A Study on Identification of Risks at Various Phases of Road Construction

Vishal Shelar[1], Asst. Prof Shruti Wadalkar[2]

[1]PG student, Dept. of Civil Engineering, Dr. D.Y Patil Institute of Technology, Pune, MH, India
[2]Asst. Professor, Dept. of Civil Engineering, Dr.D.Y Patil Institute of Technology, Pune, MH, India

---***---

Abstract— *Risk is nothing but the difficulties occurring in the completion of the project in such a way that causes delay of the project, increase in the cost of project, quality of the work etc. For a road construction projects it is very important to mitigate the risks for the completion of the project without any failure. In order to mitigate the risk factors we have to first identify the risk which are causing a greater impact and then take the steps to overcome the losses caused by them. It is important to rank the risks which will give us priority of the risk mitigation program. To do the ranking one needs to do it logically by methods such as various indices, Analytical Hierarchy Processes, fuzzy logics etc. Better way is to do it by different methods and check if the result occurred is relatively same or not, if it's same then ranking or priority that needs to be given is verified. In this paper risk ranking is done and mitigation measures are suggested.*

Keywords— Risk management, Road construction, Risk Ranking, Relative Importance Index

1. INTRODUCTION

A risk may be a potential problem which might occur or might not.

Risk contains following terms:

- Risk includes future happenings

- Risk concerns about change in mind, opinion, actions, places, etc.

- Risk is a choice and the uncertainty that choice entails.

Whereas risk management can be defined on the following terms:

- Identify possible risks; recognize things which can go wrong.

- Asses each risks on the basis of probability of its occurrence and its impact.

- Rank the risks by probability and impact, Impact may be very low, moderate and very high.

- Initiate a mitigation plan to manage those risks having high impact and high probability.

As a developing nation our country is building a huge network of roads all over the country for the better transportation which will help in growth of manufacturing industry indirectly creating more jobs and development of Indian economy. For a better road network it should be kept in mind that there will be very complex uncertainties lying at each and every stage. Road construction has number of activities which are beyond our control. There are various ways to find the uncertainties and their probabilities in order to mitigate the risks involved in the construction process. There are several different tools and techniques which have already been developed. However, there is a gap between risk management techniques and their practical application by contractor.

In our country there is a need to study the risks which occur consistently and need a plan to counter attack. First of all it is needed to prioritize the risks to mitigate them effectively.

2. OBJECTIVE

Objective of the study is to identify which risk during typical phases of the construction are needed to give an importance and start mitigation practices immediately to reduce its severity. The main objectives of this research is to rank out the identified common Risks at various stages of Road Construction Projects in Maharashtra state of INDIA, as well as to study the preventive and remedial steps to avoid or to minimize the number of Risks in Road construction and mitigation measures also to save the time and cost.

3. Data Collection

Risk involved at every stage is recognized in terms of problem statement or hazard. Risks were studied and observed on the basis of literature review and questionnaires which were distributed in the n number of field experts. A criterion for respondents was of minimum 10 years of experience. In all the questionnaires were

distributed to 120 field experts, out of which 90 questionnaires were received.

3.1 Expert opinion

While distributing the questionnaires, stakeholders were projected. All the stakeholders from contractor, site engineer, project manager and owner were taken into consideration. Questionnaire was formulated on 5-point Likert scale from 1 to 5 ratings representing as Very Low, Low, Moderate, High and Very High respectively.

3.2 Types of Respondents:

From the total experts 10% of respondents were owners, 20% project managers, 10% senior site engineers, 15% junior site engineers, 25% contractors, 10 % supervisors, 10% teaching individuals.

3.3 Experience of Field Experts:

Among the total respondents 40% of the respondents have 10 to 20 years of experience, 20% of respondents have 7 to 10 years of experience, 30 % of respondents have 5 to 7 years of experience and 10 % of respondents have below 5 years of experience.

4. Data Analysis:

For the ranking of risks two methods Relative Importance Index and Geometric mean Method was used. The details of these methods are as follows:

4.1 Relative Importance Index

Also for Comparison Relative Importance Index (RII) by following formula, was also adopted.

$$RII = \frac{\sum_{i=1}^{5} w \times x}{A \times N}$$

Where,

w: Weighting given to each factor by respondents and its ranges from 1-5

x: Frequency of the response given by each individual

A: Highest weight (i.e. 5 here)

N: Total no. of respondents

Suppose impact value given by 3 respondents were 5, 5 respondents gave value of 2 and 2 repondents gave value of 4 on a 1-5 point likert scale. The RII will be

$$RII = \frac{(3 \times 5 + 5 \times 2 + 2 \times 4)}{(5 \times 10)}$$

$$RII = 0.66$$

4.2 Geometric Mean-AHP

The geometric mean of a data set {x_1, $x_{2...}$ x_n} is given by:

$$GM = \sqrt[n]{x_1 . x_2 ..... x_n} \text{ or } (x_1.x_2....x_n)^{(1/n)}$$

For example, in a set of four numbers {1, 2, 3, 4},

the product of 1 X 2 X 3 X 4 is 24, and the geometric mean is the fourth root of 24, or 2.213. The exponent on the left side is equivalent to the taking nth root.

