



ANALYSIS OF RISK ASSESSMENT IN CONSTRUCTION OF HIGHWAY PROJECTS USING RELATIVE IMPORTANCE INDEX METHOD

Nagalla Vasishta

P.G Student, Department of Civil Engineering,
Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

D. Satish Chandra

Assistant Professor, Department of Civil Engineering,
Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

SS. Asadi

Associate Dean Academics & Professor, Department of Civil Engineering,
Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

ABSTRACT:

Evaluating Risk is essential before planning and management of risks to reduce the severe causes of risks associated with highway construction. The aspects related to risk are convoluted at several steps from designing to planning steps until the fulfillment of the project. To boost the performance of the highway project successfully we need to identify, assess and schedule various factors of risk in the project for efficient fulfillment of the project. “This analysis involves identification, classification and assessment of numerous risks involved in highway project construction using Relative Importance Index”. The Risk aspects have been arranged to their respective impacts on the project.

Keywords: Evaluating Risk, Planning, Management, Risk factors, Analysis.

Cite this Article: Nagalla Vasishta, D. Satish Chandra and SS. Asadi, Analysis of Risk Assessment in Construction of Highway Projects using Relative Importance Index Method, International Journal of Mechanical Engineering and Technology 9(3), 2018. pp. 1–6.

<http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=3>

1. INTRODUCTION

Risks are tangled in each case and highway constructions are no exclusion. Risks are often said to be the causes of loss of life, field disadvantages and could ultimately also lead to carnage. Risk Assessment consists of identification of the particular risk, classification of the risk along with risk analysis and appraisal. In this both the Qualitative assessment of risk and Quantitative assessment of risk are obtained. Highway construction activities involve a lot of hazardous risks. These risks are caused due to the association of several people like the design department team, construction contractors, sub-contractors, workers. These risks impose great threat to the construction pace and performance standards. Several risks occur mainly during initiation periods, managing periods and also in the end phases of the highway construction. These risks that occur can cause huge expenditure in case of occurrence of errors and time loss. Hence Risk Assessment consisting of identification of the particular risk, classification of the risk along with risk analysis and appraisal are to be done to keep the cost of the project in check, maintain quality in the construction and see that the project dues are on schedule. There are several techniques like the Fuzzy method, AHP method and the MCDM method that can be integrated to deal with reducing and removal of risks caused due to disparities in expenditure, decision making, allocation of funds to the necessary departments and vice versa. There are certain major risks that cause delay to the highway construction project like acquiring land, deploying correct personnel for the job along with necessary machinery. These risks can be avoided by efficient planning, using proper utilities, following quality procedures and avoiding delayed validation. The most gargantuan process in risk management is the risk assessment as it involves evaluation of probability of risk occurrence. The risk assessment is done to avoid design, planning disparities and to have a control over the project related threats. By risk assessment the tasks can be prioritized for the smooth completion of the respective highway construction project. This paper is done by proper identification of several risks, classifying them, evaluating and ranking based on the Relative Importance Index.

2. OBJECTIVES

- a) To list out several important risks that can occur in highway construction.
- b) To determine and rank various risks in highway construction
- c) To investigate and assess the various risks in highway construction.

The abstraction focus is mainly on the involvement of several risks in the construction project. The RII method, which is a quantitative tool is used to analyse and rank the risks based on their severity in the project. The greater severity risks have higher ranks and the less severe risks will be ranked below. Higher to lower risk ranks in ascending order. This ranking will help efficient planning and performance perfection.

3. METHODOLOGY

Several important risks were listed out and based on them, a questionnaire survey was made ranging from Very Low to Very high-risk basis. The questionnaire survey was conducted on 50 people and the respective data was collected. This data analysis is done using the RII method. Once the analysis was done the various risks were ranked based on their severity of impact on the highway project. RII was calculated for the probability, impact, and priority

$$RII = \frac{\sum_{i=1}^5 W_i X_i}{\sum_{i=1}^5 X_i}$$

W_i = weight assigned to the i th response; $W_i = 1, 2, 3, 4,$ and 5 for $i = 1, 2, 3, 4,$ and $5,$ respectively; X_i = frequency of the i th response; and $i =$ response category index = $1, 2, 3, 4,$ and 5 for very low, low, moderate, high, and very high, respectively.

