

FACTORS AFFECTING THE SUCCESS/ FAILURE OF ROAD INFRASTRUCTURE PROJECTS UNDER PPP IN INDIA

Ramakrishna Nallathiga*¹

Haris D Shaikh ², Tauseef F Shaikh³ and Farhan A Sheik ⁴

Abstract: India has accorded a high priority to road infrastructure development through Public-Private Partnership (PPP) and it has set a high target for investment inflows. Yet, it is widely held that road/highway infrastructure has not been developing at required pace and that the road infrastructure projects under PPP have been suffering from several hurdles and delays, thereby affecting project success/ failure. This paper is an attempt to analyze the critical success/failure factors of road infrastructure projects under PPP in India. A questionnaire survey was conducted among a sample of the stakeholders of road infrastructure projects to identify the critical success/ failure factors during all four major project stages using different approaches. Initially, the critical factors were identified through ranking based on the average/mean score. Later, the conventional RII score was used to identify the critical success/failure factors. Finally, the critical success/failure factors were also identified based on the stakeholder-wise ranking of the factors and their convergence. The assessment revealed that there was a greater convergence across the different methods and also that there was greater consensus among project stakeholder on the critical success/ failure factors of road PPP projects..

Key Words: Road infrastructure, Highway development, PPP projects, Critical Success/Failure Factors and Project Stakeholders

I. INTRODUCTION

India has accorded a very high priority to infrastructure development in the last couple of decades. The Twelfth Five Year Plan of the Government of India had set an ambitious target of \$ 1 trillion investments to be brought into infrastructure sector (GoI 2012). The Government of India allowed liberal Foreign Direct Investment (FDI) in infrastructure development so that foreign capital investments will inflow to the country. Roads and highways sector, in particular, was given high priority by allowing FDI to the extent of 100 per cent. Public-Private Partnership (PPP) was launched as a major vehicle to develop infrastructure in various sectors, including the roads and highways sector. Roads and highways sector also got nod for an accelerated development through re-orienting the National Highways Authority of India (NHAI) as a nodal agency to oversee road/highway development in India by adopting various PPP models (Nallathiga and Shah 2013).

While the focus on infrastructure development is one of the main agenda of the Government, it has not been able to deliver it in a big way when compared to other Asian countries. Although the PPP models have been operational in India for quite some time, they have not been as successful as they were in other countries. For some time, the formation of roads and highways has only been waning as evident from a large number of road/ highway projects remaining under 'under development' or 'to be awarded' category (PPP India 2012). This also points to the

numerous risks faced by the PPP projects (Kalidindi and Thomas 2002) and the failure of some PPP projects due to various hurdles, which is also the experience elsewhere e.g., Akintoye et al (2001). In fact, the Government took a very long time to even acknowledge the problems faced by the PPP projects – first through a PPP policy in 2006 and then through a PPP institution in 2012.

Another major problem faced by the Government is that it has not been able to implement infrastructure development projects at the desired pace, which means a large number of pending projects. This is because, in the current Indian scenario, the regulatory bodies face an uphill task of clearing the projects. The Government is facing the task of clearing a backlog of 218 projects that have been delayed (DNA 2014). It is well known that project delays lead to cost escalation and it is estimated that project delays would have led to cost escalation to the tune of 77.3% in a study of 238 infrastructure projects (KPMG-PMI 2013). However, there are few well executed road and highway development projects e.g., Mumbai-Pune Expressway project, Jaipur-Kishangarh highway project, Yamuna expressway project, Vadodara-Ahmedabad expressway project and Noida Toll bridge project (Maniar 2010).

Most often, the relative success or failure of any project is linked to/ measured in terms of project deliverables in a contractual framework, which involves the cost, time and quality parameters (Atkinson 1999). Therefore, the success/failure of a project is linked to meeting or not these contractual parameters. At an aggregate level, project

¹ Associate Professor, National Institute of Construction Management and Research, Pune * Corresponding Author

^{2,3,4} PGP ACM Students, National Institute of Construction Management and Research, Pune

delays involving cost rise needs urgent remedial action, while also paying attention to the projects involving cost hike (but no delays) due to various reasons. Even the projects that are delayed but would not cost more also need attention to see that the delays are cut down so that the nation gets the output from these projects expeditiously. All this also gives an impression that road PPP projects are also risky and complex than originally thought of (Kalidindi and Singh 2009). It is also observed that the infrastructure development projects undertaken in India have grown in size and large infrastructure projects are being executed in various parts of the country, which gives rise to more project risks and complexities in Indian scenario (Hariharan and Sawant 2012).

Completing infrastructure development PPP projects on time and at given cost is an indicator of efficiency for the stakeholders, but the construction process is subject to many variables and unpredictable factors, which result from many sources. There are several factors that lead to success or failure of road infrastructure development projects in the country, which need to be understood. Given the importance of factors affecting success/failure of the PPP projects, this paper brings out the results from a study of the critical success/failure factors of road infrastructure PPP projects in India, so that it leads to a better PPP implementation framework for road infrastructure development. We will review the relevant literature of project success/failure factors first and then discuss the assessment framework used for the current study. Subsequently, the study methodology and results are discussed. In the concluding section, we present a summary of the findings and their implication to improving road infrastructure development under PPP in India.

II. LITERATURE REVIEW

In this section, we review existing literature on the factors affecting success/failure of infrastructure projects, which helped us to understand the various frameworks/approaches used and factors identified in such research studies.

