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Risk Management In Road Construction

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Abstract— Risk management is fore sighting the future events and preventing before anything goes wrong. Managing risks in road construction projects is very important process in order to achieve the objectives of project in terms of time, cost, quality and safety. This paper consists of use of expected value method (EVM) to measure risk quantitavely. Risk management in road project deals with risks present with each activity and its possible effect on time and cost of the network prepared. Study deals with identification of various risks involved in road project and analysing the same in terms of likelihood, impact and severity. The measurement of risk parameters was based on the response of experts associated with present project and similar road projects. This data was analysed further to determine risk severity of various events at different stages in road project. The base cost and base time of the project is derived from the contract value and schedule prepared respectively.

Road construction projects are considered as very complex projects, as uncertainty lies at various stages. Road construction has number of active agencies involved which are beyond our control and thus makes it difficult to study network as one. This provides an ideal environment for network and risk management research. Also, road construction projects are commonly studied in management research, and various tools, techniques and methods are used and developed especially for these projects.

Keywords- Risks, Risk management, Risk factors, Expected Value method (EVM), Impact, Severity, Likelihood.

I. INTRODUCTION

A Risk can be defined as probability of occurrence of an event which can hamper project objectives negatively. Risk management is the process in which risks are primarily detected and measures to mitigate or transfer are determined and adopted. Risk management is very important part of project management and aids project managers in decision making. For a road project, risk management can be done by identifying the sources of risk in every stage of project from feasibility to maintenance as these projects have long life cycle. Once these risk are identified the next step is to analyze their severity based on various factors at different stages of project life cycle. Timely execution of such projects can be carried out by quantifying risks and their appropriate management. Every road project is different and is exposed to various risks depending on location and geography.

The project under this study is Development of ring road 30m wide from Wadala to Takli for Sihastha Kumbh Mela which is an item rate contract. Major activities consist of laying of utilities, construction of Box culvert and RCC Nalla, Road work and Footpath and Divider. In these activities I have identified the risks at various phases with the help of a questionnaire and had reviews of experts in terms of severity. The entire project was divided into various activities starting from feasibility to execution.

II. METHODOLOGY

2.1. Analysis of Risk by Expected Value Method (EVM)

It is assumed that time and costs are deterministic parameter in network.It is found that, the critical path model network has "N" activities which are indicated by j = (1…… N) and there are "M" risk sources indicated by i = (1…..M).In this section, the concept of risk analysis by the Expected Value Method (EVM).

The variables are defined as follows:

Lij : Likelihood of i^{th} risk source for j^{th} activity
Wij : Weightage of i^{th} risk source for j^{ht} activity
Iij : Impact of i^{th} risk source for j^{th} activity
CLFj : Composite Likelihood Factor for j^{th} activity
CIFj : Composite Impact Factor for j^{th} activity
BTEj : Base Time Estimate for j^{th} activity
BCEj : Base Cost Estimate for j^{th} activity

Base time estimate (BTE) of the project is the estimated on the basis of project duration determined by the network prepared in MS-project with due consideration and discussion with the project manager of the study project. The base cost estimate (BCE) is determined by referring the estimate prepared by client and the summation of cost of various items to be executed during the project. It is assume that all the quantities estimated are correct without any addition or deletion in the same. The activity under consideration may have many risk sources and each having its own likelihood of occurrence. The value of likelihood of risk should range from 0 to 1. The likelihood of occurrence (Lij), weightage (Wij), and Impact of the identified risk sources of each activity were obtained by a questionnaire survey. The respondents were experts and professionals associated with similar projects having years of experience. The summation of the weightages should be equal to 1.

$$\sum_{i=1}^{M} \text{Wij} = 1 \text{ for all j } (\text{j} = 1 \ldots . \text{N}) \ldots \ldots \ldots \quad (1)$$

In this study weightages are based on local priority (LP) where summation of weightages of all the sub-activities of a particular activity equal 1. The likelihood (Lij) of all risk sources for each activity j are multiplied by their respective weightages (Wij) to obtain the CLF for the activity.