3.1. Risk Identification and Classification

The risk identification can be done in many ways. But generally, the risks are broadly based on two types.

1. **Internal Risk:** - These risks generally comprise of technical factors, site factors and commercial factors vice versa.
 - a) Technical Factors: - Owner Changes, Material-Labor-Equipment, delays in preparation of submittals, obtaining NOC's, In efficient Planning.
 - b) Site Factors: - Existing Traffic, Archaeological Finds, Unforeseen soil conditions, Inadequate construction quality
 - c) Commercial Factors: - Delay in payment, inadequate claim administration, Poorly tailored contract forms, Third party liabilities.
2. **External Risk:** - These risks generally comprise of Political factors, Environmental factors, Socio-economic factors vice versa.
 - a) Political Factors: - Govt. Relations, Threat of war, Changes in Rules and Regulations
 - b) Environmental Factors: - Bad Weather Conditions, Site contamination, Environment impact of project.
 - c) Socio Economic Factors: - Criminal acts, Cultural differences, Bribes.

There are **other types of risks** like the project scope, Right of way, Utility conflict, A/E services, construction management related factors.

- a) Project Scope: - Project purpose is poorly defined, owner requests, changes to unforeseen environment requirements
- b) Right of way: - Errors in assessment, Land acquisition delay.
- c) Utility Conflict: - Inadequate plan reviews by designers or contractors, inaccuracy in site data.
- d) A/E services: - Delays in survey, Errors in survey, inexperienced personnel, design errors, omissions, delay in qualitative accuracy, Quality assurance and Quality control.
- e) Construction Management Factors: - Poor communication with owners and contractors, Delay of permits, sub-contractor errors, Maintenance of traffic, negligence of safety issues.

3.2. Analysis of Risks

The required information obtained from the questionnaire survey is accessed and ranked by using the Relative importance index which is a quantitative method. The obtained data is mathematically added up and ranked using this general RII formula.

$$\text{Relative Importance Index} = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

w = Weight allotted to each risk (by response to questionnaire survey)

A = Highest weight

N = Total number of people (responses) who completed Questionnaire survey

Several types of risks are collated, calculated and ranked in compliance with the RII method. If the RII value is high then the risk is severe and must be on priority. If the RII value is low then the risk is low or moderate.

Table 1 Risk Analysis Using RII

Risk Category	Risk No.	Risks	RII	Rank
Construction	R1	Owner Changes	0.513	34
	R2	Equipment resourcing	0.623	23
	R3	Inefficient Planning	0.757	7
	R4	Inadequate Construction Quality	0.773	5
	R5	Not maintaining target schedule	0.750	9
	R6	Selection of inappropriate equipment	0.843	2
Design	R7	Quality and integrity of design	0.767	6
	R8	Feasibility of construction methods	0.700	12
	R9	Lack of communication	0.783	4
	R10	Lack of co-ordination	0.877	1
Topography	R11	Insufficient Right of way	0.657	17
	R12	Unforeseen soil conditions	0.673	15
Political	R13	Delays in approval of submittals	0.670	16
	R14	Delays in obtaining NOC's	0.743	10
	R15	Delays in expropriations	0.637	20
	R16	Changes in rules and regulations	0.567	31
	R17	Bribes	0.430	39
	R18	Government Relations	0.577	30
	R19	Threat of war	0.397	40
Land acquisition	R20	Poorly tailored contract forms	0.640	19
	R21	Conflict in contract documents	0.623	23
Environmental	R22	Environmental impact of project	0.693	13
Organizational	R23	Skilled Labour	0.587	28
	R24	Delays in preparation of submittals	0.647	18
	R25	Insufficient technology/skills/techniques	0.810	3
	R26	Inadequate claim administration	0.627	22
Accidental	R27	Archaeological Finds	0.533	32
	R28	Inadequate safety measures	0.740	11
Utilities	R29	Material	0.580	29
	R30	Unexpected underground Utilities	0.613	25
Law & Order	R31	Existing traffic	0.603	27
	R32	Third party liability	0.533	32
	R33	Criminal acts	0.503	36
Climatic Condition	R34	Adverse Climatic conditions	0.500	37
	R35	Site contamination	0.687	14
Others	R36	Poor Co-ordination	0.757	7
	R37	Force Majeure	0.477	38
	R38	Delay in payments	0.633	21
	R39	Cultural differences	0.507	35
	R40	Delay in funds	0.610	26

