Risk Management in Construction Industry

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Abstract-Construction projects are characterized as very complex projects, where uncertainty comes from various sources. Construction projects gather together hundreds of stakeholders, which makes it difficult to study a network as a whole. But at the same time, these projects offer an ideal environment for network and risk management research. Additionally, construction projects are frequently used in management research, and several different tools and techniques have already been developed and especially for this type of project. However, there is a gap between risk management techniques and their practical application by construction contractor. This paper deals with the identification of risk by different methods, types of risks associated with construction project and different risk mitigation techniques.

Key words- Risk, force majeure risk, delphi technique, risk mitigation, risk avoidance, risk retention

1. INTRODUCTION

In the construction industry, risk is often referred to as the presence of potential or actual threats or opportunities that influence the objectives of a project during construction, commissioning, or at time of use. Risk is also defined as the exposure to the chance of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty. There are two types of risk:

1) Pure risk in which there is the possibility of financial loss but no possibility of financial gain

2) Speculative risk that involves the possibility of both gains and losses.

It is necessary to identify all risks involved at all the stages of the project so as their assessment and analysis can be done accordingly. There are various methods to identify risks, depending on type of project. Risk management process in case of construction industry involves following stages :

- 1. Primary stage
- Risk Identification
- 2. Secondary stage
- Risk Assessment
- Risk Analysis
- 3. Tertiary stage
- Risk Mitigation

2.RISKS AT VARIOUS STAGES OF PROJECT

The following is a listing of many construction industry risks and exposures.

2.1. Financial risks

This risk is the totality of all risks that relate to financial developments external to the project that are not in the control of the project developer. This results from consequences that may have adverse economic effects. Financial risks fall into these categories: Exchange rate risk relates to the possibility that changes in foreign exchange rates alter the exchange value of cash flows from the project. This risk may be considerable, since exchange rates are particularly unstable in many developing countries or countries whose economies are in transition. In addition to exchange rate fluctuations, the project company may face the risk that foreign exchange control or lowering reserves of foreign exchange may limit the availability in the local market of foreign currency needed by the project company to service its debt or repay the original investment. Interest rate risk forces the project to bear additional financing costs. This risk may be significant in infrastructure projects given the usually large sums borrowed and the long duration of projects, with some loans extending over a period of several years.

2.2 Political risk

The project company and the lenders face the risk that the project execution may be negatively affected by acts of the contracting authority (Government), another agency of the government or the host country's legislature. Such risks are often referred to as political risks. Political risk faced by firms can be defined as "the risk of a strategic, financial, or personnel loss for a firm because of such nonmarket factors as macroeconomic and social policies. Political risk includes risk such as change in law, payment failure by government, increase in taxes and change in government.

2.3 Legal risks

It is the risk of non-compliance with legal or regulatory requirements. Much of the law is general and will apply to all organizations e.g. employment law, health and safety, environmental legislation, etc. Others may be industry specific e.g. covering specific transport services such as railways or airlines. Some of the legal risks that a construction projects can face are related to lease of property, ownership of asset and breach of financial documents.

2.4 Environment risk

These are risks relating to occurrence of environmental incidents during the course of implementation of the project. These risks are generally within the control of the construction and the operation and maintenance consortium. This risk has increased due to the presence of strict legal liability in relation to such environmental incidents, which can result not only in adverse affects on the financials of a project but may also cause a closure of any work or operations of and in relation to the facility. The main environmental risks associated with hydro power projects are

- Loss of flora and fauna
- Loss of fertile lands
- Rehabilitation and resettlement problems

2.5 Force majeure risks

These risks are regarding the events that are outside the control of any party and cannot be reasonably prevented by the concerned party. These risks generally arise due to causes extraneous to the project. The defining of force majeure events, these include natural force majeure events, direct or indirect political force majeure events. Natural force majeure events comprise of all events that can be attributed to natural conditions or acts of god such as earthquakes, floods, cyclones and typhoons. These risks should be shared equally among the parties. Direct political force majeure events are events attributable to political events that are specific to the project itself such as exploration, nationalization. Indirect political force majeure events are events that have their origins in political events but are not project specific such as war, riots etc.

