Client:

Executive Engineer,
Border Road Project Division-II,
CPWD, Chungthang, North Sikkim

Consultancy Services for Preparation of Detailed Project Report for Additional High Altitude Roads under Phase-II in the state of Sikkim using Satellite Imagery

DETAILED PROJECT REPORT (TOONG-PARTEM-PT4865)

JOB ORDER No.: SMC/Highway/2017/644

(RISK ASSESSMENT REPORT)

Consultant:

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An ISO 9001:2008 Certified

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Risk Assessment in Project Road

INTRODUCTION

Risk assessment is necessary prior to planning and management of risks to minimize the adverse impacts of risks involved in highway construction. Risk factors are involved at every stage from designing and planning stages to completion of project. To enhance successful performance on highway construction projects, risk factors of the projects have to be identified, assessed and minimized for scheduled, safe and cost-effective completion of the projects. This study involves identification, classification and assessment of various risks in construction of highway projects using Relative Importance Index (RII). Further, risk factors are ranked according to their impacts for the project road in the hilly terrains of Manipur.

Risk is involved in every aspect, and the construction of highway projects are no exception. Risk is defined as the possibility of loss, injury, disadvantage or destruction also as a combination of the probability of frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence. Risk assessment is a stepwise procedure consisting of risk identification, risk classification and risk analysis or evaluation. Risk assessment is determination of quantitative or qualitative estimate of risk.

Highway projects consist of many risks and this is due to involvement of many contracting parties including designers, contractors, sub-contractor and suppliers. Risks are the major cause of poor performance on highway construction projects. Construction of highways involves various risk factors from designing and planning stages to completion of project. Due to these factors, there are delays in completion of project which involve large funds. So risk assessment consisting of risk identification, risk classification and risk analysis or evaluation is necessary for maintaining cost and quality of the project and for scheduled completion of the project.

Provision and plan for risks has been made at various stages. The risk may be due to accident, Vehicles crossing barriers of road, fire, sabotage, earthquake, spillage of oil and chemicals on the road. This would, depending upon the type and intensity, involve disasters in terms of loss of life and damage to the road apart from disruption of traffic. Therefore to avoid and minimize this, disaster and emergency management plays a very important role.

PROJECT BACKGROUND

NHIDCL has been entrusted by GoI to implement the 2 lane development of Yaingangpokpi-Hungpung road stretch on NH 202 under BOT/ EPC mode. In this backdrop preparation of detailed project report and finalization of construction agency needs to be taken up prior to that. In this connection, NHIDCL has been entrusted with the assignment of preparation of detailed project report for construction of road from Yaingangpokpi to Nagaland Border. NHIDCL has appointed M/s S.M. Consultants having its head office in Bhubaneswar as consultant for preparation of detailed project report for the proposed road.

The project road is situated in Imphal East, Kamjong and Ukhrul District of Manipur. It is about 43.129 km in length, starting from the Gwaltabi in Yainagangpokpi (0/000 km) and ends at the Hungpung (43/129 km). The project corridor traverses mostly through plain terrain upto 1.3 km and rest in hilly terrain. The land use is predominantly agricultural and forest with intermittent built up areas and semi-built-up areas.

OBJECTIVES

The objectives of this study are listed below:

- To define the various major risks involved in highway construction project.
- To identify and classify the various risks involved in construction of highway.
- To analyze or evaluate the risks involved in highway construction.

This study mainly focusses on assessment of various risk factors involved in construction of highway from designing and planning stages to completion of project. The risks are analyzed by using quantitative tool, i.e. RII. Risks are ranked according to their adverse impact on the highway construction project. Risk having Rank 1 has greater adverse impact than the risk having Rank 2. The assessment of risk factors will help in risk planning and risk management of any project. Further, this will help in improving the performance of highway construction projects -to maintain cost and quality of the project and for scheduled completion of the project.

METHODOLOGY

The various risks were identified and classified and based on that a questionnaire was prepared on "5-point Likert scale", where point 1 to point 5 varies from very low risk to very high risk respectively. The data collection was done for the sample size of 20, through questionnaire survey. Further, this data was compiled and analyzed using Relative Importance Index (RII) method. The analyzed risks were ranked according to their importance of adverse impacts on highway construction project.

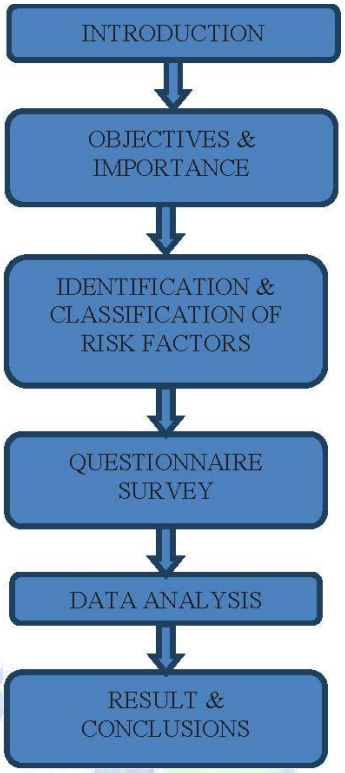

Figure 1: Flow Diagram of Risk Assessment

IDENTIFICATION AND CLASSIFICATIONS OF RISK

(1) Construction Risk:

Most risks associated with the construction are more likely to root in contractors and subcontractors. To keep the construction work on track, experienced contractors need to be involved in the project as early as possible to make sound preparations for developing valid construction programs. Machineries, delay due to rain and other causes, uncertain market conditions, contractor productivity issues, time etc. are the risks which construction phase constitutes.

