

Risk Management in Railway Projects

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Abstract -Risk management is an important concept that mainly aims at identifying, quantifying, mitigating and reviewing of events that may have an adverse impact on the organization. There is a strong link between the amount of risk management undertaken in a project and the level of success of the project. Proper risk management implies control of possible future events and thus it is a measure of security to the contractors who take up the projects and to the owners of the projects. In this study the various aspects of railway projects were investigated. Data reliability was established and according to Weighted average analysis and Relative importance index analysis results.

Key Words: Risk Management, Relative Importance Index, Weighted Average Index Method, Railway Projects.

1.INTRODUCTION

Railways are treated as an economic, efficient, environmentally friendly and very safe mode of transport. Also India's biggest department is Railway Department i.e. Indian Railway, which is having special and separate financial budget in Indian polity i.e. Railway Budget. So it is obvious that the occurrence of risks in Railway projects are more. So it is necessary to do risk management in Railway Projects.

Risk management may be described as "a specific process of looking at areas of risk and consciously determining how each should be treated. It is a management tool that aims at identifying sources of risk and uncertainty, determining their impact, and developing appropriate management responses". A systematic process of risk management has been divided into risk classification, risk identification, risk analysis and risk response, where risk response has been further divided into four actions, i.e. retention, reduction, transfer and avoidance [4]. Railway projects are inherently complex and dynamic, and involving multiple feedback processes. A lot of participants – individuals and organisations are actively involved in the railway project, and they interests may be positively or

negatively affected as a result of the project execution or project completion. Different competitor with different experience and skills usually have different expectations and interests. Which simply creates problems and confusion for even the most experienced project managers and contractors. Every Project Management Institute knowledge area in itself contains some or all of the project management processes. For example, project risk management includes:

- Risk management planning;
- Risk identification;
- Qualitative risk analysis;
- Quantitative risk analysis;
- Risk response planning;
- Risk monitoring and control.

Hence comes the requirement to define, identify, quantify and mitigate the risks in railway projects in India.

2. RESEARCH METHODOLOGY& DATA COLLECTION

The data collected to determine the most influential factors on project management of the railway project was done through a survey by explorative questionnaire to the respondents involved in daily activities of construction and design firms, railway department in various regions of India. The survey was calculated so that respondents can give the rank to their responses based on their ideas. The analysis of these data was done by a method named relative importance index (RII) method as well as weighted average method (WAM).

Present study tries to work out ranking of Risk Factors in railway projects along with ranking of frequency and impact of these Risks. Further this work includes the ranking of various preventive and remedial methods used by railway ministry for Risk resolution. The survey questionnaire was designed to get the ranking of above issues by suitable technique. The risk factors are given in appendix. The survey questionnaire is made up of 15 basic and theoretical risk factors as studied in various research papers and by observation.

Respondents have to give ranking under the category for

Less Important (1),

Relevant (2),
Essential (3),
Important (4),
Most Important (5).

1.1 Questionnaire Survey

Detailed questionnaire was distributed to many of Designing & Survey firms, construction firms who are working for railways only and government railway department. Total 150 questionnaire was distributed out of which 80 replies received.

1.2 Data Collection

The target population included design & survey firms and construction firms who are working for Railway project and railway department. The design and survey consultancies and the execution firms who work for railways and the government railway department were targeted for survey. The facts of several shareholders and total numbers of were collected through internet. These facts were considered as size of population to decide sample size of study.

In this study around 150 Questionnaires were distributed, out of which 80 questionnaires received. The analysis of these surveys helped me to compute the Relative Importance Index and Important index of each clause. The present study is going to receive responses from a pretty diverse group of professionals i.e. owners, contractors, consultants, etc.

Below given formula was used to determine the sample size of unlimited population (Creative Research Systems, 2001):

$$SS = [Z^2 \times P \times (1-P)] / C^2$$

Where,

SS = Sample Size.