From the calculation Ranking of the risks was given on the basis of Geometric Mean and RII. It was observed that both the method showed the similar ranking. This confirmed that Ranking is done accurately. Next step is to determine the weight of each factor. Weights are determined by applying AHP technique. First a pair wise comparison matrix is design. A pair wise comparison matrix, square matrix, compares the important of one alternative over that.

$$Weight1 = \frac{R01}{R01}$$

$$Weight2 = \frac{R02}{R01}$$

After calculating all the weights ranking was given as per the smallest value of sum of weights.

STAGE – I : Initial stage (Concept Stage)					
Risks	**R01**	**R02**	**R03**	**R04**	**R05**
R01	1.00	0.96	0.69	0.94	0.91
R02	1.04	1.00	0.72	0.98	0.95
R03	1.45	1.39	1.00	1.37	1.32
R04	1.06	1.02	0.73	1.00	0.97
R05	1.10	1.05	0.76	1.03	1.00
Σ	5.65	5.41	**3.90**	5.33	5.15
Rank:	**5**	**4**	**1**	**3**	**2**

Table 4.1 Sample Clculations of AHP

5. RESULT & DISCUSSION

Sr. No.	Description of Main Risks likely to occur	AHP Factor	RII
STAGE – I : Initial stage (Concept Stage)			
1	Feasibility w.r.t. specific area where the project is proposed	5.65	0.44
2	Constructability of Project concept not in line w.r.t. Design & Engineering capabilities in your Organization	5.41	0.46
3	Lack of Clarity about legal framework and restriction under which Project is to be implemented	**3.90**	**0.66**
4	Uncertainty about Political policy changes adversely affecting the project at the later stages of Execution	5.33	0.47
5	Rejection of proposal by concerned authority	5.15	0.49
STAGE – II : Fund Raising and Financial Stability			
6	Delay due to budget approvals from concerned authority	**3.21**	**0.68**
7	Various permissions to be obtained from Authorities are not clearly identified	4.85	0.42
8	Mobilization of finance	4.18	0.50
9	Lack of clarity in specifications and cost estimates	4.11	0.52

Sr. No.	Description of Main Risks likely to occur	AHP Factor	RII
STAGE – III : Tendering and Contracting of Project			
10	Non-availability of correct details of scope of work without any ambiguity along with necessary drawings	5.50	0.50
11	Properly prequalified contractors participating in the competitive bidding process is not assured	5.49	0.50
12	Availability of Professional Consultant for Designing and Project monitoring at Client's	4.53	0.62

Sr. No.	Description of Main Risks likely to occur	AHP Factor	RII
	side is not established		
13	Various permissions to be obtained from Authorities are not clearly identified	**4.06**	**0.72**
14	The environmental Impact Assessment is not available or clearances to be obtained as per provisions of the Law are not made clear	5.92	0.46
STAGE – IV : Project Planning			
15	Site is not made available to contractor with suitable access without encumbrances	5.22	0.46
16	Basic layout designs are not available and detailed drawing is not approved in time	**4.13**	**0.55**
17	Government's decision on technical issues not available in time	5.91	0.44
18	Mechanism for Dispute settlement in case of claims is not clearly established	5.44	0.46
19	Time constraint for project is not fixed initially & varies according to government policies	4.70	0.52

Sr. No.	Description of Main Risks likely to occur	AHP Factor	RII
	STAGE – V : Contract Execution, Monitoring and Control		
20	Construction equipment maintenance issues	5.06	0.57
21	Land acquisition necessary for Project is not complete or not available	4.90	0.60

22	Changes in client's design are not clear and matching, cost and time changes are not agreed	4.98	0.58
23	Suspension of Work due to reasons under Client's control is not properly understood	5.62	0.51
24	Lack of safety precautions resulting into serious accidents	**4.55**	**0.66**
	STAGE – VI : Finishing Work and Closure of Project		
25	Non Settlement dispute about reasons of delays and time extension needed to complete the project	6.24	0.60
26	Delays in settlement of pending claims and contract closer with final payments.	6.27	0.59
27	Support of local and state level bodies in smooth functioning of the infrastructure assets, is not available	6.25	0.59
28	Support of law and order authority for the maintaining peace and smooth working is not provided	6.66	0.56
29	Cost overruns of maintenance expenses reducing the income margins for the contractor	6.21	0.62
30	Delay in payment	**4.79**	**0.80**

6. MITIGATION MEASURES

All the risks in the respective Life Cycle Phases are ranked as per the weights and further used for providing mitigation measures.

