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Risk Assessment for Public-Private- Partnership Infrastructure Projects in India

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Abstract- In this paper, we discuss the method of risk measurement of project risk, based on the risk matrix method. Generally project risk management primarily deals with cost and time uncertainties and risk associated with each activity of the project network. In this paper, we have identified the major risk sources and quantified the risk in terms of likelihood, impact and severity in a complex infrastructure project. The methodology for this work was the response from the experts associated and involved in this and other projects. The risk assessment for this project is carried out by risk matrix method. And risks are categorized according to the priority.

Keywords--- *P*roject risk assessment, Risk matrix method.

1. INTRODUCTION

Risk assessment is an important part of risk management in major projects where huge amount of money is invested. For an infrastructure project, risk assessment can be carried out effectively by investigating and identifying the sources of risks associated with each activity of the project. These risks can be assessed or measured in terms of likelihood and impact. Now we will assess the risk associated with infrastructure project. The major activities concerned with underground construction are project feasibility report, sub soil exploration as well as drainage studies of area where construction is supposed to carry out. We have developed a questionnaire survey and personally interviewed experts. In this process, we have identified the risks at various phases of the project starting from the feasibility phase to the completion of the project. This paper is organized as follows section two deals with literature survey and further section three deals with methodology and objectives. In section four we will discuss the conclusion of the projects.

2. METHODOLOGY

Risk can be assessed either using a qualitative analysis. Qualitative risk analysis covers a range of techniques for assessing the impact and likelihood of identified risk. These approaches can be used to prioritize the risks according to their potential effect on project objectives and is one way to determine the importance of addressing specific risks and guiding risk responses. Quantitative analysis uses numerical ratio scales for likelihoods and consequences, rather than descriptive scales. There are many tools available for evaluation of risk and risk controls, ranging from experience – base judgment, checklists and risk matrices to specialist review and analysis techniques. Anna Klemetti explain that risk can be evaluated by estimating risk probability and impact in simple scales for example, from 1 to 5 or from high to low. The risks can be mapped in a probability – impact grid. On the grid, risk that require the most attention are easily detectable wherein actions to control them can be taken only if there are sufficient resources or if mitigating the risk costs are less than the product of possibility of risk's occurrences and its impact on project objectives (expected values). Al-bahar and Crandall [1] quantified risk as the product of probability and impact where impact may be gain or loss in a construction project. The significance of a risk is termed as 'Risk Factor' and is expressed in termed as 'Risk Factor' and is expressed in terms of its consequences or impacts on project objectives, and the like hood or consequences of those consequences arising. To calculate risk factor or levels, the descriptive like hood assessments are converted to numerical measures. P. A similar process is followed for the consequences assessments, to give an average consequence measures, C. A. risk factor RF or combined risk measure is then calculated for each risk. The significance of a risk is termed as 'Risk Factor' and is expressed in termed as 'Risk Factor' and is expressed in terms of its consequences or impacts on project objectives, and the like hood or consequences of those consequences arising. To calculate risk factor or levels, the descriptive like hood assessments are converted to numerical measures. P. A similar process is followed for the consequences assessments, to give an average consequence measures, C. A. risk factor RF or combined risk measure is then calculated for each risk.

2.1 Risk Consequence

The notion of being a function of risk likelihoods and risk impacts is known as risk consequences. There are two ways to express risk consequence. First, it can be expressed as a simple numerical rating with the value ranging between 0 to 1.

