

Risk in Highway Project Based on Operation and Maintenance : Case Study of Mumbai- Pune Expressway

Deepak Gatare¹, Abdul Attar²

P.G. Student, Department of Civil Engineering, Rajarambapu Institute of Technology, Rajaram Nager Islampur,
Maharashtra, India¹

Associate Professor, Department of Civil Engineering, Rajarambapu Institute of Technology, Rajaram Nager Islampur,
Maharashtra, India²

ABSTRACT: India is one of the fastest developing countries in the world and for any developing country transportation plays an important role in its economic growth. The roads/highways/expressways are main infrastructure of any country. These are made by government fund or through public private partnership. Once the construction of these projects is done they have to operate and maintain properly. While operation and maintenance of these projects there many types of risks are involved. In this particular study, we have to identify these risks and manage it with proper planning and allocation of it.

KEYWORDS: highways; risk identification; allocation; analysis

I. INTRODUCTION

India is a developing country and most developments are going on in construction industry, mostly in infrastructure projects. Due to lack of funds so most of projects now days completed on the basis of public-private partnership. The infrastructure projects such as highways, railways, power plants and bridges etc. are constructed by PPP.

The PPP means the long term contractually regulated co-operation between the public and private sector for efficient fulfillment of public task in combining the necessary resources of the partner and distributing existing project risk appropriately according to risk management competence of the project partner.

So, government has been promoting investment of private sector to development and delivery of large infrastructure project. There are many models are present in PPP. There is no standard method available to implement the PPP model. It depends upon parties which evolved have common understanding of PPP structure and appreciation of key issues and risk from both the parties. The strategies in the selecting funding agencies are play important role for completion of these projects by PPP. The strategy used for funding the activities involved in the phases of project implementation cycle and risk profile over these phases.

There are many risks arise from starting phase of project such as construction design, economic, legal operation, political, finance and regulatory framework of various authority. These risks affect the project directly or indirectly on the cost and duration of project. It is important to both the sectors (public and private) to find the risks in various phase of project and establish effective allocation strategies for PPP project to achieve cost effective and completion of project within the time limit.

The concept of risk allocation in PPP is relatively straight as risk should be allocated to party which best able to manage this will reduce value for money in the project.

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Types of PPP Models.

Traditionally in India, the road projects were fully financed, controlled and supervised by the government. The implementation of road projects was purely dependent on the availability of funds, their allocation and release out of the budget of the government. As the development construction and maintenance of roads involves huge costs, the government has not been in a position to allocate the required funds to the road sector. This is particularly because the government has to cater for the development of various other sectors and also for the social cause including care and education.

Because of the commercialization of infrastructure project has become the need of the day. Besides reducing the burden on the budgetary allocation of the government, commercialization also helps in increasing the efficiency of the resources deployed in the project through enforcement of better management techniques under the 'Public Private Partnership' (PPP) schemes.

I. Design-Build-Maintain (DBM)

DBM is similar to Design-Build, except that the private sector also maintenance the facility. The public sector retains responsibility for operations

II. Design-Build-Operate (DBO)

With DBO model, the private sector designs and builds the facility. Once it is completed, the title for the new facility is transferred to the public sector, but the private sector operates the facility for a specified period. This procurement model is also referred to as Build-Transfer-Operate (BTO).

III. Design-Build-Operate- Maintain (DBOM)

DBOM model combines the responsibilities of design-build procurements with the operations and maintenance of a facility for a specified period by a private sector partner. At the end of that period, the operation of the facility is transferred back to the public sector. This method of procurement is also referred to as Build-Operate-Transfer (BOT)

IV. Build Operate Transfer (BOT)

PSO enters concession contract to design, build, finance, and operate a public- sector facility over an agreed period. PVSOC recovers investment over the contract period under the pre -negotiated contract terms. The concession period is usually significantly shorter than the operating life of the facility.

V. Build-Own-Operate- Transfer (BOOT)

The government grants a franchise to a private partner to finance, design, build and operate a facility over a specific period of time. Ownership of the facility is transferred back to the public sector at the end of that period.

VI. Build-Own-Operate (BOO)

The government grants the right to finance, design, build, operate and maintain a project to a private entity, which then retains ownership of the project. The private entity is not required to transfer the facility back to the government

VII. Buy-Build-Operate (BBO)

Transfer of a public asset to a private or quasi-public entity usually under contract that the assets are to be upgraded and operated for a specified period of time. Public control is exercised through the contract at the time of transfer.