Infrastructure development projects suffer from multiple risks that lead to the success/failure of projects. These risks include both contractual risks e.g., risks of completion, operation, market, finance, environment and technology, as well as non-contractual risks e.g., political risks, legal risks, economic risks, operation risks (Kalidindi and Thomas 2002). Therefore, the success/failure of infrastructure projects depends upon the assessment of these risks and risk sharing during the project bidding stage. Apart from macro- and meso-level factors that affect the infrastructure sector, micro-level or project level factors also affect the project outcomes. Several past studies have pointed to the importance of these critical factors to project managers in having some preparatory framework to address them

At a macro level, a study commissioned by the Planning Commission, as well as a McKinsey survey of construction companies, suggests that 70 to 90 per cent of road projects suffer from land acquisition delays. In fact, land acquisition is one of the major stumbling blocks of

road and highway development in India, as indicated by several authors e.g., Upadhyay and Sinha (2009), Singh (2011), Raghuram et al (2010) and Nallathiga and Shah (2013). The real problem, however, is also inadequate compensation to land owners for giving up land and also the lack of an appropriate framework for the valuation of assets (both individual as well as community property) in large infrastructure development projects (Nallathiga 2009).

In a comprehensive study, Zhang (2005) attempted to determine the critical success factors for PPP in infrastructure development. The author identified five major critical success factors – favorable investment environment, economic viability, reliable concessionaire consortium with technical strength, sound financial package and appropriate risk allocation (through reliable contractual arrangements). Within each of the factors, several sub-factors were also identified and a survey was conducted on all major and sub-factors covering both industrial and academic respondent groups. The major factors and sub-factors were listed out and ranked based on the significance index constructed in the study. The author also performs an agreement analysis of both respondent groups for ranking major success factors.

Ram Singh (2010) finds that delays are one of the major causes of infrastructure project cost overruns. Larger projects have experienced higher cost overruns when compared to smaller ones. Likewise, when compared to other sectors, projects in road, railways, urban-development sectors, as well as those in civil aviation, shipping and ports, and power sectors, have experienced longer delays. Analysis shows that, due to imperfect techniques and contractual incompleteness, some delays and cost overruns were inevitable. However, these delays were too frequent and too large to be accounted for by imperfect techniques, contractual incompleteness and inflationary fluctuations.

Venkatesh et al (2011) conducted a study on resource related delays in construction industry in India. A structured questionnaire survey was used to solicit responses on the causes of delays from various construction professionals working in various construction firms on a Likert scale. A statistical analysis of the responses was carried out and the influence of various critical factors was drawn. The critical factors were also identified on the basis of the Relative Importance Index (RII), which was used to rank them to reflect their significance.

Nallathiga et al (2012) conducted a study of the major determinants of real estate construction projects in India. A survey of real estate/ construction professionals (categorized into project client, project consultant and project contractor) was undertaken to obtain their responses on Likert scale. The major determinant factors were identified based on the correlation coefficients between the responses of the above three groups rather than ranking. They identify the major determinant factors of project success as: Client objectives, Core competency, Project team leadership and Managerial actions. They also identify sub-factors within each of the major factors.

Doloi (2013) makes a comprehensive assessment of road sector projects success/ failure by considering exhaustive list of factors and categorizes them under: (i) contract related (ii) project management team related (iii) quality related (iv) planning related (v) contractor related. It also classifies the existing literature on project success/failure into those related to (a) project planning and monitoring (b) design efficiency (c) effective site management (d) communication (e) contractor's efficiency (f) project clearances (g) due diligence (h) market competition.

Patil et al (2013) conducted a study to determine the causes of project delays and their importance according to project participants, i.e., project owner, consultant and contractor. Sixty four causes of delay were identified in the research. Project delays are common and notable - as 72% of the total infrastructure projects (reported by all the respondents) were delivered late, whereas only 28% were completed on time. Client respondents indicated that 59% of the public projects they were involved in were delivered late. Consultant respondents reported that 62% of the projects they were involved in were completed late. Contractor respondents also share similar view and articulated that 77% of the projects they are involved in exceeded the preset duration. The top five important causes of construction delays in transportation infrastructure projects are: Land Acquisition, Environmental Impact Assessment, Financial closure, Change orders by the client, Poor site management and supervision by contractor.

Rajan et al (2014) conducted a study of infrastructure project success/failure in terms of cost/time overruns, and assessed the importance of (a) technical parameters (d) economic parameters and (c) state specific factors in a diagnostic framework. They also conducted a survey of professionals using a Likert scale of significance. They finally list out the success/failure factors within each of the major parameters based on the ranking of parameters using the Relative Importance Index (RII).

Deeppa and Krishnamurthy (2014) make a study of the causal factors of project delays resulting in time and cost overruns in infrastructure projects in India. They conduct a survey of professionals to rank the importance of various factors on a Likert scale. They use the conventional analysis to identify significant factors through ranking based on the RII scores. Subsequently, they perform principal component analysis to group these factors under major factors of – contractor related factors, professional management related factors, material related factors, labour and equipment, government related factors, external factors, project related factors, owner related factors, contractual responsibilities, design and documentation.

Patel et al (2015) is another study that examined the factors affecting cost and time overruns in construction projects. They conduct a survey of construction professions using a Likert scale of importance on the factors identified by them. Later, they apply the conventional analysis of ranking based on the RII score to identify the major factors of project cost and time overruns. They group these factors into four major factors: Lack of

budgetary support, inaccurate estimation, non-availability of design and drawings, and frequent changes/deviations.