2.2 Risk Factor (RF)

The risk factor is expressed in terms of its consequences or impacts on project objectives, and the likelihood or occurrences of those consequences arising. The risk factor can be calculated by using following formula,

$$RF = P + C - (P * C) \quad (1)$$

Where;
RF = Risk factor.
P = Probability (occurrences) measure on a scale 0 to 1.
C = Consequences (impact) measures on scale 0 to 1.
The risk factor will be high if probability P is high, or consequences C are high or both are high. This formula only works if P and C are scales from 0 to 1. The simple matrix as shown in graph.3 is used to combine the likelihood and consequences rating to generate initial priorities for the risk. Risk matrix is plotted using two dimensional scales from 0 to 1 of impact/consequences and occurrences/probabilities. Risk matrix gives idea about the criticality of risk. Risk matrix groups risks in 4 categories as low, medium, high, critical. Group Low means risk is of no more importance, so it may be ignored or solve in last priority. Similarly group critical means all those risk laying in this group need more serious attention of project manager and team. These risks need to solve on higher priority. Risk profile can be plotted with respect to the decreasing order of calculated risk factor as shown in graph.2.The project focuses on use of 'risk and priority model' for assessing various risk identified in real estate projects where prioritized in real of risk and a detailed understanding of the impact upon the success of the project should they occur and consequence and likelihood ratings, agreed risk priorities and inherent risk levels are obtained. The responses collected were in the form of opinions of experts regarding the likelihood occurrences of the various risk and there corresponding impact of the risk on the project. The opinions are in the form of scores scaling from 1 to 5 for the four case studies as shown in table 2.The numerical scores of occurrences and impact for risk are converted from scale 1 to 5 to scale 0 to 1 by using following formula:

Required score = (responded score * 2)/10.

Risk factor (RF) or combined risk measure is then calculated for each risk by using Eq.1.

The score and calculated risk factors are indicated in table 3.Risk matrices are plotted using two dimensional scales 0 to 1 of Impact/ Consequences and Occurrences / Probability which are also plotted with respect to the decreasing order of calculated risk in order to resolve it. Risk matrix (Refer graph.3) and risk profile (Refer graph.2) are plotted. As stated by Cooper, et. al[2] the scale of 1 to 5 was chosen and converted to 0 to 1.

Table: 1 Scale of likelihood and impact

Value Scale	**Assessment of Likelihood (P)**	**Assessment of Impact (C)**
1	Rare	Nil/Very minor effect
2	Considerable	Low effect
3	Medium	Medium effect
4	Frequent	High effect
5	Always	Extreme high effect

The survey also asked the respondents has to give the probability (chance of occurrence) & their possible/ probable Impact scaling from 1 to 5 in order to assess risks.

Table: 2 Questionnaires Responses

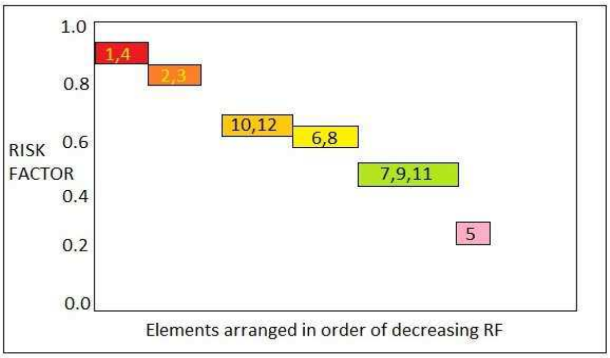
Sr. No.	**Risks shortlisted**	**Responses (On scale 1 to 5)**	
		Occur rence	**Impact**
1	Risks due to delay in approval of detailed project report(DPR)	4	4
2	Land acquisition risks	3	3
3	Design risks	3	3
4	Technology selection risks	4	4
5	Approval and permit risks	1	1
6	Joint venture risks	2	2
7	Financial and investment risks	2	2
8	Political risks	2	2
9	Environment related risks	1	2
10	Geo technical risks	1	2
11	Major / minor accidents during execution	1	2
12	Unforeseen heavy rain	1	3
13	Force Majeure risks like flood, fire earthquake etc.	Group insurance	