Z = Z Value (e.g. 1.96 for 95% confidence interval).

P = Percentage picking a choice, expressed as decimal, (0.50 used for sample size needed).

C = Confidence interval (0.1)

POP is the Population

Correction for finite population:

$$SS_{new} = \frac{SS}{1 + \frac{SS-1}{POP}}$$

A. Relative Importance Index Technique:

This technique is used to determine the relative importance of the various causes and effects of delays. The method is adopted in this study within various groups (i.e. project engineers, proprietor and site supervisor, designers, surveyors). The four-point scale ranged from 1 (very little degree affect) to 5 (very high degree affect) is adopted and

transformed to relative importance indices (RII) for each factor as follows:

$$RII = \Sigma W / (A * N)$$

Where,

W is the weighting given to each factor by the respondents (ranging from 1 to 4),

A is the highest weight (i.e. 5 in this case), and

N is the total number of respondents.

Higher the value of RII, more important was the reason of delays.

B. WEIGHTED AVERAGE METHOD:

Data of all these table were analyzed by a weighted average was calculated for each type of claims as follows:

$$\text{Weighted Average Index} = (W_i * X_i) / N;$$

Where

W_i is the weight assigned to the ith option;

X_i is the number of respondents who selected the ith option; and

N is the total number of respondents (80 in this study).

2. RESULTS AND DISCUSSION

Sample Size Calculation

The formula given below is used for the calculation of sample size.

$$SS = [Z^2 \times P \times (1-P)] / C^2$$

Where,

SS = Sample Size.

Z = Z Value (e.g. 1.96 for 95% confidence interval).

P = Percentage picking a choice, expressed as decimal, (0.50 used for sample size needed).

C = Confidence interval (0.1)

POP is the Population = 146

The Ministry of Railways has transferred 146 projects to Rail Vikas Nigam Ltd (RVNL) for execution, so that is why the population size is taken as 146.

$$SS = [1.96^2 \times 0.5 \times (1 - 0.5)] / 0.1^2$$

$$= 96.04$$

Correction for finite population:

$$SS_{new} = \frac{SS}{1 + \frac{SS-1}{POP}}$$

$$= 58.172$$

Here, in this case total 80 replies are there, which is proven to be good for present study.

3. COMPARISON OF RII & WAM

	Risk Factor	RII Indi	RII Overall	WAM Indi	WAM Overall
1	FINANCIAL RISK				
1.1	Delayed payments on contract	1	5	1	5
1.2	Unmanaged cash flow	2		2	
1.3	Inflation	4		4	
1.4	Financial failure of the contractor	3		3	
1.5	Construction cost overruns	6		6	
1.6	Labor and Material Costs (Contract, Outsourced)	5		5	
1.7	Interest Rate Changes (Credit and Interest Rate Risks)	7		7	
2	DESIGN RISK				
2.1	Defective design (incorrect)	1	3	1	3
2.2	Design Changes	2		2	
2.3	Awarding the design to inexperienced Designer	3		3	
3	POLITICAL RISK				
3.1	New governmental acts or legislations	1	14	1	14
4	LEGAL RISK				
4.1	Ambiguity of work legislations	3	11	3	10
4.2	Difficulty to get	2		2	

	permits				
4.3	Disputes among the parties of contract	1		1	
5	MANAGEMENT RISK				
5.1	Poor communication between involved Parties	3	7	3	6
5.2	Improper planning	4		4	
5.3	Changes in management ways	5		5	
5.4	Resource management	1		1	
5.5	Management of Contracts & Joint Ventures	2		2	
6	MATERIAL RISK				
6.1	Material not conforming to the specification	1	2	1	1
6.2	Availability of material	2		2	
7	SITE SAFETY				
7.1	Occurrence of accidents because of poor safety procedures	2	6	2	8
7.2	Labor safety	1		1	
7.3	Security of material and equipment	3		3	
7.4	Varied labour and equipment productivity	4		4	
8	SITE RISK				
8.1	Improper site investigation	3	1	3	2
8.2	Land use and acquisition/	1		1	