(2) Design Risk:

This may result from issues such as variations in design and defective designs. The design risks arise due to uncertainty in horizontal alignment, uncertain indirect costs and consideration of improper basic parameters while designing. To avoid defective design, the design team needs not only to fully understand what the clients want as defined in the project brief, but also to establish an efficient communication scheme among the designers.

(3) Political Risk:

"Excessive approval procedures in administrative government departments" and "bureaucracy of government" are not seldom complained by clients and contractors. These risks are normally out of the control of the project stakeholders. To attract investment within their administrative territory, the government agencies should always make great efforts to create a friendly environment in

which the approval procedures are reduced or at least the approval time is shortened, and the bureaucracy is minimized.

(4) Organizational Risks:

Lack of skilled labour, lack in knowledge level of lead group, etc. are the example of organizational risks. Lack of skilled labour can lead to project delays, poor workmanship, safety and liability issues.

(5) Accidental Risks:

Unanticipated damage during construction is an accidental risk. Any type of accidents on construction sites like machineries accidents, overexertion, accidental falls etc. can be disastrous for the project.

(6) Uncertain market conditions:

Uncertain market conditions usually called as "price inflation of construction materials" is identified to be related to external environment. The price of construction materials is always changing in response to the inflation and the relation between supply and demand in the construction material market. As this risk is usually unavoidable, clients should choose an appropriate type of contract; while contractor should always avoid using fixed price contracts to bear the risk.

(7) Time/Funds:

As time and cost are always closely correlated, a lengthy schedule will undoubtedly wreck the project cost benefit. Correlation between time and cost is a quantitative risk. In extreme cases the risk of time and cost overruns can compromise the economic viability of the project, making a potentially profitable investment untenable.

(8) Utilities:

Utilities include: electricity, gas, water, fuel, etc. which plays a huge role in construction projects completion; shortage of these utilities would create problems on site. For example, use of ground water is prohibited by government agencies for highway construction projects in India.

(9) Disasters

In roads & highways project, during construction and operation phases, disaster may occur due to the following:

- Floods
- Earthquake
- Biological Disaster or Epidemic of Human/ livestock/ crops

ANALYSIS OF RISKS

Risk may be defined as the potential realization of unwanted consequences of an event (i.e. the product of the probability of an event and the consequences of the event). Both the probability of occurrence of an event and the magnitude of its consequences are thus involved. Acceptance criteria can be established either in the form of a predefined set of "Risk Acceptance Criteria" or in the form of "Optimum cost criteria".

The Risk acceptance criteria are normally imposed by the authorities to reflect the willingness of people and society to accept risks. Optimum cost criteria are Acceptance Criteria based on cost effectiveness analysis comparing the cost of the road strengthening and protection measures against the benefits of risk reduction. The analysis should take into account consequence of collision, such as

- Damage to road
- Damage to the users of the road
- Inconvenience cost of society and business
- Social losses
- Damages to the environment

The risk acceptance criteria are intended to cover the aggregate probability of accident due to several types of causes such as fire and explosion. For this project it is recommended that specific evaluation should be carried out for:

- Importance of the road connection to the public and society, to business and industry, to the national defense etc.
- Fatality risk in the case of high traffic volume
- Cost effectiveness of improving the safety for the road.

The data collected through questionnaire survey was analyzed by using quantitative method of relative importance index (RII). The RII is computed using equation:

$$RII = \frac{\sum W}{A \; X \; N}$$

$(0 \leq RII \leq 1)$

Where:

W-is the weight given to each risk by the respondents and ranges from 1 to 5, (where "1" is very low risk and "5" is very high risk)

A- Is highest weight (i.e. 5 in this case) and

N- is the total number of respondents

The various risks categorized under different categories were calculated and ranked. The higher value of RII represent significant risks affecting construction of highway project. The Table I below shows the risks with RII value and their ranks