Table: 3 Calculation of Risk Factor

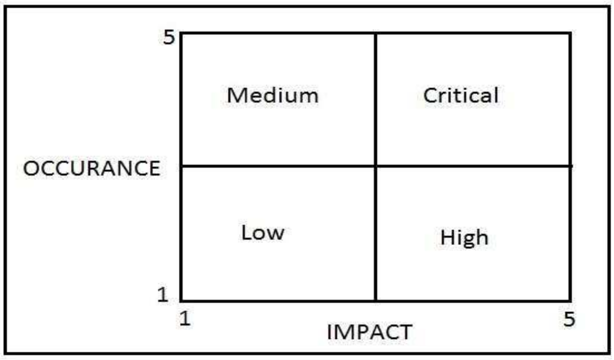
Q. No	**Occurrences**		**Impact**		**Risk fact or**
	Resp	**Score**	**Respon**	**Scores**	

	onde d Score	**s (P)**	**ded Score**	**(C)**	
1	4	0.8	4	0.8	**0.96**
2	3	0.6	3	0.6	**0.84**
3	3	0.6	3	0.6	**0.84**
4	4	0.8	4	0.8	**0.96**
5	1	0.2	1	0.2	**0.36**
6	2	0.4	2	0.4	**0.64**
7	2	0.4	2	0.4	**0.64**
8	2	0.4	2	0.4	**0.64**
9	1	0.2	2	0.4	**0.52**
10	1	0.2	2	0.4	**0.52**
11	1	0.2	2	0.4	**0.52**
12	1	0.2	3	0.6	**0.68**

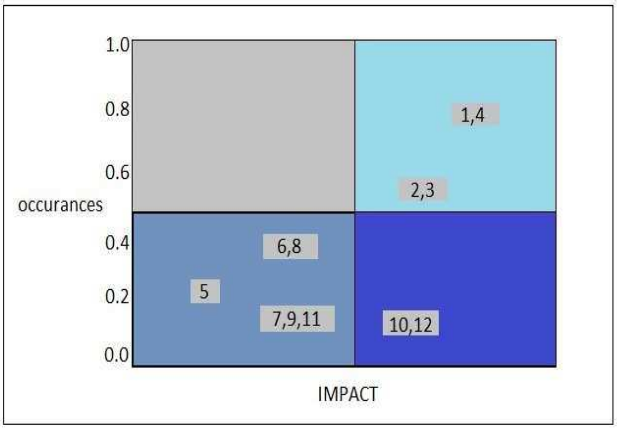
1st Priority	1st and 4th
2nd Priority	2nd and 3rd
3rd Priority	12th
4th Priority	6th,7th and 8th
5th Priority	9th,10th and 11th
6th Priority	5th



Graph: 1 Risk Occurrence Verses Impact Matrix



Graph 2: Risk Profile for collected data



Graph 3: Risk Matrix for Collected data

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3. CONCLUSION

In this research, the critical risks associated with India's BOT projects were investigated. The main conclusions are as follows:

- The identified critical risks in order of importance are: delay in approval, change in law, cost overrun, dispatch constraint, force majeure risks and environmental risk.
- The measures for mitigating each of these risks have been evaluated by respondents. Most of the measures were regarded as effective to some degree, however the most effective measures to mitigate each risk are:

1. For delay in approval, maintaining a good relationship with government authorities, especially officers at the state or provincial level;

2. For change in law, obtaining government's guarantees via adjusting either the tariff or extending concession period;
3. For cost overrun, entering into contracts with the project participants so that all share the responsibility and the incentive;
4. For dispatch constraint, entering into take-or-pay contracts with other parties;
5. For force majeure risks, obtain government's guarantees to adjust tariff or extend concession period;
6. For environmental risk, Dust suppression on roads, restricted routes and hours, cleaning equipment **.**

It suggests that mechanisms be reviewed to improve the communication and coordination links between different levels of government, that thought be given to developing mechanisms to coordinate actions by different government agencies and that the lessons learned from individual BOT projects be shared among government servants so that unintended barriers to BOT are dismantled. The most important task for a risk management should be to ensure to effective decision-making for objectives to maximize the profit and minimize the future losses

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