2.6 Operating risks

Some of the risks that may face in a construction project apply during operations and maintenance (O&M) type services. More specifically, operational risk can be defined as the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events²². Some of the risks and actions available to the concession company include:

1. Performance risk-The completed facility cannot be effectively operated or maintained to produce the expected capacity, output or efficiency.

2. Operation cost overrun- The operating costs exceed the original estimates.

3. Operating contractor default- The concession company may terminate the operations and maintenance contract and appoint a new O&M contractor.

4.Default- The default may be caused by the actions of a third party, in which case the concession company could make claims of damages against that party.

3. RISK IDENTIFICATION PROCESS:

Risks exist from the very outset of a project. Therefore we need to identify what they are, ascertain when they might arise, what effect they may and what measures need to be taken to prevent their occurrence or mitigate their potential impact. The identification of risks may be considered as the most important stage in Risk Management, if only in terms of bringing considerable benefit to all parties in the greater understanding of the project, irrespective of whether further action is taken or not. When identifying risks, it is important to appreciate not merely the risk itself but the source, the event that may lead to the risk materializing and the effect of the risk if it does materialize. Table shows the techniques, assessment and categorization of risk in risk identification process.

Techniques	Assessment	Categorization
Check list	Potential	Unacceptable
Interviews	impact	Critical
Expert system		Significant
Questionnaire	Probability	Insignificant
The Delphi technique	of occurrence	Acceptable

4. RISK IDENTIFICATION METHODS

4.1 Questionnaires or Checklists:-

Questionnaires are usually drawn up from a combination of previous experience and specific project criteria. There are two forms of questionnaire, one is a very general form with non-specific prompts or questions and the other can be detailed as is required by the particular project. Questionnaires also facilitate consistently presented answers from different team members which allow less time consuming and more meaningful comparisons. Therefore the risk manager can ascertain more readily any apparent consensus.

4.2 Interviews:-

This is technique that has been used historically by personnel departments and other consultants to extract information. It has also been used by risk managers to identify possible risk in a development. The interviews may take place on a one to one basis or on a many to one basis. The many to one basis should consist of projects members from different disciplines so that the subjects raised can be viewed from different perspectives. The problem with this method is that it is time consuming not only to carry out the interviewing but also record the risks arrived at there from.

4.3 Expert system:-

A lot of research is being done on artificial intelligence and expert systems. Specifically, one of the most sophisticated models that can be developed for risk management is by making use of knowledge-based systems or human-computer cooperative systems. This system is designed to assist the project managers in achieving more effective control over risks by providing them with appropriate knowledge, gathered from many project managers and compiled into a knowledge-base. It is designed to warn project managers of risks that may follow etc. While doing this, the logical thinking and the intuitive thinking of the managers is accounted for in the system

4. 4 The Delphe technique:-

The Delphe technique attempts to produce objective results from subjective discussions. It is a systematic, interactive forecasting method which relies on a panel of independent experts. This method may be applicable to the identification of risks but it is more suited to attaching likelihood of occurrence and potential impacts of previously identified risk events. This method basically involves the following sequence of events:

1. A questionnaire is forwarded to all the appropriate members of the project team by the appointed risk manager.

- 2. The members of project teams gives their objective views in response to the questionnaire and returns them to the risk manager.
- 3. The risk manager then collects these results and redistributes them. Each project participant now receives a different set of views and is requested to reconsider their original answers and resubmit them to the risk manager.
- 4. These revised results are again collected by the risk manager and redistributed again in the same manner as above.
- 5. This iterative process is continued until the risk manager is satisfied that a consensus o opinion has been reached.