EXPOSURES					
14.1	Contractual Liability (Breach, Third Party Action)	3	4	3	4
14.2	Liquidated, Consequential and Punitive Damages Clauses	4		4	
14.3	Force Majeure Clauses (Schedule Delay)	2		2	
14.4	Subcontractor Default, Abandonment	1		1	
15	HUMAN RESOURCE RISK				
15.1	Inadequate succession planning	1	9	1	13
15.2	Inability to attract quality personnel	3		3	
15.3	Manpower Risks- Specialized manpower leaving the jobs	2		2	

land is procured and handed over by the government. Also by sending pre notice to the land owner for the acquisition, so that acquisition process can easily be done. For proper site investigation, the Daily Project Report (DPR) system should be installed properly, and the format of DPR should contain site photographs, daily material consumption, daily manpower used, and amount of work done etc.

2. Material Risk

Material risk is one of the major risk found in not only the railway projects but also other construction projects. To achieve such a risk the engineers of railway department should first aware about the purchasing of the materials, the dealers of the material should be approved by ISO certification. Also they should provide the quality certificate for each materials, like ballast, sleepers, rails etc. which are majorly used in laying of railway line.

Again, the department should have multiple options i.e. multiple number of dealers of the materials. So that if one fails due to deliver the required material on time, other could deliver that particular item on site on time, to avoid risk associated with delay.

3. Design Risk

As the major time required for the completion in railway project is Design and survey phase, Perfect design is must necessary in railway projects, as millions of kg of load is going to transfer on that particular way.

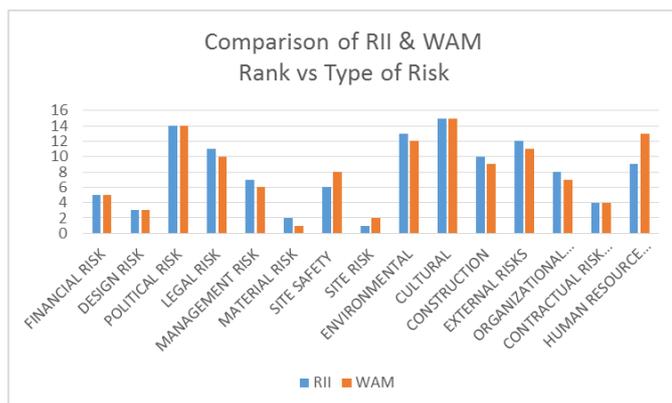
So railway department spends more time for preparation of design and survey reports. Here in this case the tender winning firm, who is preparing the design and survey reports of this project have six month to complete whole reports which includes GADs (General arrangements of sheet), Hydrology of every major and minor bridge, Railway curves, Track details with varying chain age.

So it can be mitigated by ensuring good design report and vetted by owner and consultant before the project commences. And also by hiring experience surveyors and designers or giving proper training to the fresher employee under the guidance of experts such a risk can be mitigated.

Also by providing Defect liability clause in contract it can be done. [7]

4. Contractual risk & Exposures

The contractual Liability types of risk found very serious effect on project, here in this case for design phase one private consultancy firm failed to carry the whole survey of particular route, so breach of contract happens, to complete such an incomplete work, railway ministry has to out again another tender, and after all the tedious procedure of tendering some another consultancy firm will take the responsibility to complete the remaining work, which causes



Here the results got from both the method are approximately same, which proves that ranking given by respondents are right and data is correct.

4. RISK MITIGATION MEASURES

1. Site Risk

The risk associated with the land acquisition can be mitigated with the project starting only after all the required

lots of miss interpretation and tedious work. To mitigate such a risk the ministry of railway should be strictly aware on breaching of contract initially in tendering process.