Nallathiga et al (2015) examined the important factors hindering the progress of infrastructure projects in India. They identify the major factors affecting project delays at all major project stages – planning, design, execution and monitoring – by conducting a survey of professionals in infrastructure sector to obtain their scores on Likert scale and rank these factors based on mean scores. The study brings out the major factors causing delays in infrastructure projects in India based on the RII scores of various stakeholder i.e., stakeholder convergence. Stakeholder-based assessment of critical factors was applied for the first time in India that renders the assessment innovative.

As evident, there has been a good amount of international and Indian literature that dealt with breadth and depth of the issues of project success/failure, and different studies have used different frameworks but most of them used the ranking analysis based on mean scores or the RII or its variants for identifying critical success/failure factors. Further, some research studies went beyond the project success/ failure to reach out different areas of construction/infrastructure sectors. Table I shows some application frameworks of such studies concerning.

TABLE I
Studies and Application areas of Literature on Project Success/Failure

Author/ Study	Application area
Chan and Kumaraswamy (1997)	Factors affecting project delays in Hongkong construction sector
Cooke-Davies (2002)	Real factors of project success in construction sector
Zhang (2005)	Critical success factors in infrastructure PPPs
Hardcastle et al (2006)	Critical success factors for PPP/PFI projects in UK
Ramsingh (2010)	Critical factors of delays in infrastructure projects
Venkatesh et al (2011)	Factors causing delays in construction sector projects
Pundhir et al (2011)	Critical success factors of construction projects
Hariharan and Sawant (2012)	Critical factors of time and cost overruns in infrastructure projects
Nallathiga et al (2012)	Determinants of project success in real estate projects
Doloi (2013)	Factors affecting project success/failure in construction projects
Oke and Ukaeke (2013)	Factors of team effectiveness/ineffectiveness in construction projects
Salanke and El-Gafy (2013)	Factors affecting energy savings in buildings
Rajan et al (2014)	Factors affecting overruns in road sector PPP projects
Deeppa and Krishnamurthy (2014)	Factors affecting time and cost overruns in infrastructure projects
Nallathiga et al (2015)	Factors affecting delays in infrastructure project delays
Kamal et al (2015)	Factors affecting human resources management (attrition risk) in construction sector
Patel et al (2015)	Factors affecting cost and time overruns in Construction projects
Farhan and Talware (2015)	Factors affecting dispute resolution in construction projects

III. SUCCESS/ FAILURE FACTORS IN ROAD INFRASTRUCTURE PPP PROJECTS

Road infrastructure projects, like other projects, have project life cycle, during which project activities suffer from unsuccessful/successful completion, delays and escalation, which are attributed to different factors operating at project level. Therefore, various factors have been considered in different stages of PPP projects in roads sector in India for further analysis of the project success/failure. The different project life cycle stages that are considered in our research study are:

- Planning stage
- Procurement stage
- Development stage
- Construction, operation and maintenance stage

While the literature survey helped us to understand various factors associated with project success/ failure, we shortlisted the factors that affect road PPP project success/failure over project life cycle after consultation with senior infrastructure project management professionals. While most of the conventional studies confine to ranking based on the mean scores, the current study uses both stakeholders' assessment as well as conventional RII score for identifying them. It, therefore, combines the studies using conventional approach e.g., Venkatesh et al (2011), and stakeholders approach e.g., (Doloi 2013) to present the study findings. The study framework and methodology are explained in the following sections.

Planning Stage

This is the first stage of road infrastructure PPP projects which includes the studies like the need of the project, feasibility studies and assessment of risks associated with the project. This is a formative stage that develops a plan to implement the PPP project. The various factors we considered in this stage are shown in table II.

TABLE II
Factors Affecting Project Preparation Stage

Factor	Description
Traffic assessment	Study of current traffic and projected traffic(Volume and pattern of traffic)
Market analysis	Potential available for project in the market
Changes/ amendments in tolling laws and policies	Rules and regulations pertaining to the project
Public protest and opposition	Support or reaction from people for the project

Procurement Stage

The major activity involved in this stage is bidding process and associated activities. The terms of contract and transparency of bidding process play a major role in the attractiveness of project. The factors that we considered for our research study are in shown in table III.

TABLE III
Factors Affecting Procurement Stage

Factor	Description
Bid criteria	Financial and technical capabilities of contractors
Bidding process (Awarding a project)	Fairness, transparency, duration for submitting bid etc.
Financial attraction of the project to investors	Perceived benefits for the stakeholders
Influence of higher authorities and political properties	Perceived influence by the higher authorities or political parties which may have direct impact on project
Incompleteness of concession/contract	Missing clauses in the contract like termination clause etc.

Development Stage

After the feasibility studies and the award of road project, the project gets grounded in this stage. The factors at this project stage which are considered for our research work are shown in table IV.

TABLE IV
Factors Affecting Development Stage

Factor	Description
Land acquisition	Easiness/Difficulties in Obtaining the land for the project.
Approval and clearances	Environmental, Forest clearances etc.
Well defined project scope	Need for alterations and deviations
Infusion of capital into the project	The amount of money that can be inputted into the project
Organization and coordination among stakeholders	Communication and relationship among each stake holder
Procurement of equipment, material and labor	Availability of resources
Force majeure	Unforeseen conditions
Interest and inflation rates	Prevailing market conditions or changes in government rules pertaining to interest / exchange rates

Construction, Operations and Maintenance Stage

This stage includes activities which are undertaken while and after construction work. This is the stage which consumes more resources and time. The factors which we considered at this stage in our research work are shown in table V.