5 RISK ASSESMENT

Risk assessment is the process of estimating and communicating workplace safety risk, and deciding whether this risk is acceptable. Conducting a risk assessment involves making a value judgement based on this information and any available evidence within the workplace and industry. This may include numbers of current and past incidents, severity of injuries from the identified hazard, lost work time from injuries and number of people involved in incidents. Specific information such as environmental measurements of hazards, eg noise levels, dust levels, and comparisons made between the workplace measurement and the legally required measurement can also assist in the risk assessment process. Widely used method is risk matrix. The risk matrix records the level of risk which is determined by the relationship between the likelihood of an incident occurring from the hazard, and the consequence caused by the hazard. This is recorded as either a numerical or alphabetical code. The relationship between likelihood and consequence determines how dangerous the hazard is.The level of risk or code that is determined is referred to as a risk priority rating. This priority rating allows employers to prioritise the hazards identified to ensure that the hazards with high potential of creating an incident are eliminated or controlled first. Controlling a hazard may involve inspections, investigations and/or monitoring control activities with managers, supervisors and work teams involved as appropriate depending on the circumstances.

LIKEKYHOOD	CONSEQUENCE				
	SEVER	MAJOR	MEDIUM	MONOR	NEGLIGIBLE
ALMOST CERTAIN	Е	Н	н	М	М
LIKELY	Н	н	М	М	L
POSSIBLE	Н	М	М	L	L
UNLIKELY	М	М	L	L	Т
RARE	М	L	L	Т	Т

Table 2 Risk Matrix

5. RISK MITIGATION

The uncertainty of a risk event as well as the probability of occurrence or potential impact should decrease by selecting the appropriate risk mitigation strategy. Four mitigation strategy categories commonly used are: **5.1 Risk avoidance**

. Risk avoidance may include a review of the overall project objectives leading to a reappraisal of the project as a whole. Risk avoidance is often perceived as the ultimate mitigation strategy in that it implies that the project may be aborted. It means making a decision not to enter in to new way of working because of inherent risk this would introduce. This method of mitigation involves the removal of the cause of the risk and therefore the risk itself. Ideally any approach involving avoidance is best implemented by the consideration and adoption of an alternative course of action. Other examples of risk avoidance include the use of exemption clauses in contracts, either to avoid certain risks or to avoid certain consequences flowing from the risks. Risk avoidance is most likely to take place where the level of risk is at a level where the project is potentially viable.

5.2 Risk reduction

This method adopts an approach whereby potential exposure to risks and their impact is alleviated. Often this is achieved by the managing or designing out of potential risk. Methods of risks reduction may require some initial investment that should then reduce the likelihood of the risk occurring. Risk reduction occurs where the level of risk is unacceptable and alternative action is available. Typical action to reduce risk could be:

- 1. Detailed site investigation where adverse ground conditions are known to exist but the full extent is not known; a detailed ground investigation will improve the information upon which the estimate has been prepared.
- 2. Alternative procurement route- by utilizing an alternative contract strategy risks will be allocated between project participants in a different way.
- 3. Changes in design to accommodate the findings of the risk identification process.

5.3 Risk retention

Once all the avenues for response and mitigation have been explored a number of risks will remain. This does not imply that these risks can be ignored; indeed it is these risks, which will in most instances, undergo detailed quantitative analysis in order to assess and calculate theOverall contingency levels required. The aim of the previous responses is to reduce project uncertainty and in doing so increase the base estimate to reflect the more certain nature of the project. However, it does not imply that these retained risks can simply be ignored. Indeed, they should be subject to effective monitoring, control and management to ensure that they are within the contingency allowances set. It should be noted that this contingency should be made up of residual risks, which are assessed, to be of a low likelihood and low potential impact. High probability and high impact risks should undergo further rigorous examination so that that an alternative response can be found.

