivery system, project payment method, contract provisions concerning risk, owner's risk policy, contractor's risk policy, project characteristics, and contractor's railroad experience. Risk response method based on table 2 shows the contractor selection for each study, the risk factors of railroad engineering construction projects can be summed up the relevant measures, see table 7.

Table 7. Number of risk factors for each risk response measure

No	Risk response measures	Number of risk factors	Percent (out of 43 factors)
1	Risk retention	23	53.49
2	Risk reduction	19	44.19
3	Risk transfer	11	25.58
4	Risk avoidance	1	2.33
5	Contingency allowance	6	13.95
6	Not considered	22	51.16

According to table 7. the total risk factors are not equal to 43, as some risk factors were chosen for more than one action. On the basis of contractor risk response analysis, the contractor widely used measures of risk reduction, risk retention, risk transfer. For risk avoidance on the results of the study, the contractor does not consider risk aversion, because the railway engineering construction projects are from government programs. Therefore the terms and conditions of the contract form must be in accordance with requirements of the government. Improvements in the terms of the contract in the form of probability is less, in addition the research result shows there are many risk factors which contractor doesn't take into account, because they considers the possibility of occurrence of a risk is small or even not happened.

4. Summary and conclusions

Risk-response is a key component of risk management in tunnel construction. It involves choosing appropriate measures to eliminate or reduce the chances of risk happening or mitigating its impact in case of occurrences. Making these choices requires project information, technical knowledge, and contractor's experience. In this paper, we explained risk-response measures contractors employed in railroad projects in Thailand. We began with the compilation of 43 risk factors borne by contractors in tunneling work, followed by the results of a questionnaire survey and detailed interviews through which we gathered the necessary information from nine experts. It was found that the risk-response measures adopted by these experts for each rail road risk factor were quite diverse. The most common risk-response measures were risk-reduction (44.19 percent), risk-retention (53.49 percent), and risk-transfer (25.58 percent). However, there were also several tunneling risk factors (46.2 percent) that were ignored by the respondents. We also investigated the criteria used by contractors when considering risk-response measures. Nine important criteria were identified: cost project delivery system, project payment method, contract provisions, owner's risk policy, contractor's risk policy, project characteristics, and contractor's experience. These results can be used by railroad contractors to develop appropriate risk management plans for future projects. Also, future research

could compare these findings to strategies in other construction markets by type, location, and time. In this paper, the railway construction project risk response are analyzed in detail, and showed importance of risk response management. The owner and the contractor cannot be ignored. Insurance, as one of the main risk response should be vigorously promoted. Engineering insurance can strengthen enterprise's ability to resist risk; the project payment default to solve the problems and avoid the need of engineering and technical risk, also need to develop foreign markets. Presently, Thailand's relevant laws and regulations is not perfect, to a large extent affected the development of engineering insurance and needs modifications. It is suggested that government departments further modify and perfect the security law, insurance law, construction law, contract law and other laws and regulations of engineering insurance. In addition, strengthen the guarantee of market development, development of insurance intermediary institutions, and foundation of engineering insurance work conditions.

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