TABLE V
Factors Affecting Construction, Operations and Maintenance Stage

Factor	Description
Availability of contractor's resources	Availability of 4Ms- Manpower, Machinery, Material and Money
Construction time delay	Delay in construction due to various reasons
Construction cost overruns	Cost overruns in construction due to problems like delay etc.
Maintenance cost overruns	Cost overruns due to tolling operations etc.
Levels of tariffs	Tariff differentiation depending upon type of vehicle and project
Delays in payment to contractors	Time lost in getting the money for the work done by the contractor.
Technical and financial closure	Completing all project related financial transactions, accounts and ensuring the requirements of the project.

IV. RESEARCH METHODOLOGY

We used the 'Primary Research Method' to understand the critical success/ failure of road development PPP projects, which involves questionnaire survey of target respondents. We had drawn a sample of respondents for conducting the survey. The respondents were grouped under the following 'stakeholder' categories, which we considered for the study:

- Government Firms
- Consultants
- Road Contractors
- Financing Institutions
- Users

A. Components of Questionnaire

Figure I shows the components of the survey questionnaire. We designed a survey questionnaire which consisted of two components covering the following aspects.

Component 1: It comprised questions on the profile of respondent. The three basic questions included were - the name of respondent, his/her organization and the designation of respondent. These questions helped us in deciding which of the stakeholder category the respondent belongs to. Also by knowing the designation the level of experience in the field could be judged.

Component 2: It consisted of the various factors which affect a road infrastructure PPP project. The factors were categorized in four stages project preparation stage, procurement stage, development stage and operation and maintenance stage.

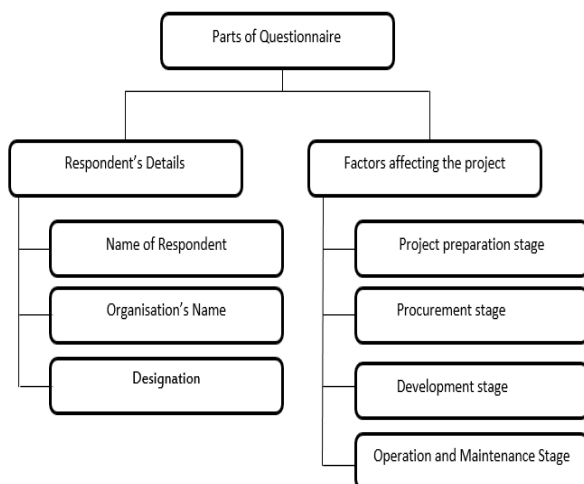


FIGURE I
Components of Questionnaire

B Questionnaire Survey

We designed a survey questionnaire and conducted the survey by sending it through e-mails to target respondents. It was followed up further by asking them to send us reply e-mail along with the filled-in questionnaire. The respondents were asked to rank the critical success/ failure

factors on a Likert Scale. We chose a 6 point scale that combines the 3 point scale each for success factors and failure factors (Likert scale normally has a 3 or 5 or 7 point scale). Table VI shows the description, metrics and scale used in the questionnaire given to respondents.

TABLE VI
Likert Scale and Details of Questionnaire

Order	Shown in Questionnaire	Description	Metrics Used in analysis
1		Severely Adverse	-3
2		Significantly Adverse	-2
3		Minimally Adverse	-1
4		Minimally Beneficial	1
5		Significantly Beneficial	2
6		Highly Beneficial	3

C. Description of Survey Respondents

According to the NSDC (2012), there are about 800,000 construction professionals working in various parts of India. If we divide the country into four zones, there are 200,000 professions in each zones and our survey confined to professionals in West Zone. If we adopt a margin of error of 5%, then for this population size, we need to draw a sample of 384 respondents. We adopted a higher margin of error (10%) and arrived at the sample size of about 200, assuming less than 50% response rate. However, as we were certain about higher responses, we had set an initial target of at least 100 responses from the various respondents of road development PPP projects. It was revised to 80 during the operational phase of the questionnaire survey due to time constraints. The total number of responses received was 55, of which 35 were valid responses that could be used in the study. The profile of stakeholders based on the respondents' reply to the questionnaire is shown in figure II.

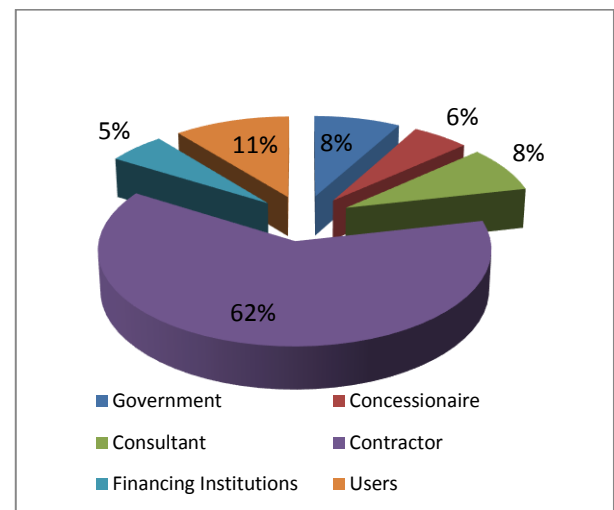


FIGURE II
Stakeholders' Profile of the Survey

Further, all the respondents were categorized into three levels viz junior level, middle level and senior level, based on the length of project work experience. Figure III shows

the profile of respondents in terms of length of experience in the road infrastructure PPP projects.