Stage of Project Life Cycle	Risk Description	Recommendations as Mitigation Measures
STAGE – I : Initial stage (Concept Stage)	Lack of Clarity about legal framework and restriction under which Project is to be implemented.	To provide an enabling legal & statutory framework. Provide consent when required for significant legal or regulatory decisions. The tender documents should be spcific by the government and documents should be made available to various implementing agencies for use. Maintain perception of current and emerging laws, and regulations affecting project to assess their impact on the organization's business.
STAGE – II : Fund Raising and Financial Stability	Delay due to budget approvals from concerned authority	Detailed estimation and secured sources of financing should be made available. Clear indications about the amount of expenditure with financial constraints

		should be given to spending agencies at the start of the budget preparation process. A "fundamental program" within the budget should be arranged and higher priority given to this program during budget execution.
STAGE – III : Tendering and Contracting of Project	Various permissions to be obtained from Authorities are not clearly identified	It is must to have a management collabrations in place to deal with the Tender Process, thus ensuring the legitimacy are studied and that possesion of the process is assigned.
STAGE – IV : Project Planning	Basic layout designs are not available and detailed drawing is not approved in time	Designated consultancies should be hired for the specific work of making designs and drawings of pavement. Authorities regarding timely approval should be audited on fixed time intervals. Online approvals should

		be made mandatory to keep this in a legal framework to eliminate issues like corruption from the system.
STAGE – V : Contract Execution, Monitoring and Control	Lack of safety precautions resulting into serious accidents	Safety of workers and officials working on the project should be given high priority so as to boost their confidence. This will ensure them with secure working environment and will also increase their work efficiency. Recognition Initiative about "The Minimum Wages Act, 1948", "The Building and Other Constructions Workers' (Regulation of Employment and Conditions of Service) Act, 1996" Should be conducted.
STAGE – VI : Finishing Work and Closure of	Delay in payment.	Have necessary clauses in contract for compensation. Agree payment terms in advance

Project		to control cash flow management at the source. Invoicing correctly & promptly. Chasing payment immediately when it becomes overdue. Create incentive for prompt payment. Assess accrued interest charges beginning on the first day the payment becomes late. Make sure this policy is clearly stated in contract.

CONCLUSIONS

The research was carried out throughout the life cycle of the project and hence it included all types of risks that can be encountered in the whole life of project. All the risks in all the stages were given points based on the expert's views and with the help of these the criticality of the risks were found out. This will help to concentrate on specific risks at proper stages. Then the various ways were found out to mitigate these risks which will help to take the appropriate measures so as to avoid the losses.

As per the findings and inferences arrived at as indicated above, further analysis and verification can be carried out with the help of qualitative as well as quantitative assessment. With the help of quantitative assessment, the cost impact of each of the risks can be found out. And after adopting the above mitigation measures, its effect on the cost impact can be found out.

ACKNOWLEDGEMENT

REFERENCES

1] Mr. N. V. Patil, Dr. P. G. Gaikwad (July 2015) "Risk Management In Road Construction" International Journal of Modern Trends in Engineering and Reaserch; e-ISSN No.:2349-9745

2] Katkar M.B., Dr.Khandekar S.D (June 2015) "Study of risk management for National Highway Project" International Research Journal of Engineering and Technology (IRJET)e-ISSN: 2395 -0056

3] Rinaj Pathan, Prof. Dr. S. S. Pimplikar (Feb 2013) "Risk Assessment of BOT Road Projects" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684Volume 5, Issue 3), PP 40-59

4] SatishKamane, SandipMahadik.(2014), "Risk Management in Construction Industry", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 59-65.

5] KinnareshPatel(2013), "A study on risk assessment and its management in India", American Journal of Civil Engineering, doi: 10.11648/j.ajce.20130102.13.

6] Patel AnkitMahendra, Jayeshkumar R. Pitroda, J. J. Bhavsar (October 2013) "A Study of Risk Management Techniques for Construction Projects in Developing Countries"International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-3, Issue-5, October 2013

7] Sharmila Mane, Dr. S.S.Pimplikar (August 2013). "Risk Assessment of BOT Projects". International Journal of Computational Engineering Research||Vol, 03||Issue, 8||