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Critical Risk Factors Causing the Time and Cost Overruns of Indian Railway Projects in India

Ravindra Shrivastava, Sumeet Gupta, Ankur Mittal, Brijendra Saxena

Abstract— ***overrun in terms of increase in cost and time of the infrastructure project are considered to be one of India's major infrastructure issues. Any overrun of the infrastructure project will result in huge national losses as it uses taxpayers ' money. These losses can be caused due to poor managent of risk in the construction projects. Overrun is a common phenomenon that affects almost all railway projects. However, the limited effort has been made to limit the occurrence of overruns, the author attempts to define the significance risk factors of which are the outcome of the eighty-four(84) attributes that cause overruns and further the possible ways to deal with possible mitigation for Indian railway projects. The eighty-four (84) risk attributes have been identified through a detailed literature review and pilot study. The questionnaire survey is being conducted on the professionals working in the railway project. The statistical tool Exploratory factor analysis (EFA) was performed to understand the behaviours of the risk attributes. All the identified eleven factors are related to Contractors risk, PMC risk, Design risk, Safety & security-related risk, Financial risk, nature-related risk, Government approvals and site clearances risk, Quality related risk, contractor's cash flow related risk and fundamental risk***

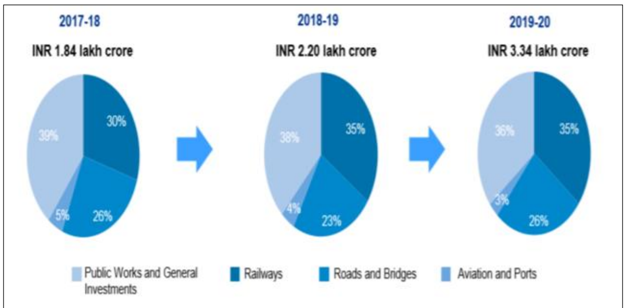
Keywords – Risk factors, Railway construction project, factor analysis

I. INTRODUCTION

Research on risk and uncertainty forecasting and their management is one of the most influential research areas in construction management. The area deals with the research related to the identification of the risk influencing the performance of the projects, assessment of the risk and finally the mitigation measures to deals with the risk. According to a report (GCP, G. C. P., & Economics, O., 2015) on International construction market predicts a big construction market of $15.5 trillion by 2030, With three nations, India, China and, the US 57% of global growth is leading the way. However the in the past the phenomenon of overrun observed worldwide affecting the projects and industry as a whole and further increasing value lost (in terms of money lost due to overruns).

According to the report (Beckers et al., 2013, p.18), Many of the difficulties reported are due to a lack of experience in implementing the proactive risk management strategy to manage risk in the projects. Due to inadequate management of the risk, the large infrastructure projects suffers significantly at almost all stages of a project's value chain and life cycle. Direct value losses due to inadequate management are expected to be over $1.5 trillion in next five years may reach $1.5 trillion. This projects long-term implementation and uncertainty require a strategy that accurately represents the risk and vast range of challenges posed by the project over the life cycles.

India's government has a large investment project near INR 5.97 lakh crore over 2040, according to the study conducted by KPMG & GOI (2019).



Three year capital expenditure perspective in lakh crore	2017-18	2018-19	2019-20
Railways	0.55	0.77	1.17
Roads and Bridges	0.48	0.51	0.87
Aviation and Ports	0.09	0.08	0.10
Public works and general investments	0.72	0.84	1.20

(Source: GOI and KPMG report on Indian Infrastructure project)

The current fiscal and GDP contribution from the construction sector in the infrastructure sector is high at INR 2.49 lakh crore. Addition, approximately INR 304 lakh crore is estimated to require investment in required until 2040 to promote the development of the country

According to the latest report (MOSPI, May 2019) Indian infrastructure projects worth Rs. 1500 million and above reflect total cost overruns of Rs 377.12 billion around 19.59 percent and an average overrun of 36.98 months in the 496 delayed projects.