4. RESULT&DISCUSSIONS

The Risk ranks and importance are attained from the analysis done by using Relative Importance Index (RII). This is based on the obtained responses via the Questionnaire survey. The ranks of the risks are based on how much harm they can cause to the project. The importance of the risks is based on the obtained ranks.

According to the survey done, the obtained top five major risks are R4, R6, R9, R10, R25- bar analysis shown in (Fig. 1) and the five least harmful risks to the project are R17, R19, R33, R34, R37- bar analysis shown in (Fig. 2).

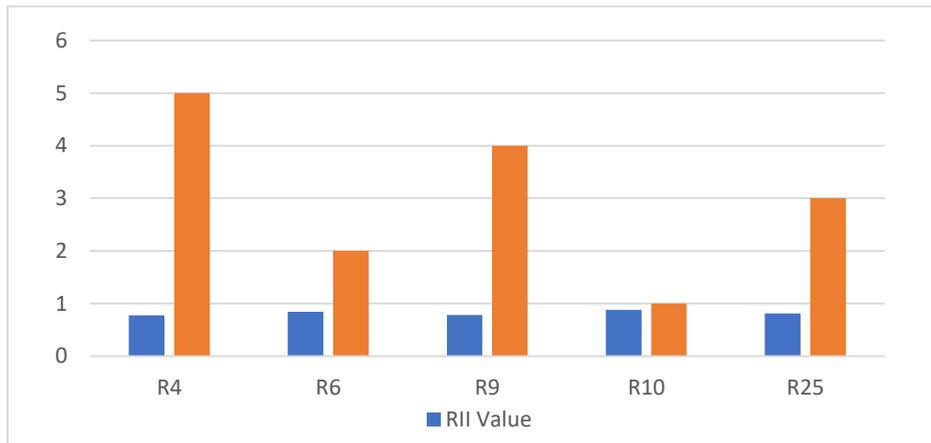


Figure 1 Bar chart Analysis of top harmful five obtained major risks

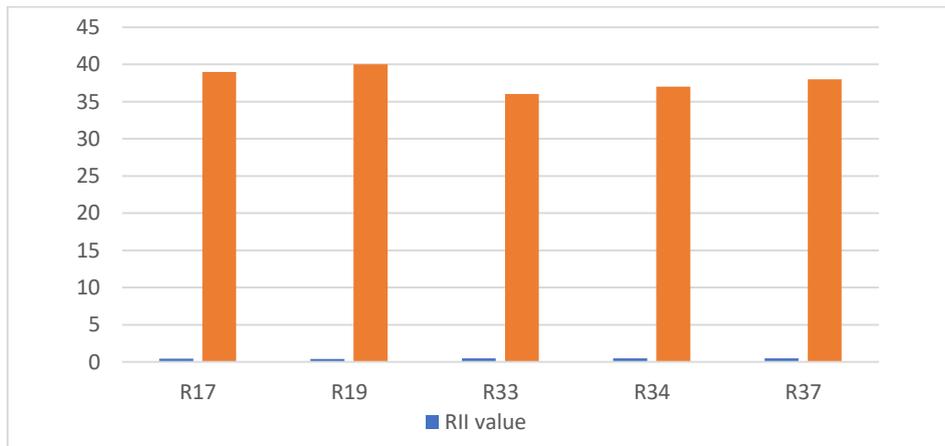


Figure 2 Bar chart Analysis of least harmful five obtained major risks

Risk Assessment is a crucial task which is to be conducted to avoid harmful effects that could pop-up, while initiation of Highway project construction. This study is conducted to obtain better knowledge on Risk Assessment and how important it is for a project to run smooth. Risk assessment will help in better understanding consequences that could occur in the highway construction period. It helps avoid certain disasters by decision making and plan for preventive measures. With Risk assessment, there will be certain performance improvements in the project. In this study, it was made clear that mainly Inadequate construction quality, Selection of inappropriate equipment, Lack of communication, Lack of coordination and Insufficient technology/skills/techniques are the top five major risks in the highway construction project. Knowing these major risks will help in developing preventive mechanism, so there will be negligible problems, less time lost and better budget planning while execution of the construction project.