VIII. Operate and Maintain (O&M)

Private sector organization (PSO) enters contract to operate a public-sector facility on behalf of a public- sector organization over an agreed period of time.

IX. Hybrid Annuity Model (HAM)

The government has decided to introduce Hybrid Annuity Model (HAM) to revive PPP (Public Private Partnership) in highway construction. By features the HAM is a mix between the existing two models – BOT Annuity and EPC. In financial terminology hybrid annuity means that payment is made in a fixed amount for a considerable period and then in a variable amount in the remaining period. This hybrid type of payment method is attached under the HAM.

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II. INTRODUCTION OF EXPRESSWAY.

Section	Technical Consultants	Est. Cost in crores	Contractor
Section 'A' (Kon to Chowk) 13.232 km.	Stup Consultants with Hyder Consulting Ltd. U.K.	127.33	IJM / SCL Joint Venture
Section 'B' (Chowk to Aadoshi) 16.629 km.	Intercontinental Consultants & Technocrats Pvt. Ltd. India	183.73	Hindustan Construction Co. Mumbai
Section 'C' (Kusgaon to Ozarde) 22.995 km.	FrishmannPrabhu (India) Pvt. Ltd.	177.46	Larsen and Toubro Ltd. Mumbai
Section 'D' (Ozarde to Dehu Road) 6.150 km.	Sir Owen Williams Innovestment	132.70	V.M. Jog Engineering Ltd. Pune
Ghat Section Package - I Aadoshi to long tunnel 7.13 km.	Consulting Engg. Service (India) Ltd.	86.46	ShapoorjiPallonj& Co. Mumbai.
Ghat Section Package - II Long tunnel to Lonavala bypass 8.28 km.	Consulting Engg. Service (India) Ltd.	108.96	Larson & Toubro Ltd. Chennai
Panvel Bypass Package - I 0/0 to 8/200, 8.20 km.	Technogem Consultants Thane	108.00	PBA - PCEC (JV) M. Venkat Rao Visakhapatnam
Panvel Bypass Package - II 8/200 to 9/750, 1.550 km.	Technogem Consultants Thane	64.50	PBA - PCEC (JV) M. Venkat Rao Visakhapatnam
Tunnel Work 5 Twin Tunnel 5724 m. Tunnel Length		200.00	Konkan Railway Corp. Ltd.
Other Exp. Toll plaza, Building, fencing sign boards, Technical consultant's fees, etc.			Konkan Railway Corp. Ltd.
	Total	1200.46	

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III. LITERATURE REVIEW

Kalidindi S et al,(2009) [1]

The Author state that, National highways play a key role in the economic growth of the country. The Union Government of India has taken various measures to upgrade the capacity and quality of the National Highways network. PPP routes have been adopted by the government to meet the funding gap and use techno-managerial efficiencies of the private sector to obviate the inefficiencies in the traditional public procurement system.

Suresh M, et al, (2013) [2]

PPP has several advantages such as huge investment in public infrastructure, efficient delivery of services, cost effectiveness, performance based contracts, risks sharing, optimum use assets and long term investment opportunities. Though India follows the mixed economic approach which relies on public private involvement in economic activities. Public private partnership is delivering infrastructure services is now decade old, with majority of project coming in lie within last 5 years. In the context of new economic reforms and globalization, the scope for PPP's is vast and wide and likely to take lead in future. Union Finance Minister Hon PRANAB MUKHERJEE has rightly said that "with effectiveness use of PPP we can achieve the desired level of growth." Taking the lead from the above statement, it can be concluded that the need of India is not a PPP but effective PPP.

GeethanjaliNataraj, et al,(2014) [3]

The public sector is expected to continue to play an important role in building transport infrastructure. However, the resources needed are much larger than the public sector can provide and public investment will therefore have to be supplemented by private sector investment PPP. This strategy was followed in the eleventh plan and it has begun to show results. PPP's are still a relatively new phenomenon in India and in a nascent stage compared to the experienced of a number of other countries' have compensated for the budgetary and borrowing constraints of the governments. They also imply efficient use of resources, availability of modern technology and better project design. They have also led to faster implementation, reduced life cycle cost and more optimal risk allocation. The private sector has responded to Governments attempts to encourage private sector led growth and investment for meeting infrastructure deficit. Projects in the road sector now attracts for more bidder than they did 5 year ago,

Shri. Manmohan Sighn, et al, (2014) [4]

(Source – PM inaugurate address at the conferences on PPP in national highway)

Public Private Partnership projects takes much less time to complete and the government does not have to bear cost overruns. This will not only enable us to leverage our limited public resources but also improve efficient of service delivery.