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* Correspondence Author
Mr. Ravindra Shrivastava*, PhD scholar & Assistant professor, National Institute of Construction Management & Research (NICMAR), Delhi NCR, India.(Email: ravindra.shrivastava2@gmail.com)
Dr. Sumeet Gupta, Sr. Associate Professor, School of Business, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India. (Email: sumeetgupta@ddn.upes.ac.in)
Dr. Ankur Mittal, Associate Professor, School of Business, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India. (Email: amittal@ddn.upes.ac.in)
Dr. Brijendra Saxena, Retired Professor, Tolani Maritime Institute, Pune, Maharashtra, India (Email: bksaxena@hotmail.com)

Railways sector has shown the highest investment in all the infrastructure projects in the current year on the other hand the sector also has the maximum time and cost overrun 36% and 54 % respectively in all type of infrastructure projects.

Keeping in mind the significance of construction sector on the economy, the various countries across the world have undertaken the research and various initiative to improve the performance these projects, and this further help the efficient utilisation of investment for the development purpose. In the past there are many construction projects which were unsuccessful in meeting the timeline and cost owing to multiple intrinsic risks associated with the project may be related to internal and external factors. Critical thinking is required to manage these associated risk. A lot of research conducted in developed countries, however research specific to sub-sectorial profiles of infrastructure projects to be explored. The current study is undertaken to explore the risk involved in the railway's infrastructure projects.

II. OBJECTIVE

To Identify the key risk factors that causing the overruns of the Indian railway project.

III. LITERATURE REVIEW

As per the dictionary the meaning of risk is associated to adverse risk i.e. safety fire risk, hazard, failure of structures and threats etc. The definition of the risk as per ISO 31000:2009 "risk is effect of uncertainty on objectives". The meaning emphasises on the uncertain event which is probabilistic in occurrence and their effect in terms of impact on the predefined objectives (ISO, I., 2009).

Construction is one of the most complex, risky and demanding industry. Construction projects have wide range of characteristics such as Complexity (structure and socio-political complexity), Dynamic stakeholders management (significant interface risk), Financial intensity, unique procedures, frequent changes, Lengthy duration, Offensive environment, Some of the factors fundamental type such as situation of market, political and economic variations (Mills., A.,2001, 245-252). The project may have combinations of above risk; It is vital to predicting all the expected risk which may likely to come across the lifecycle of the project and prepare with a mitigation plan to achieve the project objective. However, In the construction projects, there may be downside risk which are pure or negative (threat) and also opportunity which are positive (opportunity). The effort should be made to avoid the negative risk and in cash or exploit the positive risk. (Smith & Jobling, 2014, 01-19)

As per the author (PMBOK, 2017) the risk management is a part of Project management. It emphasises on the processes related to the identification, assessment and mitigation i.e. to minimize the magnitudes of adverse event and exploit the result of the positive events (Rita M., 2003, 21-22). The risk management process in the projects has many benefits including improved chances of project success, exploiting opportunities, contingency and reserve management, cost-effective decision making, maximum efficiency and increased team motivation. Risk management has two important characteristics; first, the decisions are risk based means before choosing an option the choice is evaluated based on associated risk and opportunities second the integration with other processes will improve the other processes also, and the process must repeat throughout the lifecycle of the project (Hilson & Simon, 2007). The success of effective management of risk depends on the Organization attitude, competency of people, simple & scalable processes and methods to be followed in the project (Hilson & Simon, 2007). Keeping in mind the importance of the subject area it has been proactively addressed by many professionals associations across the world.The widely accepted process are by PMBoK (2017), this includes the Plan entire process, Identify the risk, assessment (Qualitative and quantitative), plan and implement risk response or mitigation measures and finally the monitoring of the risk. Risk identification is one of the initial and essential steps because "The defined risk is a risk that can be handled". The aim is to identify all the unknown, known unknown and unknown risk type of risk in the project (Smith & Jobling, 2014, 01-19). This step provides a structured process to identify the risk in the project. There are various research conducted across the world for risk identification specific to a country and a sector too. Assaf *et al.* (1995) identified risk causing time overrun and their significance, on the basis of stakeholder's perception for major construction projects (Buildings) in Saudi Arabia. As per the research Contractor's the significant factors are; Design and approvals, delay in payment and frequent design change by owners are the most significant factors, the consultant the significant factors are; processing claims and bills, subcontractors relationships and coordination, timeline for execution, and delayed decision by the owners and; the owners the significant factors are; errors design, Excessive bureaucracy in the management of works, labor shortages, and lack of skills & shortage of labor. Wang & Chou (2003) identified the critical risk, their allocation and management for a road projects in Taiwan. By comparing multiple case studies, the author analyzed the possible different allocation strategy i.e. which risk to be transfer, avoidance, mitigation and retention) specific to road project in Taiwan. El - Sayegh (2007) identified the significant risk attributes and their impact and proper allocation in the projects in UAE . The study result shows that there are significant economic risks such as increasing material costs, labour & material shortages and certain major risk factors are; owner risks such as unrealistic time for the project, constant interference, and changes in design. The outcome of the study suggests that the financial risk are significant in the projects and maximum risk are passed on to contractors amon all the stakeholders. Wang *et al* (2004) developed framework which includes defining significant risks & their types, specific mitigation strategies for each risk and their relative significance and the interdependence of various risk. The outcome suggest that Country-level risks are more severe than at market-level risk, and at project-level, market-level is more important.