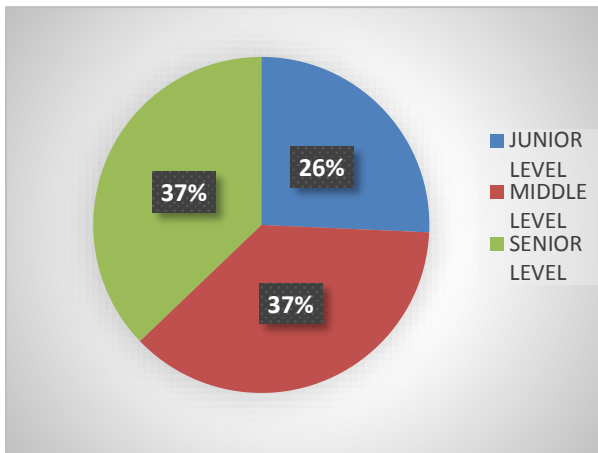


FIGURE III
Occupation Level of Respondents

IV. DATA ANALYSIS AND RESULTS

Based on the responses received in the questionnaire survey, we calculated the mean scores of the responses to various factors presented to them. The mean scores are used to rank the factors so as to assess the critical success/failure factors of road infrastructure PPP projects. Throughout the paper, we use the connotation of positive scores to imply success factors and negative scores to imply failure factors, as defined in Table VI. The following sub-sections perform analysis of the responses received through questionnaire survey and assess the critical factors in all four major project stages. Three methods are used for data analysis, which include:

- Ranking of Factors based on Mean Scores (Average Ranking)
- Ranking based on Relative Importance Index (RII)
- Ranking of Factors based on Stakeholders' preference

A. Average Ranking of Factors Causing Success/Failure in Various Project Stages

Planning Stage

We obtained the mean scores of responses received for each factor in this project stage and ranked them in an ascending order based on it. The results are shown in table VII.

TABLE VI
Ranking of factors in planning stage

Factors	Mean Score	Rank	Standard Deviation
Traffic Assessment	1.800	1	1.568
Market Analysis	1.771	2	1.165
Changes/amendments in tolling laws and policies	1.171	3	1.403
Public protest and opposition	-0.943	4	1.714

Source: Based on survey.

We can conclude that the factor most responsible for the success of PPP road projects in project preparation stage is 'traffic assessment'. We can also conclude that the factor most responsible for the failure of road PPP projects is 'Public protest and opposition'.

Procurement stage

We obtained the mean scores of responses received for each factor in this project stage and ranked them in an ascending order based on it. The result of analysis is shown in table VIII.

TABLE VIII: RANKING OF FACTORS IN PROCUREMENT STAGE

Factors	Mean Score	Rank	Standard Deviation
Bid Criteria	1.600	1	1.701
Bidding process(Awarding a project)	0.629	2	1.848
Financial attraction of the project to investors	1.600	1	1.418
Influence of higher authorities and political parties	-0.371	4	1.767
Incompleteness of concessions/Contract.	-0.200	3	1.712

Source: Based on survey

We can conclude that the most responsible factor for the success of a PPP road projects in procurement stage is 'Bid criteria' / 'Financial attraction of the project to investors'. We can also conclude that the most responsible factor for the failure of PPP projects is 'Influence of higher authorities and political parties'.

Development stage

We obtained the mean scores of responses received for each factor in this project stage and ranked them in an ascending order based on it. The result of analysis is shown in table IX.

TABLE IX: RANKING OF FACTORS IN DEVELOPMENT STAGE

Factors	Mean Score	Rank	Standard Deviation
Land Acquisition	0.543	4	2.133
Approvals and clearances	0.371	5	1.942
Well defined project scope	0.257	6	1.755
Infusion of capital into the project	1.343	1	1.413
Organization and co-ordination amongst the stakeholders	1.114	2	1.605
Procurement of Equipment, material and labors.	0.914	3	1.976
Force Majeure	-0.886	8	1.967
Interest and inflation rates	-0.400	7	1.866

Source: Based on survey.

We can conclude that the most responsible factor for the success of road PPP projects in development stage is 'Infusion of capital into the project'. We also conclude the most responsible factor for the failure of road PPP projects is 'Force majeure'.

Construction, operation and maintenance stage

We obtained the mean scores of responses received for each factor in this project stage and ranked them in an ascending order based on it. The result of analysis is shown in table X.

TABLE X
Ranking of factors in construction, operation & maintenance stage

Factors	Mean Score	Rank	Standard Deviation
Availability of Contractor resources	1.143	1	1.734
Dispute resolution	0.629	2	1.942
Construction time delay	-0.400	6	1.786
Construction cost over-runs	-0.257	5	1.729
Maintenance cost over-runs	-0.629	8	1.682
Levels of tariffs	-0.057	4	2.014
Delay in payments to contractors	-0.429	7	1.703
Technical and financial closures	0.571	3	1.929

Source: Based on survey

We can conclude that the factor that is most responsible for the success of PPP road projects in construction, operation and maintenance stage is 'Availability of resources- contractors'. We can also conclude that the factor that is most responsible for the failure of the PPP road projects is 'Maintenance cost over-runs'.

B Ranking based on the Relative Importance Index (RII)

An importance/ significance index based the ranking is normally used in various studies to identify critical factors e.g., Doloi (2013). Such index can be constructed for each factor (in corresponding project stage) by accounting for the number of responses received by each Likert score i.e., it uses the responses received by each Likert score as a weightage. Herein also, to determine the relative ranking of factors, the Relative Importance Index (RII) was computed for each factors in each project stage using the following formula:

$$\text{Relative Importance Index (RII)} = \sum_i S_i \times N_i / (A \times N)$$

Where S_i is the scores on the Likert scale used (here, it ranges from -3 to +3), N_i is the number of responses to the Likert scale score, A is the highest score (here +3) and N is the total number of respondents (here, 35). Essentially, the RII uses the weightage of responses to each score and normalizes it using the highest possible score that can be assigned by all the respondents. RII can be computed for each factor using the above equation at the various stages of road PPP projects, which is shown in the sub-sections below alongwith an analysis of it.