Table 1: Evaluation of Risk Analysis using RII

Risk Category	Item	*For each item, enter the frequency with which each response option was observed:*					*Computed values, given the 5 frequency entries:*				
		Frequency of "5" responses	Frequency of "4" responses	Frequency of "3" responses	Frequency of "2" responses	Frequency of "1" responses	Total respondents (N)	Weighted total	RII	Rank	Item Mean
Construction	Machineries	3	8	2	7	0	20	67	0.670	**29**	3.350
	Delay due to rain or other causes	10	2	8	0	0	20	82	0.820	**12**	4.100
	Natural Hazards (Landslides, Earthquakes etc.)	14	4	1	1	0	20	91	0.910	**3**	4.550
	Uncertain construction market conditions	2	6	6	4	2	20	62	0.620	**32**	3.100
	Contractor productivity Issues	4	8	6	2	0	20	74	0.740	**23**	3.700
	Time	11	3	4	1	1	20	82	0.820	**11**	4.100
Design	Development around road analysis	9	5	4	2	0	20	81	0.810	**14**	4.050
	Uncertainty in horizontal alignment	5	4	9	1	1	20	71	0.710	**27**	3.550
	Uncertainty in access requirements	15	3	2	0	0	20	93	0.930	**2**	4.650
	Uncertain indirect costs: design, construction,	7	6	4	3	0	20	77	0.770	**18**	3.850

Risk Category	Item	*For each item, enter the frequency with which each response option was observed:*					*Computed values, given the 5 frequency entries:*				
		Frequency of "5" responses	Frequency of "4" responses	Frequency of "3" responses	Frequency of "2" responses	Frequency of "1" responses	Total respondents (N)	Weighted total	RII	Rank	Item Mean
	project management										
	Design errors and omissions	9	8	3	0	0	20	86	0.860	**8**	4.300
	Consideration of improper basic parameters	6	7	2	4	1	20	73	0.730	**25**	3.650
Topography	Construction in hilly region	8	9	2	1	0	20	84	0.840	**9**	4.200
	Uncertainty in landscaping activities	3	5	6	6	0	20	65	0.650	**30**	3.250
Political	Issues related to Govt. permits	12	6	2	0	0	20	90	0.900	**4**	4.500
	Other Political or external issues	13	4	1	2	0	20	88	0.880	**7**	4.400
	Change in policies	7	6	4	1	2	20	75	0.750	**21**	3.750
EIA Required	Natural Obstruction: Hills, rivers, trees	9	5	3	3	0	20	80	0.800	**15**	4.000
	EIA Required	7	6	4	3	0	20	77	0.770	**17**	3.850
Organizational	Skilled Labour	6	8	4	2	0	20	78	0.780	**16**	3.900
	Knowledge level of lead group	8	4	4	3	1	20	75	0.750	**20**	3.750
Accidental	Unanticipated damage during construction	6	5	5	3	1	20	72	0.720	**26**	3.600

Risk Category	Item	*For each item, enter the frequency with which each response option was observed:*					*Computed values, given the 5 frequency entries:*				
		Frequency of "5" responses	Frequency of "4" responses	Frequency of "3" responses	Frequency of "2" responses	Frequency of "1" responses	Total respondents (N)	Weighted total	RII	Rank	Item Mean
Utilities	Utilities not relocated on time	7	4	7	1	1	20	75	0.750	**19**	3.750
	Fuel: availability, price	13	3	3	1	0	20	88	0.880	**6**	4.400
	Electricity	12	5	3	0	0	20	89	0.890	**5**	4.450
Minerals	Mineral mining issues	8	6	6	0	0	20	82	0.820	**10**	4.100
	Cost of Minerals	7	2	9	2	0	20	74	0.740	**22**	3.700
Law and order	Local Disturbances	8	6	5	1	0	20	81	0.810	**13**	4.050
Climatic condition	Unforeseen climatic changes	5	4	3	6	2	20	64	0.640	**31**	3.200
Others	Quantity: construction, product	4	4	7	5	0	20	67	0.670	**28**	3.350
	Funds/ Money	14	5	1	0	0	20	93	0.930	**1**	4.650
	Emotional issues	3	2	4	8	3	20	54	0.540	**33**	2.700
	Heritage Issues	5	7	5	2	1	20	73	0.730	**24**	3.650

The relative importance index (RII) for the risk priority is calculated based on all responses for each risk. The priority of each risk is given by the relative importance index (RII) value which is according to the adverse impact of each risk. The risks are prioritizing according their ranks. The priority helps to identify the most significant risks.

CONCLUSION

This study concluded that an effective risk assessment is determination of quantitative estimate of risks as risks are involved at every stage of highway construction project. This study provides a good understanding of the risk assessment procedure to assist in assessing the risks involved during construction. Risk assessment is an effective tool for supporting decision-making and corrective actions in construction. This assessment of risk factors will help in risk planning and risk management of any highway construction project. Further, this will help in improving the performance of highway construction projects, i.e., to maintain cost and quality of the project and for scheduled completion of the project.

From analysis and results, for overall risks mainly funding, disaster management plans, obtaining government agencies approvals, construction in hilly terrain and land acquisition impose high risk on any highway construction project. In construction risk category delay in project impose the high risk. Similarly, in design category errors in designing due to consideration of improper basic parameters and in environmental category natural obstructions have the greater impact on highway construction project. These were the significant risks which mainly cause the delay of the project. As time and cost of the project are related, hence as the time of the project overruns the cost also overruns and impose high risk on highway construction project.