Doloi *et al* (2011) conducted research in Indian context to analyse risk factors which cause the time overrun in projects and also developed a regression model to determine the relative importance of the attributes causing the delay. The outcome suggests that most significant factors affecting the delays in India are The contractor's financial difficulties and cash flow, owners delay in decisions, poor productivity of labour, architects' unwillingness for rework and changes in the scope. Patrick et al. (2007) identified the key risks in projects in China and further developed strategies to manage them. The author also suggested the role of stakeholders in managing key risks throughout the project lifecycle. The outcome of the research suggest that the owner, Consultants (design) and government should work closely to mitigate the risk from the early phase of the project, the construction team should be deployed early to establish the constructability and design coordination with better inputs to design team and finally will contribute in achieving the time, cost and quality objectives of the project. Iyer & Jha (2006) Investigated the critical factors affecting scheduling efficiency in the construction industry in India. The author identified the project success and failure factors and the profile of variables for schedule as performance criteria. The significant success factor is the stakeholder's commitment; competence of owner

and the most significant failure factor is conflicts between the stakeholders. The success parameter and failure parameter identified affects significantly based on the peciption of professionals of the construction industry. Renuka & Umarani (2018) identified the key risk factors and their impact for medium-sized projects that cause cost overruns. By using factor analysis on variables the key factors were found. The key factors are Sufficiancy of scope of work, risk related to Environment, risk related to legal and documentation, building and functional risk, asset efficiency risk, information distribution, site management related risk, financial risk and lean construction-related risk. Further, a framework to assess the likelihood of cost deviation in construction projects was developed by the author. R. Shrivastava *et al.* (2019) has performed a critical review of literature on critical risk factors to be considered before taking infrastructure projects in Asian countries, the study reveals the various significant risk factors specific to different Asian countries.

In the review of various academic and professional literature, it was observed that many of the articles available on country-specific risk identification but very few articles available on sector-specific risk identification

IV. RESEARCH METHODOLOGY

Questionnaire design

It is difficult and crucial to recognize the different attributes that cause the overruns and equally difficult prepare and conduct the questionnaire survey for the desired outcome of the study (Doloi et al., 2012). The study started with a detailed literature review of the different attributes considered as a risk in the project management. Two hundred and twenty-eight (228) risk attributes are defined based on the literature. A pilot study on these identified risk attributes is being carried out to render it unique to a railway construction project in India. The five experts chose more than 25 years of railway project experience for the pilot study. On the basis of the pilot study, eighty-four risk attributes were identified and used in the questionnaire survey that influences the time and cost overrun of the railway projects.