5. Financial Risk

After identifying the risk involved in a Railway project, it is very important to look at the techniques for analyzing project cash flow, which is a major function of risk management process. [8]

Unmanaged cash flow

The basic cash flow management technique says that, in first two phase and last two phase of the construction phase, the expenditure of the project should be 8% to 10% of the total expenditure and in remaining duration, it varies with increasing in starting, highest in middle and decreasing in ending, which follows a "bell curve".

6. Site Safety

Such a risk found to be a very common in not only the railway projects but also in every construction industries. And the measures to mitigate such a risk is also very common like wearing safety equipment like helmets, hand gloves, boots, goggles etc. most of the government enterprises and private firms do not follow such a measures, which they should be aware of.

Apart from this, many acts are there for the welfare of labors for example

- The Workmen's compensation act, 1923
- The Employees Compensation act, 1923
- The Trade Unions Act, 1926
- The Payment of Wages Act, 1936
- The Employers Liability Act, 1938 and many more.

7. Management Risk

Management risk are found to be very important risk in such a projects who are dealing with public enterprises. Here railway ministry outs the tender to the private entities, and private entities work in their comfort according to available resources. Sometimes resources are not available on time so to mitigate such a risk they should have alternate options of dealers available, so that project should not stop due to unavailability of resources.

8. Organizational Risks

Again, in this case study such a kind of risk happens in private consultancies who are going to work for Railway Ministry, the subcontracted items and other design reports like GADs, Hydrological reports etc. could not reach on time to the head office or respective site locations, which aims to

delay in getting permits and delay in execution of work as well. So to overcome such a risk the private consultancies should manage proper transportation systems.

Also, the materials stored on site should be protected well against rain, wind and other unnecessary things like thief, wasting etc.

9. HUMAN RESOURCE RISK

Here, such a risks again happens majorly with private consultancies, due to some trained employees working on such big projects leaves the jobs, so the companies have to hire some other new employees and have to train them first, which consumes too much time which indirectly effects the project delay.

10. CONSTRUCTION

Such a risks are more common in every construction industries, generally such a risk happens at the time of execution phase of the projects. The specification given in the drawings and design reports are getting differ at site, due to misunderstanding. To resolve such a risk the site engineer should first discuss whole the plan with senior engineer.

Also the execution process should be done properly as millions of kg of weight is going to transfer on that route. Modern equipment should be utilized by the government for easy and quality construction instead of ethic traditional methods.

11. Legal Risk

Many of government agencies / civic bodies etc. that are affected in one or other by the development of this Railway line, had to grant various approvals for the project, which is going to be a complex and time consuming process during the construction period. So, the government should provide a single window clearance for a project of this magnitude. [8]

12. EXTERNAL RISKS

Major dependence on one client

Here in this case study, it is found that due to uneconomical site conditions and lack of site data available, the government employees are providing incorrect row data required for the design, which aims to repetition of work again and again, so the government forced to consultancies to work over there, in their site location for designing also. Which aims to unnecessary comfort and unnecessary extra expenditures like printing of drawing, design reports establishment of new set ups etc.

So it is found that private consultancies who work for such a government body should establish their office on

every particular site locations to overcome such an unnecessary cost and comfort.

New stakeholders emerge and request changes

Unsupportive stakeholders & loggerhead between shareholders are the major source of such a risks. Which can be mitigated by working closely with the major stake holders and by knowing their aspirations.

13. ENVIRONMENTAL

It is found that such a risk are not affecting majorly on projects, because railway ministry are carrying the design phase in rainy seasons and execution phase in non-rainy seasons.

But to reduce the pollution creating by the execution work, the ministry and other contractors should follow the environmental acts.

14. POLITICAL RISK

New governmental acts or legislations

15. CULTURAL

Political and cultural risk are the risk that civil/political problems may surface as a result of project, manifesting in boycotts, sabotage etc. such a disturbance may arrive from a number of different concerns, public objection to imposition of tariff public discontent with the environmental impact of civil work or other features of the project an event similar to any of above could impair the capability of concessionaire to collect revenue thereby affecting project viability.