The relationship of calculation of CLF is given below:

Composite Likelihood Factor (CLF)j = $\sum_{i=1}^{M}$ Lij Wij for all j. ..... (2)

$0 \leq \text{Lij} \leq 1$ and $\sum_{i=1}^{M} \text{Wij} = 1$ for all j

The risk impact can be understood as negative factor restraining achievement of project goals. Risk impacts have direct relationship with time and cost of project. Further, composite impact factor (CIF) are determined on the same background as that of CLF, here the relationship is given:

Composite Impact Factor (CIF)j = $\sum_{i=1}^{M}$ Iij Wij . ..... (3)

$0 \leq \text{Iij} \leq 1$ and $\sum_{i=1}^{M} \text{Wij} = 1$ for all j

Risk severity can be explained as direct intensity with which project goals are affected in terms of extension costing and schedule of project. Severity value for the study ranges from 0 to 1. This severity can also be expressed in terms of qualitative rating as "Low severity" for value 0 to 0.10, "Medium severity" for value 0.11 to 0.20, "High Severity" for value 0.21 to 0.25 and "Very High severity" for a value 0.26 to 1.

Following relationship is used to obtain Risk Severity (RS):

Risk Consequence / Severity $(RS)_j = L_j \text{ x } I_j$ for all j …..... (4)

After determination of risk severity, small values are unimportant risks that can be ignored and large values represent important risks that need to be managed effectively. This helps in guiding project managers to understand critical risk and their mitigation measure.

III. DATA COLLECTION AND ANALYSIS

The project under consideration is the construction and development of 30m wide road from Wadalagaon to Takligaon under Nashik Municipal Corporation (NMC) from chainage CH-2800.00 to CH-5600.00 The project is undertaken to facilitate lacks of pilgrims entering into the city during Sihastha Kumbha Mela(SKM) next year i.e. September 2015 onwards. As the infrastructure facilities present in the city are not sufficient to sustain such huge load of pilgrims and present city traffic there was an urgent need to increase the capacity of infrastructure in the city before June 2015. Projects undertaken by NMC are time bound "time is the essence of project" and must be completed in order to maintain a healthy circulation of traffic within the city during Sihastha.
The project under study comprises of Open Nalla construction in RCC, Utility laying i.e. water supply, storm water and drainage lines, Slab culvert at intersection point of major road crossing and flexible pavement construction. The details of the project and activities are enlisted below.

Project Description	***Details***
Total Project Cost -	24.86 Crores
1. Length of Road -	2.80 Kms
2. Length of Open RCC Nalla -	1.40 Kms
3. Length of utilities to be laid -	5.60 Kms
4. Length of slab Culvert -	0.25 Kms
Major scope of civil engineering works	
a. Excavation	73,000 cum.
b. Concreting	3,500 cum.
c. Reinforcement	233 Mt.
d. Murum filling	50,000 cum.
e. GSB Works	8,500 cum.
f. WMM Works	13,000 cum.
g. BM (3% Bitumen)	3,200 cum.
h. DBM (4.50%)	3,200 cum.
i. AC (6.25%)	2,100 cum.

Depending on the data required the project WBS (Work Breakdown Structure) of activities is prepared and risk enacting on their sub-activities are enlisted and questionnaire is prepared. Questionnaire is then passed on to 20 field experts having years of experience in road projects and were asked for their feedback in terms of likelihood of occurrence, weightages that can be assigned to the risk encountered and the impact in term of time and cost. The questionnaires were collected from the experts was through personal approach and telephonic conversation. The said experts were Project Managers, Senior Engineers, Deputy Project Managers, Managing Directors, Consultants, Quality Engineers and Safety Engineers.

Microsoft Project (2010) software was used for scheduling the said project and it was done on the basis of contract quantity and amount, the project base cost and base time was determined which will be monitored to check whether there is cost and time overrun on account of risk factors.
Base Time Estimate (BTE) = 598 Days, Base Cost Estimate (BCE) = 24.86 Cr