Planning Stage

The RII scores are computed for all factors in the project preparation stage, which are shown in table XI.

We can conclude that the earlier observation we had obtained by calculating mean scores of the critical factors of projects holds true as they are supported by the ranking of factors using RII values.

TABLE XI
RANKING OF FACTORS BASED ON RII IN PLANNING STAGE

Factors	-3	-2	-1	1	2	3	RII	Rank
Traffic Assessment	0	4	0	6	10	15	0.600	1
Market Analysis	0	1	2	6	18	8	0.590	2
Changes/amendments in tolling laws and policies	1	2	2	13	14	3	0.390	3
Public protest and opposition	8	5	13	5	3	1	-0.314	4

Source: Based on survey.

Procurement Stage

The RII scores are computed for all factors in the project procurement stage, which are shown in table XII.

TABLE XII: RANKING OF FACTORS BASED ON RII FOR PROCUREMENT STAGE

Factors	-3	-2	-1	1	2	3	RII	Rank
Bid Criteria	2	1	2	7	10	13	0.533	1
Bidding process(Awarding a project)	4	2	4	11	11	3	0.210	2
Financial attraction of the project to investors	1	2	0	9	15	8	0.533	1
Influence of higher authorities and political parties.	1	8	16	2	4	4	-0.124	4
Incompleteness of concessions/Contract.	1	9	10	8	5	2	-0.067	3

Source: Based on survey.

We can conclude that the earlier observation we had obtained by calculating mean scores of the critical factors of projects holds true as they are supported by the ranking of factors using RII values.

Development Stage

The RII scores are computed for all factors in the project development stage, which are shown in table XIII.

TABLE XIII
RANKING OF FACTORS BASED ON RII FOR DEVELOPMENT STAGE

Factors	-3	-2	-1	1	2	3	RII	Rank
Land Acquisition	3	5	7	3	9	8	0.181	4
Approvals and clearances	2	5	9	5	9	5	0.124	5
Well defined project scope	0	8	8	8	8	3	0.086	6
Infusion of capital into the project	0	2	4	9	14	6	0.448	1
Organization and co-ordination amongst the stakeholders	0	3	6	7	13	6	0.371	2
Procurement of Equipment, material and labors.	3	3	4	7	10	8	0.305	3
Force Majeure	7	10	9	3	2	4	0.295	8
Interest and inflation rates	2	12	8	4	7	2	0.133	7

Source: Based on survey.

We can conclude that the earlier observation we had obtained by calculating mean scores of the critical factors

of projects holds true as they are supported by the ranking of factors using RII values.

Construction, Operation and Maintenance Stage

The RII scores are computed for all factors in the project construction, operation and maintenance stage, which are shown in table XIV.

TABLE XIV
RANKING OF FACTORS BASED ON RII FOR CONSTRUCTION, OPERATION AND MAINTENANCE STAGE

Factors	-3	-2	-1	1	2	3	RII	Rank
Availability of Contractor resources	2	3	2	7	16	5	0.381	1
Dispute resolution	2	6	4	7	11	5	0.210	2
Construction time delay	2	9	12	5	4	3	0.133	6
Construction cost over-runs	1	6	16	4	3	4	0.086	5
Maintenance cost over-runs	2	13	8	7	4	1	0.210	8
Levels of tariffs	5	7	4	10	6	3	0.019	4
Delay in payments to contractors	3	6	14	6	4	2	0.143	7
Technical and financial closures	1	7	5	9	6	7	0.190	3

Source: Based on survey.

We can conclude that the earlier observation we had obtained by calculating mean scores of the critical factors of projects holds true as they are supported by the ranking of factors using RII values.

C Stakeholders' Ranking of Success/Failure Factors in Various Project Stages

In this analysis, the respondents were classified into different stakeholders as discussed earlier (Section 4). This provides us the knowledge as how each of the stakeholders perceived in the survey. The usefulness of this approach is also discussed in Nallathiga et al (2015). The analysis and their interpretation in various stages are discussed below.

Planning Stage

The responses to the questionnaire were classified on different project stakeholders. The mean score of the responses for project preparation stage was worked out and ranking analysis was done, which is summarized in table XV.

TABLE XV
STAKEHOLDERS' RANKING IN PLANNING STAGE

Factors	Government Firms	Concessionaire	Consultant	Contractor	Financial Institution	Users
Traffic	2	1	3	1	1	1

Assessment						
Market Analysis	1	3	1	2	2	2
Changes/amen- dments in tolling laws and policies	3	2	2	3	3	3
Public protest and opposition	4	4	4	4	4	4

Source: Based on survey.

Based on the mean scores of responses for each stakeholder, we conclude the following:

- ❖ According to the Government firms, the most responsible factor for project success is 'Market analysis' and the most responsible factor for project failure is 'Public protest and opposition'.
- ❖ According to the Concessionaires, the most responsible factor for project success is 'Traffic Assessment', and the most responsible factor for project failure is 'Public protest and opposition' or 'Market analysis'.
- ❖ According to the Consultants, the most responsible factor for project success is 'Market analysis' and the most responsible factor for the project failure is 'Public protest and opposition'.
- ❖ According to the Contractors, the most responsible factor for project success is 'Traffic assessment' and the most responsible factor for project failure is 'Public protest and opposition'.
- ❖ According to the Financial institutions, the most responsible factor for project success is 'Traffic assessment' and the most responsible factor for project failure is 'Public protest and opposition'.
- ❖ According to the Users, the most responsible factor for project success is 'Traffic assessment' and the most responsible factor for project failure is 'Public protest and opposition'.