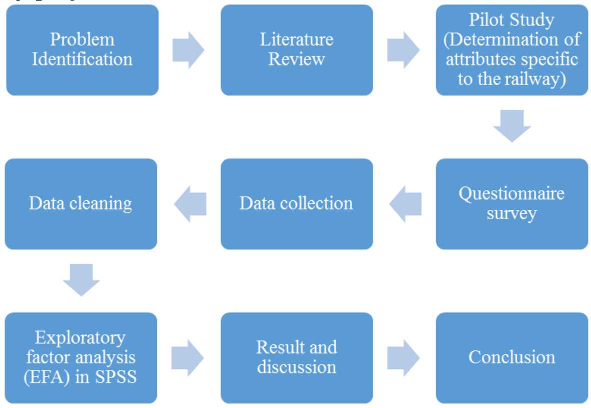

Figure 02 – Research Methodology

Samples and Instruments

A questionnaire survey was conducted to understand the effect of various risk variables on the overruns of the railway projects in India. A five-point ordinal scale is being used for the questionnaire survey, 01 refers Not at all concerned, 02 refers to Slightly concerned, 03 refers to Somewhat concerned, 04 refers to Moderately concerned, 05 refers to Extremely

concerned. The targeted population for the survey was engineering and management employee of various stakeholders working in railway sector such as owner, contractors, consultants, PMC, supplier and inspection agencies with varying experience. The survey was conducted through email, Survey-Monkey software and hardcopy. An overall 520 number of responses were received.

Data analysis

The statistical tool Exploratory factor analysis (EFA) and further a part of it, Principle component analysis (PCA) was used to reduce the attributes into the risk factors; the responses were analysed using the SPSS software. The Principal Component Analysis, PCA has been developed to better analyze many of these variables relationships in a simpler way. The analysis of KMO and Bartlett is used to evaluate the sample size adequacy. Communality is tested to understand the data is appropriate for the Principle Component Analysis. (Williams Brett, 2010).

The analysis started with Correlation matrix for any coefficient value if it exceeds the 0.9 and all values are less than 0.9. This reflects the suitability of factor analysis, as there is little correlation between the values. The Multi-colinearity checked through the determinant of the matrix. The value is 0.000822 and is higher than the 0.00001 necessary value. The Multi-colinearity is not an issue for the given dataset, all the questions correlate reasonably well, none of the coefficients was particularly large. Therefore no items are required to be omitted.

KMO and Bartlett's Test Outcome

The second performance is the sampling adequacy, the indicator is Kaiser-Mayer-Olkin (KMO) value and for multicollinearity, the indicator is Bartlett's test of sphericity test. These are the essential requirement for Exploratory Factor Analysis (EFA). The value of KMO range from 0 to 1. The value greater than 0.5 indicates the adequacy of sample size. The KMO value for the present study is 0.934 which falls in the range of **'Superb'** indicating sufficiency of data samples.

KMO and Bartlett's Test Outcome		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.934
Bartlett's Test of Sphericity	Approx. Chi-Square	39599.108
	Df	3486
	Sig.	0.000

Table – 01 Outcome of KMO and Bartlett's Test

Bartlett's test with a significance value that 0.000 for the analysis which is lesser than 0.05. It gives confidence that the collected data would be reasonable and would produce good results making data suitable for factor analysis.

The Cronbach alpha coefficient of was determined using the SPSS to decide the accuracy and reliability of the scale.

Table – 01 Outcome of Cronbach's Alpha coefficient

Reliability Statistics	
Cronbach's Alpha	N of Items
.98	84

Communality

The following table shows the communalities before and after extraction. Before all communities are extracted, 1 indicates all common variances before extraction. The populations reflected common variation in the data structure after extraction, which ranged in large part from 0.578 to 0.85. The average communality after extraction is 0.712, making the data suitable for factor analysis (The Communalities after extraction should be greater than 0.6).