REFERENCES

- [1] El-Sayegh, S.M. and Mansour, M.H., 2015. Risk assessment and allocation in highway construction projects in the UAE. *Journal of Management in Engineering*, 31(6), p.04015004.
- [2] Diab, M.F., Varma, A. and Nassar, K., 2012, April. Using risk assessment to improve highway construction project performance. In *Proceedings of the ASC Annual 48th Annual International Conference*, Birmingham, England April (pp. 11-14).
- [3] Salawu, R.A. and Abdullah, F., 2015. Assessing risk management maturity of construction organisations on infrastructural project delivery in Nigeria. *Procedia-Social and Behavioural Sciences*, 172, pp.643-650.
- [4] Le, T., Caldas, C.H., Gibson Jr, G.E. and Thole, M., 2009. Assessing scope and managing risk in the highway project development process. *Journal of Construction Engineering and Management*, 135(9), pp.900-910.
- [5] McGoey-Smith, A., Poschmann, A. and Campbell, L., 2007. Quantitative Risk Assessment and Risk Management of a Large Transportation Project. In *Annual Conference and Exhibition of the Transportation Association of Canada: Transportation-An Economic Enabler (Les Transports: Un Levier Economique)*.
- [6] Decò, A. and Frangopol, D.M., 2011. Risk assessment of highway bridges under multiple hazards. *Journal of Risk Research*, 14(9), pp.1057-1089.
- [7] Ashley, D.B., Diekmann, J.E. and Molenaar, K.R., 2006. Risk assessment and allocation for highway construction management (No. FHWA-PL-06-032).
- [8] Patil, M., Shinde, R.D. and Hailkar, M.S., *International Journal of Engineering Sciences & Research Technology Ranking of Risk in Railway Projects*.
- [9] Muhwezi, L., Acai, J. and Otim, G., 2014. An assessment of the factors causing delays on building construction projects in Uganda. *International Journal of Construction Engineering and Management*, 3(1), pp.13-23.
- [10] Pablo Jr, R.M., 2009. Risk assessment of highway bridges: A reliability-based approach. *The Technology Interface Journal*, Winter Special, (2009).
- [11] Han, S.H., Kim, D.Y., Kim, H. and Jang, W.S., 2008. A web-based integrated system for international project risk management. *Automation in construction*, 17(3), pp.342-356.
- [12] Molenaar, K.R., 2005. Programmatic cost risk analysis for highway megaprojects. *Journal of Construction Engineering and Management*, 131(3), pp.343-353.
- [13] Sharaf, M.M.M. and Abdelwahab, H.T., 2015. Analysis of Risk Factors for Highway Construction Projects in Egypt. *Decision making*, 11, p.12.
- [14] Dinesh, K.S., Asadi, S.S. and Prakash, S.B., *Study on Enhancement of Human Safety Protection Factors in Construction Industry*.
- [15] Varun Teja, T. and Asadi, S.S., 2016. An Integrated Approach for Evaluation of Environmental Impact Assessment-A Model Study. *International Journal of Civil Engineering and Technology*, 7(6).
- [16] Kumar, R.P., Sheikh, A. and Asadi, S.S., 2017. A Systematic Approach for Evaluation of Risk Management in Road Construction Projects–A Model Study. *International Journal of Civil Engineering and Technology*, 8(3).
- [17] Abhiram, P., Asadi, S.S. and Prasad, A.V.S., 2016. Implementation of Lean Methodology in Indian Construction. *International Journal of Civil Engineering and Technology*, 7(6).