Table No.1 Identification and classification of risks involved in the project

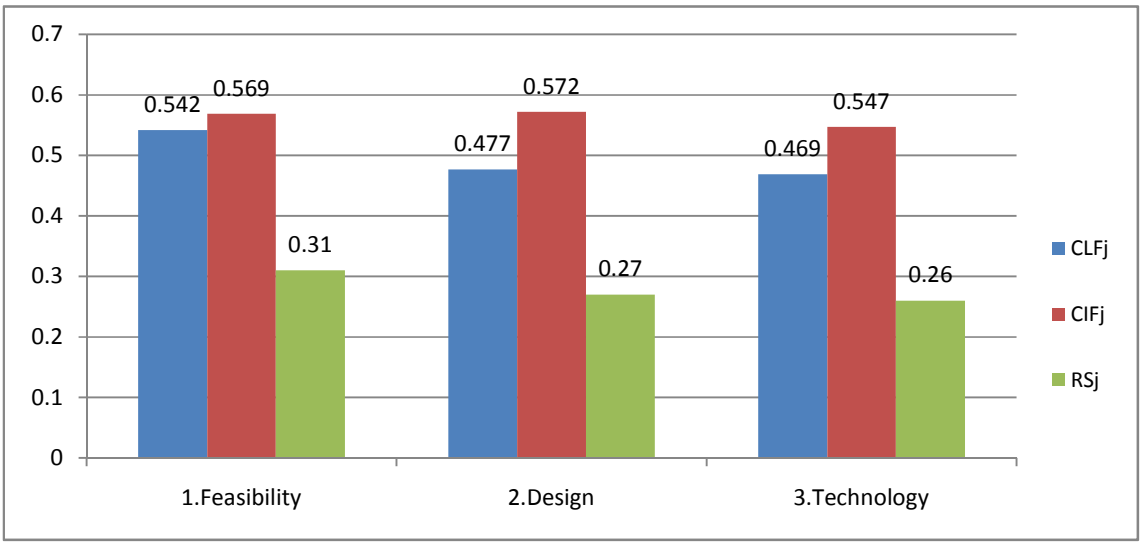
Sr. No.	Risk Classification Nomenclature	Risk Description
1	FPR	Feasibility Project Risk
2	PEPR 1	Pre execution Project Risk – Design Risk
3	PEPR 2	Pre execution project risk – Technology risk

Table No.2 Quantitative and Qualitative Analysis of Severity

Sr. No.	*Risk Classification Nomenclature*	*Risk Description*	*SEVERITY*			
			(CLF)j	*(CIF)j*	*Quantitative*	*Qualitative*
1	***FPR***	***Feasibility Project Risk***			CLFj x CIFj	
A		Political interference	0.050	0.065		
B		Interference of environmental activists	0.085	0.085		
C		Delay due to interdepartmental issues	0.058	0.058		
D		Delay in clearance from environmental and forest departments	0.170	0.164		
E		Lenders not comfortable with project viability	0.047	0.044		
F		Cancellation of project after bidding	0.041	0.058		
G		Review of technical specification and Bill of quantities (BOQ)	0.090	0.094		
		Summation	*0.542*	*0.569*	**0.31**	**V.High**
2	***PEPR 1***	***Pre execution Project Risk – Design Risk***				
A		Design error and omissions	0.128	0.159		
B		Design process takes longer than anticipated	0.113	0.144		
C		Failure to carry out work in accordance with contract	0.117	0.159		
D		Request late changes	0.118	0.112		
		Summation	*0.477*	*0.572*	**0.27**	**V.High**
3	***PEPR 2***	***Pre execution project risk – Technology risk***				

A		Physically inappropriate to handle projected demand	0.160	0.222		
B		Improper method/machinery used	0.308	0.325		
		Summation	*0.469*	*0.547*	**0.26**	**V.High**

Fig. No.1 Graphical Representation of data Analyzed.



IV. CONCLUSION

Sihastha Kumbh Mela is scheduled in August this year; the project has to be completed by June 2015 or before that in order to avoid time and cost overrun as per schedule. During the lifecycle of road project many and different types of risks are encountered which can be termed as major or minor risk depending on the severity they have. In this study risk severity has very high rating in feasibility, design and technology stage of project. Proactive approach need to be used than reactive, which is possible only by understanding and implementing risk management principle. Mitigation measures can be worked out in advance, ensure the probability of successful completion of the project within the stipulated time and cost. Therefore it can be concluded that in order to eliminate/mitigate the risks in project a proper recording, tracking and analysis is necessary. Risk management ultimately results increase in profit of the organisation by targeting schedule and costing of project.

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