Table – 01 Communalities before and after extraction

Communalities					
Variables	**Initial**	**Extraction**	**Variables**	**Initial**	**Extraction**
V1	1.000	.622	V43	1.000	.700
V2	1.000	.686	V44	1.000	.802
V3	1.000	.622	V45	1.000	.804
V4	1.000	.619	V46	1.000	.815
V5	1.000	.742	V47	1.000	.750
V6	1.000	.644	V48	1.000	.751
V7	1.000	.664	V49	1.000	.597
V8	1.000	.632	V50	1.000	.781
V9	1.000	.578	V51	1.000	.679
V10	1.000	.769	V52	1.000	.699
V11	1.000	.784	V53	1.000	.773
V12	1.000	.782	V54	1.000	.687
V13	1.000	.633	V55	1.000	.775
V14	1.000	.743	V56	1.000	.648
V15	1.000	.653	V57	1.000	.696
V16	1.000	.688	V58	1.000	.702
V17	1.000	.750	V59	1.000	.764
V18	1.000	.749	V60	1.000	.739
V19	1.000	.655	V61	1.000	.691
V20	1.000	.747	V62	1.000	.676
V21	1.000	.662	V63	1.000	.791
V22	1.000	.754	V64	1.000	.701
V23	1.000	.662	V65	1.000	.770
V24	1.000	.656	V66	1.000	.752
V25	1.000	.734	V67	1.000	.701
V26	1.000	.776	V68	1.000	.695
V27	1.000	.677	V69	1.000	.594
V28	1.000	.696	V70	1.000	.735
V29	1.000	.720	V71	1.000	.724
V30	1.000	.689	V72	1.000	.673

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V31	1.000	.741	V73	1.000	.794
V32	1.000	.730	V74	1.000	.715
V33	1.000	.728	V75	1.000	.681
V34	1.000	.682	V76	1.000	.709
V35	1.000	.773	V77	1.000	.708
V36	1.000	.729	V78	1.000	.710
V37	1.000	.749	V79	1.000	.704
V38	1.000	.702	V80	1.000	.702
V39	1.000	.747	V81	1.000	.733
V40	1.000	.669	V82	1.000	.743
V41	1.000	.748	V83	1.000	.760
V42	1.000	.730	V84	1.000	.668
	Extraction Method: Principal Component Analysis.				
		Average	**.712**		

In SPSS, The Principle component analysis was applied to evaluate the main risk factors for the data from 520 responses collected. The initial solution extracted to show ' Unrotated Factor Solution ' and ' Scree map ' to check changes in perception due to rotation. The Scree plot represent fifteen (15) factors has Eigen-value greater than one (1). The total variance explained for this 15-factor is 71.198 per cent. The following chart shows the values of Eigen associated with each linear component and the level of variance described by the linear component in question.