Das T, et al,(2014) [5]

PPP is an agreement between the government and the private sector for the purpose of provisioning of public services or infrastructure with a common vision, the enterprise of both the sector is blended in a platform for accomplishment of mutual benefits. It is one of the alternatives in the hands of Govt to attract the investment when it cannot alone bear the burden infrastructure development. An attempt has been made in the study to examine its execution at different project level in real life situation in Indian context. Many states in India have resorted to PPPs for financing infrastructure and other public utility services. Projects in physical infrastructure sectors covered under this model include: airports, education, healthcare, ports, power, railways, road, tourism, urban development, culvert and bridges, telecommunication. An attempt has also been made to focus on the constraints that are revealed in course of our study over the implementation of PPP projects.

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IV. METHODOLOGY

For data collection questionnaires was prepared on the basis of objectives of the project. Then for questionnaires survey and data collection of site is studied, Ideal Road Builders Pvt. Ltd. is take care of operation and maintenance for “Yashvantroachavan expressway”.

Regulatory Environment in Indian Infrastructure Sectors

Sector Relevant	Statues	Regulatory Authority
Roads	National Highway Authority Act 1998 Central Road Fund Act 2000 The Control of National Highways Act 2002 MORTH (Ministry of Road Transport and Highways) Land acquisition act, 1894/ land acquisition bill,2007	No regulatory authority. NHAI works as regulator and operator. States have floated their own corporate. Investors have no recourse to an independent regulator

V. RISK IDENTIFICATION

Better operation and maintenance of highway provides varied benefits to the society. Improvement in highway result in several benefits to the road users such as,

- 1) Reduction in vehicle operational cost per unit length of road.
- 2) Saving in travel time and resultant benefits in terms of time fuel cost of vehicle and the Passengers
- 3) Reduction in accident rates.
- 4) Improved level of service and ease of driving So, it is very important that highways should effectively operate and maintained but there lots of risks involved in this operation and maintenance.

The risk identification process can involve, wherever appropriate, participants such as project manager, project team members, risk management team, subject matter experts from outside the project team, customers. The project team should be involved in the identification process so that they can develop and maintain a sense of ownership of the risks and associated risk mitigation actions.

Suitable starting point for identification of risk is to use the checklist of risks that typically applies to infrastructure projects. The checklists can be developed based on the historical information and knowledge accumulated from previous similar projects. For instance, the risk breakdown structure of the previous project can provide useful information for risk identification. A risk breakdown structure is a hierarchy of risks of a project arrange under various risk categories. The lowest level of risk breakdown structure can be used as risk checklist.

The review of project documentation such as plans, project files, and other documentary in a structured manner will also help in identifying the risks in the project. Some of the information gathering techniques used in identification of risks include: brainstorming, Delphi technique, interviews, SWOT, and diagramming techniques.

For this research, interviewing technique is used for risk identification. Prior set of questions were prepared and interviews of project team member were taken. Respondents participated in the interview were 18 which includes project managers, senior engineers, junior engineers, supervisors, surveyors and departmental officials.

Respondents' analysis according to years of experience:
Total Respondents = 18

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No.	Years of experience	No	%
1	0-5	8	44.44
2	5-10	6	33.33
3	10 above	4	22.22

i) Questionnaire Survey

1. What are the risk Occurred during operation of expressway?
2. What are the risk Occurred during maintenance of expressway?
3. Which party is best able to conduct a feasibility study for identification of risk?
4. Which party is best able to plan, organize, lead, and control O & M risk?
5. Which part is best able to secure financing for the project for O & M?
6. Which are the best able to utilize efficient and effective construction methods and techniques for O & M?
7. What are best method to control the project in terms of safety and quality for easy operation?
8. Which party is best able to coordinate the field work, handle administration procedures, and provide overall operation?
9. Which are the problems occurring during operation and maintenance?
10. Which party is best able to handle labor relations, including subcontractors' claims for maintenance of highway?
11. what are the technical directions of O&M?
12. what are the level of service & level of basic maintenance?
13. what are the field work required for O&M?
14. what are the performance categories for O&M?
15. what are the causes of reduction of operation?