Procurement Stage

The responses to questionnaire survey were classified based on the project stakeholder category. The mean scores were obtained for each stakeholder in project procurement stage and ranking was done based on it, which is summarized in table XVI.

TABLE XVI: STAKEHOLDERS' RANKING IN PROCUREMENT STAGE

Factors	Government Firms	Concessionaire	Consultant	Contractor	Financial Institution	Users
Bid Criteria	1	2	1	1	1	3
Bidding process (Awarding a project)	4	4	3	3	3	2
Financial attraction of the project to investors	1	1	2	2	2	1
Influence of higher authorities	2	1	4	5	4	5

and political parties.						
Incompleteness of concessions/ Contract.	3	3	5	4	4	4

Source: Based on survey

Based on the mean scores of responses for each stakeholder, we conclude the following:

- ❖ According to the Government firms, the most responsible factor for project success is 'Bid criteria'/'Financial attraction of the project to investor' and the most responsible factor for project failure is 'Bidding process'.
- ❖ According to the Concessionaires, the most responsible factor for project success is 'Financial attraction of the project to investor'/'Influence of higher authorities and political parties', and the most responsible factor for project failure is 'Bidding process'.
- ❖ According to the Consultant, the factor which is responsible for the success of a project bid criteria and the factor which is responsible for the failure of the project is incompleteness of concession/contract.
- ❖ According to the Contractors, the most responsible factor for project success is 'Bid criteria', and the most responsible factor for project failure is 'Influence of higher authorities and political parties'.
- ❖ According to the Financial institutions, the most responsible factor for project success is 'Bid criteria', and the most responsible factor for project failure is 'Incompleteness of concession/contract' / 'Influence of higher authorities and political parties'.
- ❖ According to the Users, the most responsible factor for project success is 'Financial attraction of project to the investor', and the most responsible factor for project failure is 'Influence of higher authorities and political parties'.

Development Stage

The responses to questionnaire survey were classified based on the project stakeholder category. The mean scores were obtained for each stakeholder in project development stage and ranking was done based on it, which is summarized in table XVII

TABLE XVII
STAKEHOLDERS' RANKING IN DEVELOPMENT STAGE

Factors	Government Firms	Concessionaire	Consultant	Contractor	Financial Institution	Users
Land Acquisition	2	1	2	5	2	3
Approvals and clearances	2	1	3	7	2	4

Well defined project scope	2	5	4	4	3	5
Infusion of capital into the project	1	4	1	1	3	1
Organization and co-ordination amongst the stakeholders	3	2	2	2	1	2
Procurement of Equipment, material and labors.	4	3	4	3	2	2
Force Majeure	6	6	5	8	4	6
Interest and inflation rates	5	5	5	6	5	7

Source: Based on survey.

Based on the mean scores of responses for each stakeholder, we conclude the following:

- ❖ According to the Government firms, the most responsible factor for project success is 'Infusion of capital into the project', and the most responsible factor for project failure is 'Force Majeure'.
- ❖ According to the Concessionaires, the most responsible factor for the success of a project is 'Land acquisition' / 'Approvals and clearances', and the most responsible factor for project failure is 'Force Majeure'.
- ❖ According to the Consultants, the most responsible factor for project success is 'Infusion of capital into project', and the most responsible factor for project failure is 'Force Majeure'/'Interest and inflation rate'.
- ❖ According to the Contractors, the most responsible factor for project success is 'Infusion of capital into project', and the most responsible factor for project failure is 'Force Majeure'.
- ❖ According to the Financial institutions, the most responsible factor for project success is 'Organisation and coordination among stakeholders', and the most responsible factor for project failure is 'Interest and inflation rate'.
- ❖ According to the Users, the most responsible factor for project success is 'Infusion of capital into project', and the most responsible factor for project failure is 'Interest and inflation rate'.

Construction, operation and maintenance stage

The responses to the questionnaire survey were classified based on the project stakeholder category. The mean scores were obtained for each stakeholder in project construction, operation and maintenance stage and ranking was done based on it, which is summarized in table XVIII.

TABLE XVIII
STAKEHOLDERS' RANKING IN CONSTRUCTION, OPERATION AND MAINTENANCE STAGE

Factors	Government Firms	Concessionaire	Consultant	Contractor	Financial Institution	Users
Availability of Contractor resources	1	2	1	1	2	2
Dispute resolution	3	2	2	2	1	4
Construction time delay	4	4	3	6	4	6
Construction cost over-runs	5	3	3	4	4	6
Maintenance cost over-runs	4	4	6	8	5	7
Levels of tariffs	2	2	4	5	3	3
Delay in payments to contractors	6	5	5	7	4	5
Technical and financial closures	1	1	2	3	1	1

Source: Based on survey

Based on the mean scores of responses for each stakeholder, we conclude the following:

- ❖ According to the Government firms, the most responsible factor for project success is 'Availability of resources-Contractor' / 'Technical and financial closures', and the most responsible factor for project failure is 'Delay in payments to contractors'.
- ❖ According to the Concessionaires, the most responsible factor for project success is 'Availability of resource-Contractors', and the most responsible factor for project failure is 'Delay in payment to contractors'.
- ❖ According to the Consultants, the most responsible factor for project success is 'Availability of resources-Contractor', and the most responsible factor for project failure is 'Maintenance cost over-runs'.
- ❖ According to the Contractors, the most responsible factor for project success is 'Availability of resources-Contractor', and the most responsible factor for project failure is 'Maintenance cost over-runs'.
- ❖ According to the Financial institutions, the most responsible factor for project success is 'Dispute resolution' / 'Technical and financial closures', and

the most responsible factor for project failure is 'Maintenance cost over-runs'.