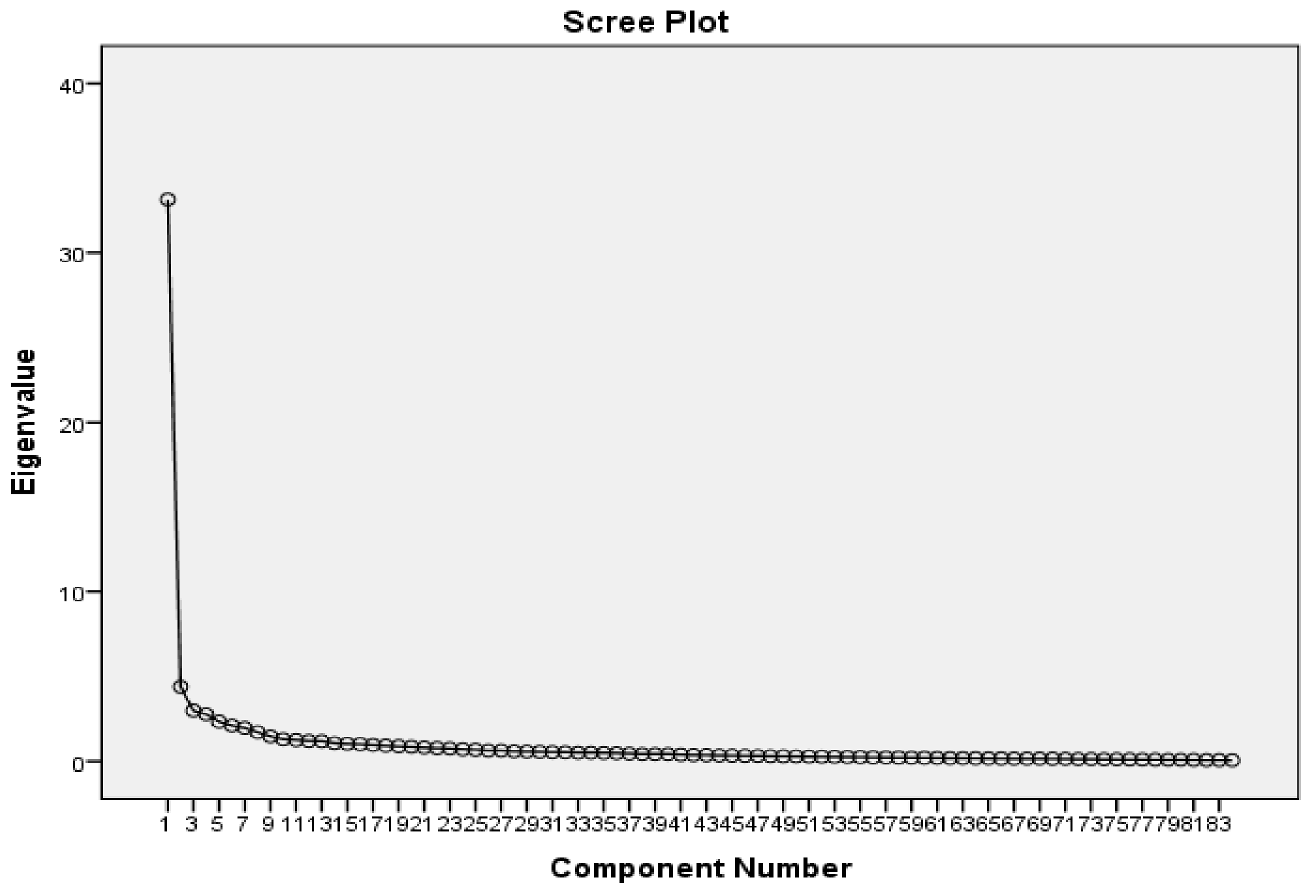

Figure 03 – Scree plot

The total variance Table shows the Eigenvalues in terms of the amount of variance described before rotation. First factor accounts for 13.653% of the total variance explained after rotation. The Eigen values associated with these factors are again displayed in the extraction sums of square loadings. The outcome of the factors with Eigen-value more than 1 in extraction sum of square loading & rotation sum of square loading are reduced to 15. The following table shows the values of Total Variance Explained with Extraction Sums of Squared Loadings and Rotation Sums of Squared Loadings. The table is showing the details of only 20 components out of 84 components which includes 15 components having Eigen-value more than 1.

Table – 02 Total Variance Explained (Only top 25 variables)

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	33.147	39.460	39.460	33.147	39.460	39.460	11.790	14.035	14.035
2	4.383	5.218	44.678	4.383	5.218	44.678	6.876	8.185	22.220
3	2.981	3.548	48.226	2.981	3.548	48.226	6.857	8.163	30.383
4	2.767	3.294	51.520	2.767	3.294	51.520	5.948	7.081	37.464
5	2.327	2.770	54.290	2.327	2.770	54.290	4.189	4.987	42.451
6	2.100	2.500	56.790	2.100	2.500	56.790	3.791	4.513	46.964
7	1.961	2.334	59.124	1.961	2.334	59.124	3.603	4.290	51.253
8	1.708	2.033	61.157	1.708	2.033	61.157	3.353	3.992	55.245
9	1.459	1.737	62.894	1.459	1.737	62.894	3.203	3.813	59.058
10	1.289	1.535	64.428	1.289	1.535	64.428	2.428	2.890	61.948
11	1.242	1.479	65.907	1.242	1.479	65.907	1.690	2.011	63.960
12	1.188	1.414	67.321	1.188	1.414	67.321	1.682	2.003	65.963
13	1.176	1.400	68.721	1.176	1.400	68.721	1.658	1.974	67.936
14	1.061	1.263	69.985	1.061	1.263	69.985	1.473	1.754	69.690
15	1.019	1.213	71.198	1.019	1.213	71.198	1.267	1.508	71.198
16	1.000	1.190	72.388						
17	.947	1.127	73.516						
18	.910	1.084	74.599						
19	.875	1.042	75.641						
20	.838	.997	76.639						
21	.797	.949	77.588						
22	.766	.912	78.500						
23	.741	.882	79.382						
24	.699	.832	80.214						
25	.670	.798	81.012						

Rotated Solution maximizes the load on one of the extracted variables of each variable while reducing the load on all other factors.