Traffic survey

Type	Car/Jeep	Bus	Truck	Multi Axle
Tollable Traffic	18252	1323	884	536
Non Tollable	15304	2206	1263	967
Total Traffic	33556	3529	2147	1503

Accident Survey

Year	No of Accident	Major
2002 -2012	1758	482
2013 – 2014	352	128
2014 – 2015	412	187
2015 – 2016	376	204
2016 – 2017	248	62

ii) Result of questionnaire survey:

From the basis of questionnaire survey the following main risks are identified they are-

SR.NO.	RISK
1	Government Policy
2	Political Risk
3	Natural disasters

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4	Traffic accident
5	Traffic diversion
6	Traffic congestion
7	Operation financial risks
8	Operation cost overrun
9	High maintenance cost
10	Traffic revenue risk
11	Labour accidents
12	Project/Operation change Technologicalrisk
13	Maintenance more frequent than Expected
14	Unsafe working conditions
15	Labour availability
16	Low operating productivity
17	Insolvency/default of subcontractors/suppliers
18	Design deficiency
19	Regulatory & administrative risk
20	Algae formation on road
21	Heat generating between tyer and road

VI. RISK ASSESSMENT

After identifying the risks in the projects, the next stage in the risk management process is to carry out risk assessment in order to quantify the risk by estimating the probability of occurrence of the risk and the impact of the consequence if the risk occurs. Risk analysis plays a very important in ensuring effective risk management of the project. Rigorous risk analysis before a project is embarked upon will help the concerned authority to establish the financial and technical feasibility of the projects. It can also help to screen out financially unsound projects and can help in overcoming foreseen technical difficulties. An increased understanding of the project risks will lead to formulation of more realistic plans in terms of cost estimates and programs. Knowing the magnitude of the possible impact that may be caused by the contingent factors, the parties can seek for better allocation of the risks through the agreement of suitable contract clauses, procurement of insurance or other risk response measures.

Qualitative risk analysis:

Qualitative risk analysis quantifies the magnitude of the potential consequences and the likelihood that those consequences will occur in linguistic terms using words. Qualitative risk analysis is normally use as a technique for prioritization of the identified risks for further detailed

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analysis. Linguistics scale with descriptions can be used to describe the probability and impact of risks. Linguistic scale to solicit responses from experts on probability of risk event occurring could be a five-point scale with the levels described by the linguistic terms, very low, low, medium, High and very High, in ascending order. Similarly, the scale for soliciting consequence of risk can be a three-point scale with the five levels described with the linguistic terms: low, medium, High in ascending order.

Sr. No.	Risk	Probability of Occurrence			
		Very High	High	Moderate	low
1	Government Policy		*		
2	Political Risk	*			
3	Natural disaster		*		
4	Traffic accident	*			
5	Traffic diversion			*	
6	Traffic congestion		*		
7	Operation financial risks	*			
8	Operation cost overrun	*			
9	High maintenance cost		*		
10	Traffic revenue risk		*		
11	Labour accidents			*	
12	Project/Operation change Technologicalrisk				*
13	Maintenance more frequent than Expected		*		
14	Unsafe working conditions			*	
15	Labor availability		*		
16	Low operating productivity			*	
17	Insolvency/default of subcontractors/suppliers		*		
18	Design deficiency			*	
19	Regulatory & administrative		*		

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	risk				
20	Algae formation on road			*	
21	Heat generating between tier and road			*	

After qualitative assessment on linguistics scale, assigning values to the linguistics scale risk factor calculated which is useful for risk prioritization. Risk prioritizations will helpful to know which risks has significant impact on road projects.

Values of linguistics scale for Probability (P):

Linguistics scale	Low	Medium	High	Very high
Probability score	0.3	0.5	0.7	0.9

Values of linguistics scale for Impact (I):

Linguistics scale	Low	Medium	High
Impact Score	03	05	10

After assigning values to the probability and impact risk factor (R) is calculated.

Risk factor = Probability X Impact

Consider risk event delay in site possession, one respondent's view of probability occurrence is very high and impact also high then,

$$\text{Risk factor} = \text{Probability} \times \text{Impact}$$

$$= 10 \times 0.5 = 5$$

For every risk events risk factor is calculated for all the respondents and average of every event is calculated and risk factor used for risk prioritization. The risk factor for every risk is calculated.

VII. CONCLUSION

While studying this project, we can understand that every infrastructure project completed under and according laws of regulatory framework.

In operation and maintenance project of highways there mainly 21 risks are identified on the basis of questionnaire survey.

Probability of occurrence of some of risk is very high and some of them is high so we have to concentrate on mitigation of these risks which affect the proper operation and maintenance of expressway.

In mitigation of these risk are Avoidance, Acceptance, Retain and Neglect the risk.

In these 21 risks, which are identified the most affected risk on operation and maintenance are political risk, government policy, accident, operation financial risk, cost overrun etc.

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