5.4 Risk transfer

Risk transfer is the technique that plays a far greater role in development projects and involves the complete or partial transfer of risks among the various parties involved in the implementation of the project. Risk can be transfer by two ways. First is through insurance and second is through contract. This is achieved through the web of documents that is formulated during the course of implementation of projects. The documentation structure provides for the flow of risk transfers that are negotiated and agreed to in the course of development of project.

Because all these risks can arise throughout the project life cycle, it is believed that effective risk management should be an iterative process and not limited to a one-time analysis. Given the evolving nature of risk, the primary value of the mitigation tool is highest during the program decision and pre-project planning phases and to be most effective.

Though contracts are the mechanism to allocate liabilities and responsibilities of project participants in construction, contract language alone is insufficient to specify and appoint all the risks, an ideal process would address the individual needs of each organization and each project. The distribution of risk between the client and contractor tends to overshadow effective management strategies and investigations show that contactors and owners give minimal consideration to risks outside the realm of their own concerns.

6.0 RISK MANAGEMENT EXAMPLE

A Company makes lysight girders for Asian market and is at present operating at near production capacity. The sales and marketing director of company anticipated market for this product increase by 15% in next twelve months. The board must decide how to react to this change in demand. There are three strategies that are being considered.

- **S1**-Install new equipment to improve productivity with a new system of working.
- S2-Institute overtime and weekend working.
- S3-Continue to work at capacity and let rival or new firm satisfy the increase in demand.

First case will lead to profit of Rs.240000, second case would yield Rs 210000 and third case would yield Rs 170000. These values are based on assumption that market grows by 15%. There are two other outcomes are possible.

• Demand falls by 10% as result of new high Japanese technology Japanese entering in to European market.

• Demand remain unchanged because lack of construction growth.

Decision matrix can be constructed as follows:

Strategy	15%	Stable	-10%
S1	240	130	0
S2	210	150	0
S 3	170	150	0

Probabilities can be assigned to the various outcomes.

Market outcome	Probability
15% rise	0.6
stable	0.3
10% fall	0.1

Expected values for particular strategy are obtained as follows

For Strategy 1

Outcome	Pay off	Probability	EMV
15% rise	240000	0.6	144000
stable	130000	0.3	39000
10% fall	0	0.1	0
		Total	183000

The same process can be repeated for S2 and S3

Strategy	EMV
S1	183000
S2	171000
S3	147000

This leads to favors S1 because it has highest EMV.Other factors should be taken in to consideration in comparison of these strategies. The variability of returns is important and can be used to give a further measure of degree of risk. This can be found out by using standard deviation. It is calculated as follows.

Strategy 1

Outcome	EMV	Deviationn	D2	Probabilityy	Total
240	183	57	3249	0.6	1949
130	183	53	2809	0.3	842
0	183	-183	33489	0.1	3348.90

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variance	6140.90
Std .deviation	78.36
The same process can be repeated for S2 and S3	

Strategy	Std Deviation
S1	78.36
S2	63.00
\$3	49.80

Now we have EMV and std deviation. Since higher EMV tends to higher st deviation so we should calculate the coefficient of variation.

Coefficient of variation= Standard Deviation/ Expected Value

Strategy	EMV	Std Deviation	Coeff. Of variance
S1	183	78.36	0.42
S2	178	63.00	0.36
S3	154	49.80	0.33

Select the option S3 as it having lower value of std. deviation and coeff. Of variation

7. CONCLUSION

It may be stated that risk Management is the core of project management. The success of every project depends on how efficiently and effectively the. Risk avoidance may include a review of the overall project objectives leading to a reappraisal of the project as a whole. depends on how efficiently and effectively the uncertainties are handled. Every project is unlike the earlier one, the problems are distinctive and their solutions are also different. Risk management will not remove all risks from the projects. Its main objective is to ensure that risks are managed most effectively. The formal risk analysis and management techniques are rarely used by construction industry due to lack of knowledge and expertise. The industry is also unknown about the suitability of these techniques to construction industry. The control and risk transfer is most useful method in construction industry. Joint venture widely used as a tool for risk transfer

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