Total Variance Explained after Rotation:

We were expecting the variables to be independent, so we chose “Verimax” orthogonal rotation. The rotation has the effect of improving the factor structure, and the relative importance of these 15 factors has been equalized as a result of this approach.

V. FINDINGS AND OUTCOME

Principle component Analysis extracted 15 significant Factors, in factor 13 and 14 the total variance explained is very low, and the characteristics of the elements are aligned with factor no 12 so these factors clubbed with factor number 12.

Factor 01; has a total variance explained of 14.035 % and contributing maximum among all the factors.

This factor involves maximum variables contributing to overruns in railways project. The variables presented here in descending order of score are; Financial Default of Contractor/Subcontractor, Lack of technical professionals, Lack of coordination with subcontractors, Delay in mobilization, Poor planning, scheduling or resource management, Congested construction site, Lack of experience of similar projects, Shortage of manpower, Low productivity and Inadequate skills of workforce, Contractors cash flow, Irregular payments of sub-contractors, Construction Work Permits, Conflicts between contractor, consultant and owner, Improper construction methods implemented by contractor, Delays in sub-contractors work, Poor site management and supervision, Lack of Training personnel for model construction operation, Inaccurate tender cost estimating, Shortage of equipment, Low productivity and efficiency of equipment, Lack of high-technology mechanical equipment, Shortage of materials and delay in material procurement and delivery. All the variable explaining the factors closely associated with the risk related to Contractors performance in the construction project; hence the name of the factor can be considered as "Contractors risk".

Factor 02; has total variance explained of 8.185% and it indicates the second-highest value and further also the risk of project overruns in railways construction. The variables presented here in descending order of score are; Week design coordination and delay in communication, Slow response to Request For Information (RFI) or technical quarries, Delay in inspection, Level of involvement in quality control, Change in scope of work, Delay in approving major changes, Delay in claim approval, Deployment of technical staff on-site, Inadequate definition of substantial completion, Lack of systematic engineering method to identify the time. All the variable explaining the factors are closely associated with the risk related to PMC's performance in the construction project; hence the name of the factor can be considered as "Risk related to PMC".

Factor 03; has total variance explained of 8.163%, and it indicates the third-highest value and further, it is considered to be the third-highest risk factor causing the project overruns. The variables presented here in descending order of score are; Frequent interference, Unrealistic contract duration imposed by client, Financial difficulties & Irregular payments of work-done, Delay in Permissions, approvals & statutory clearances, Learning from best practice and experience of others, Delay in Decision making, Lack of capability of client representative, Suspension of work by owner, Breach or modifications of contract by owner, Delay in performing final inspection and certification. All the variable explaining the factors are closely associated with the risk related to Client's performance in the construction project; hence the name of the factor can be considered as "Risk related to Client".

Factor 04; has total variance explained of 7.081%, and it indicates the fourth-highest value, and further, it is considered to be the fourth-highest risk factor causing the project overruns. The factor has a weight of 5.776%. The variables presented here in descending order of score are; Mistakes and inadequate details, Delays in producing design documents, Complex project design, Incomplete investigation and survey and feasibility studies, Misunderstanding of Client's requirements, Unforeseen or Differing site conditions, Inadequate experience, Inaccurate project cost estimating, Inflation/price fluctuation, Incomplete contract details. All the variable explaining the factors are closely associated with the risk related to design consultant performance in the construction project; hence the name of the factor can be considered as "Risk related to Design".

Factor 05; has total variance explained of 4.99%, and it indicates the fifth-highest value, and further, it is considered to be the fifth-highest risk factor causing the project overruns. The variables presented here in descending order of score are; Pollution and Safety compliance, accidents and labour Injuries, damage to existing Structure(Utilities beneath ground), Theft of material and equipment's, Safety assessment system in organization, Project location is safe to reach. All the variable explaining the factors are closely associated with the risk related to safety & security in the construction project; hence the name of the factor can be considered as "Risk related to safety & security".