- ❖ According to the Users, the most responsible factor for project success is 'Technical and financial closure', and the most responsible factor for project failure is 'Maintenance cost over-runs'.

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusions from Analysis

Every stage in the road PPP project has unique requirement which has to be satisfied to make the PPP project a successful one. The PPP project can fail due to the failure in one or more stages in the project cycle. We found the critical success/failure factors at different project stages, which will help in giving a fair idea about the major project risks involved in road PPP projects and thereby help project managers in taking appropriate steps to handle them at various project stages. We now summarize the conclusions from ranking analysis performed earlier in this section.

Critical Success Factors from Ranking Analysis

Table XIX shows the success factors of various stages based on three different criteria applied in the analysis - Mean Scores, RII Score and Stakeholders' consensus.

TABLE XIX
SUCCESS FACTORS OF ROAD DEVELOPMENT PROJECTS

ANALYSIS USED	Ranking Based on Mean Score	Ranking Based on RII	Ranking Based on Stakeholders' Consensus
PROJECT STAGE			
Project Preparation Stage	Traffic Assessment	Traffic Assessment	Traffic Assessment
Procurement Stage	Bid Criteria Financial Attraction of Project to Investors	Bid Criteria Financial Attraction of Project to Investors	Bid Criteria
Development Stage	Infusion of Capital into Project	Infusion of Capital into Project	Infusion of Capital into Project
Construction, Operation and Management	Availability of Contractor's Resources	Availability of Contractor's Resources	Technical & Financial Closure

Source: Based on survey

According to the above results, it can be clearly understood that the most responsible factor for project success of road PPP projects in project preparation stage is **Traffic assessment**, as it is the common factor in all three analyses.

According to the above results, it can be understood that the most responsible factor for project success of road PPP projects in procurement stage is **Bid criteria**, which is the common factor in all three analyses.

According to the above results, it can be clearly understood that the most responsible factor for project success of road PPP projects in development stage is



Infusion of capital into project, which is the common factor in all three analyses.

According to the above results, it can be understood that the most responsible factor for project success of road PPP projects in construction, operation and maintenance stage is the **Availability of contractor's resources**, which is the common result obtained in two of the three analyses.

Critical Failure Factors from Ranking Analysis

Table XX shows the failure factors of various stages based on three different criteria: Mean Score, RII Score and Stakeholders' consensus.

TABLE XX: FAILURE FACTORS OF ROAD DEVELOPMENT PROJECTS

ANALYSIS USED 	Ranking Based on Mean	Ranking Based on RII	Ranking Based on Stakeholders' Consensus
PROJECT STAGE 			
Project Preparation Stage	Public Protest & Opposition	Public Protest & Opposition	Public Protest & Opposition
Procurement Stage	Influence of Higher Authorities & Political Parties	Influence of Higher Authorities & Political Parties	Incompleteness of Concession/ Contract
Development Stage	Force Majeure	Force Majeure	Force Majeure
Construction, Operation and Management	Maintenance Cost Overruns	Maintenance Cost Overruns	Maintenance Cost Overruns

Source: Based on survey

According to the above results, it can be clearly understood that the most responsible factor for project failure of road PPP projects in project preparation stage is **Public protest & opposition**, which is the common factor in all three analyses.

According to the above results, it can be clearly understood that the most responsible factor for the failure of road PPP projects in procurement stage is the **Influence of higher authorities & political parties**, which is the common factor in two of the three analyses.

According to the above results, it can be clearly understood that the most responsible factor for the failure of road PPP projects in development stage is **Force majeure**, which is the common factor in all three analyses.

According to the above results, it can be clearly understood that the most responsible factor for the failure of road PPP projects in construction, operation and maintenance stage is **Maintenance cost overruns**, which is the common factor in all three analyses.

B Some Suggestions

This study focused on the critical success/failure factors of the road infrastructure PPP projects using ranking analysis by adopting different approaches to it i.e., mean score, RII and stakeholder convergence. The results can become more robust when a larger sample size is chosen. Due to time and resource constraints and also lower

responses, we got a lesser sample than the target. Further, our sample survey confined of the respondents who are associated with the projects in the Western region of India. While the Western region has a large number of infrastructure PPP projects in India, the results are sensitive to regional concentration of projects i.e., they may vary if one extends the survey to other regions of the country.

We also bring out some suggestions for dealing with each critical factor to make road PPP projects more successful. Table XXI shows the critical factors and the corresponding suggestions.

TABLE XXI: CRITICAL FACTORS AND SUGGESTIONS

CRITICAL FACTORS	SUGGESTION
Traffic assessment	Robust traffic assessment has to be done. Potential for alternate route has to be studied clearly.
Bid criteria	The criteria should be realistic to ground level and needs to create more competitive conditions i.e., more contractors to be eligible to bid
Infusion of capital into the project	Besides incentives for capital inflow, the Government has to give incentives like performance bonus for early completion to make the projects attractive to investors.
Availability of resources- contractors	During bidding process itself the contractors with high resource capability need to be given higher scores or it has to be made a part of pre-qualification criteria
Public protest and opposition	PPP development framework should be socially as well as environmentally responsive.
Influence of higher authorities and political parties	Bidding process has to be made transparent and bidding criteria has to be adhered to
Force majeure	Government support needs to be provided to the developers in case of any force majeure situation
Maintenance cost overruns	Innovative tools like automatic tolling system etc to be deployed to reduce the maintenance cost.

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