Thus, the project should be designed that provides adequate cover against these risk.[8]

5.CONCLUSION

Present study finds that which risk is having first Rank among all Risk factors.

According to above analysis of collected data it is conclude that Site risks, Material risk are most important in Railway projects.

According to preventive method analysis it is concluded that generally risk is transferred to other party or they refer previous and ongoing similar projects.

- Whenever project objectives are suffer they
- closely coordinate with their subcontractors,
- Increase manpower and
- Increase working hours.

REFERENCES

- [1] Er.Amit Bijon Dutta,"Study of Risk Management In Construction Projects", International Journal of Management, Volume 5
- [2] S.M.H Mojtahedi,"A Non-Parametric Statistical Approach for Analyzing Risk Factor Data in Risk Management Process", Journal of Applied Science, 2009
- [3] Pejman Rezakhani,"Current state of existing project risk modelling and analysis methods with focus on fuzzy risk assessment-Literature Review", IGF-ESIS, 2012
- [4] Jonathan K. Fabi,"A Study of Risk Management Practice of Highway Projects in Nigeria", JESD, Vol 6, 2015
- [5] Ranking of "Risk Factors" and "Risk Management Actions" Affecting Building Construction Projects in Gujarat , Patel Kishan, Dr.Rajiv Bhatt, Prof.J.J.Bhavsar,IJAERD, Volume 2, May 2015
- [6] RII & IMPI:Effective Techniques for Finding Delay In Construction Project, Mamata Rajgor, Chauhan Paresh, Patel Dhruv, Panchal chirag, Bhavsar Dhmesh, Volume:03, Jan 2016
- [7] Risk Management in Motorway PPP Projects: Empirical-based Guidelines, ublin Institute of Technology ARROW@DIT, Nunzia Carbonara, April 2014
- [8] Risk Assessment of BOT Road Projects, Engineer Rinaj Pathan & Prof.Dr.S.S.Pimplikar, IOSR Journal of Mechnical and Civil Engineering (IOSR-JMCE), Volume 5, Issue 3, Jan-Feb 2013
- [9] Risk Analysis of Infrastructure Projects under Public Private Partnerships, M.A.Ravindhar Raja, IJCIET, Vol:6, June 2015
- [10] Safety Risk Analsis and Proposing Risk Mitigation Stragegies for Operations and Maintenance Activities in Highways: A Qualitative Methods, Sayanti MUKHOPADHYAY, Jennifer S.SHANE, PhD, and Kelly C. STRONG, ASCE 2012
- [11] Qualitative Risk Assessment and Mitigation Measures For Real Estate Projects In Maharashtra, Sneha Khedekar, Dr.A.W.Dhawal, IJTRA, Volume 3, July Aug 2015
- [12] Risk Assessment: A Case Study for Transportation Projects in India, T.H. Nguyen, G.Bhagavatulya and F.Jacob, Volume 3, Issue 9, September 2014
- [13] Identifying and Evaluating Risk of Construction Projects in Fuzzy Environment: A case Study in Iranian Construction Industry, Sotoodeh Gohar, M.Khanzadi, Maryam Farmani, IJST, Vol:5, Nov 2012
- [14] Project Risk Identifucation Methods for Construction Planning and Execution, Robert G.Batson, M.ASCE, 2012
- [15] Integrating Risk Assessment in Planning for Sustainable for Infrastructure Projects, Mohamed F. Diab MBA, Ph.D., A.M.ASCE, 2013
- [16] Risk Assessment in Construction of Highway Project, Ankit Vishwakarma, IJERT, Volume:5, Feb 2016
- [17] 13th Annual Report 2015-16, RVNL (Rail Vikas Nigam Limited)