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Factor 06; has total variance explained of 4.51%, and it indicates the sixth-highest value, and further, it is considered to be the sixth-highest risk factor causing the project overruns The variables presented here in descending order of score are; High-interest rate, Cost of variation/Change orders, Change in currency price, Availability of Funds from lenders, Exchange Rate Fluctuation. All the variable explaining the factors are closely associated with the risk related to Finance in the construction project; hence the name of the factor can be considered as "Financial risk".

Factor 07; has total variance explained of 4.289%, and it indicates the seventh-highest value, and further, it is considered to be the seventh-highest risk factor causing the project overruns The variables presented here in descending order of score are; flood, earthquake, landslide and unexpected weather conditions. All the variable explaining the factors are closely associated with the risk related to nature; hence the name of the factor can be considered as Risk related to nature.

Factor 08; has total variance explained of 3.992%, and it indicates the eighth-highest value, and further, it is considered to be the eighth-highest risk factor causing the project overruns. The variables presented here in descending order of score are; Approvals and clearances, Land acquisition & site handover, Environmental & Tree Cutting, Changes in government regulations and laws and Rehabilitation & Resettlement of affected families. All the variable explaining the factors are closely associated with the government approvals and site clearances hence the name of the factor can be considered as Risk related to government approvals and site clearances.

Factor 09; has total variance explained of 3.813%, and it indicates the ninth-highest value, and further, it is considered to be the ninth-highest risk factor causing the project overruns. The variables presented here in descending order of score are; Site Supervision, Quality assurance & Control and Quality assessment system in organisation and Implementation of method statement. All the variable explaining the factors are closely associated with the government approvals and site clearances hence the name of the factor can be considered as "Risk related to Quality".

Factor 10; has total variance explained of 2.89%, and it indicates the tenth-highest value, and further, it is considered to be the tenth-highest risk factor causing the project overruns. The variables presented here in descending order of score are; Unavailability of incentive clause for early completion, Cash flow of project, Profit rate of project and cost of rework.

All the variable explaining the factors are closely associated with the contractor's cash flow hence the name of the factor can be considered as "Risk related to the contractor's cash flow".

Factor 11; has total variance explained of 2.89%, and it indicates the eleventh-highest value, and further, it is considered to be the eleventh -highest risk factor causing the project overruns. All the remaining factors and their variables presenting the similar characteristic as of factor eleventh so clubbed into one factor. The variables presented here in descending order of score are; Social and Cultural influences of workmanship, Issues in interstate or Central to state coordination, Strike, Traffic control and restriction at job site. All the variable explaining the factors are external in nature that means project team can not control it. hence the name of the factor can be considered as "fundamental risk".

Each factor is a linear combination of its components with component score as variance of each component within the factor and hence each factor is expressed in terms of all its components.

VI. CONCLUSION

To improve the performance of the railway construction project in India, the exposure of key risk factors project must be defined and understood. This work established the eleven (11) high-risk factors that explained the eighty-four (84) risk attributes causing overruns in railway development projects. The statistical tool Exploratory factor analysis (EFA) and further a part of it, Principle component analysis (PCA) was performed to understand the behaviours of the risk attributes. The questionnaire survey conducted on various management and engineering staff working for the project, this further provided the perception of stakeholders on various risk attributes. The coefficient value also reflects the suitability of factor analysis, as all values are less than 0.9. The value is 0.000822 and is higher than the 0.00001 necessary value. The Kaiser-Mayer-Olkin (KMO) value is 0.934 (superb) Bartlett's test with a significance value that 0.000 for the analysis which is lesser than 0.05. It gives confidence that the collected data would be reasonable and would produce good results making data suitable for factor analysis. Further, the Cronbach's Alpha value makes analysis more reliable with a value of 0.98. All the identified eleven factors are Contractors risk, PMC risk, Design risk, Safety & security-related risk, Financial risk, nature-related risk, Government approvals and site clearances risk, Quality related risk, contractor's cash flow related risk and fundamental risk. These factors can be useful in developing the model for risk management model.

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