Risk Management in BOT

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Abstract: ***The significance of the road sector in India cannot be undervalued. It's one in all the key factors within the economic and cultural progress of the nation. The growth of the infrastructure sector in India has been comparatively slow compared with the commercial and manufacturing sectors. The energy shortage, an inadequate transportation network, and an inadequate water system have caused a bottleneck within the country's economic growth. The Build-Operate-Transfer (BOT) scheme is currently becoming one in all the prevailing ways that for infrastructure development in India to fulfill the requirements of India's future economic growth and development. Risk management used as a tool in managing projects so as to reduce risk particularly for projects that involved an enormous amount of cash. In this paper, the factors liable for time overruns for BOT projects are known through a survey. Analysis of the data collected from experts is done by AHP. The relative importance and significance of those factors are investigated. The various types of risk encountered in BOT projects were investigated from the aspect of various key participants. The main purpose of this present work is to investigate critical risks related to Build-Operate-Transfer (BOT) projects in India.***

Keywords: Risk management, BOT, Infrastructure projects, AHP, risk analysis.

I. INTRODUCTION

Civil infrastructure is very important for the nation's economic progress. Infrastructure could also be regarded to be the skeleton on which the society is established. It includes highways, bridges, hydraulic structures, power plants, tunnels, railways, ports, municipal facilities like sanitation and water system, and different facilities helping public desires. Adequate funding is needed to make and manage the requisite infrastructure. The urgent want for such projects including chronic budget deficits experienced by public agencies has urged the use of innovative funding.

Construction project management is a difficult, challenging and often a hazardous profession with high danger due to uncertainties in the business environment. The preparation, design, construction, management, and operation of a new construction facility is a complex project. For successful project achievement and constant operation, risks should be well addressed and allotted. One of the major risks faced by the owner is the cost and time overruns.

The term BOT (build-operate-transfer) can be characterized as a primary start-up business venture wherever personal organizations provide to create and operate a project, which might ordinarily be initiated by the government and deliver the possession to the government when a hard and fast concession amount. The Build Operate Transfer (BOT) method is an alternative for the government to source public projects to the private quarter. Beside BOT, the private sector designs, finances, constructs and manages the ability and eventually, once a detailed concession amount, the possession is shifted to the government. Therefore, BOT may be seen as a developing methodology for infrastructure comes by utilizing private enterprise and funding. Such infrastructure projects involve a good collection of public facilities with the primary function to help public desires, to afford social services and support money activity within the private sector. The foremost frequent examples area unit roads, bridges, water and airports, ports, sewer systems, and public buildings. The hypothesis of BOT is as per the following: [8]

- BUILD- A privately owned business (or consortium) concurs with an administration to put resources into an open foundation venture. The task then secures their own particular financing to build the undertaking.
- OPERATE- The private designer that possesses, keeps up and deals with the office for concurred concession period and recovers their venture through charges or tolls.
- TRANSFER- After the concessionary period the organization exchanges proprietorship and operation of the office to the legislature or pertinent state power.

Risk management may be a discipline that tries to spot and management of future events which will have an adverse impact on the value, schedule, or quality of a project. It provides processes, methods, and tools to manage risks. It provides a disciplined atmosphere for proactive decision-creating to accomplish the subsequent goals:

- Continuously assess potential risks
- Prioritize risks
- Develop and implement mitigation ways for addressing risks
- Continually improve the danger management method

The Analytical Hierarchy method (AHP) technique has been adopted during this study to find Critical Success Factors (CSFs) for projects, displaying a hierarchical model. A hierarchical model for project success was taken supported a typical project environment during which the success-related factors were sorted into the various level of hierarchies. [15]

OBJECTIVES OF THE PRESENT STUDY

In view of the above, the analysis work is planned with the subsequent specific purposes:

i. To conduct field survey by questionnaire and private interviews with the specialists to identify principal causes of delay for BOT projects, and to get the perceptions of main participants: owner, contractor, and consultant causing project delays.
ii. To spot and rank essential success issue for BOT projects based on accumulative information and judgment of consultants within the business using the Analytical Hierarchy method (AHP).
iii. To spot and discuss varied problems that governments should modify for BOT mechanism to figure smoothly.

II. LITERATURE REVIEW

Project delivery technique of Build-Operate-Transfer (BOT) will increase the commencement likelihood of public construction works through private investments. Public construction activity worldwide that adopt the BOT model as their project delivery technique are increasing step by step. Though several BOT projects are implemented at numerous stages, some projects encounter major obstacles for advancement. During its life cycle, a BOT project is exposed to varied risks that, if not lessened, might financially distress sponsors and lenders. Therefore, before getting in contractual arrangements, sponsors and lenders appraise the risks concerned within the project very carefully. If they're not comfortable with the extent of such risks and there are no available options to mitigate them, they'll probably withdraw from the project. In different words, sponsors and lenders conclude the BOT project "only if" the mitigation of the project's danger improves the chance that their investment is profitable. Thus, risk management and risk mitigation play a central role in the productive realization of BOT infrastructure comes.

RISK MANAGEMENT IN CONSTRUCTION INDUSTRY

Mahendra et al. [1] proposed that the risk management technique should be applied to any construction project at the initial stage of the project to get the maximum benefit of the technique. There should be the most wholesome approach towards risk management instead of the present irregular approach towards the risks.

Kamane & Mahadik [2] stated that construction projects are regularly used in management research, and there is a gap between risk management techniques and their practical application by the construction contractor. It may be stated that risk management is the core of project management. Risk avoidance may include a review of the overall project objectives leading to a reappraisal of the project as a whole.

M. Shaikh [3] found that the construction industry is extremely risk-prone, with complex and dynamic project environments creating an atmosphere of high uncertainty and risk. In light of this, it can be said that an effective system of risk evaluation and management for construction industry continues a challenging assignment for the industry practitioners.

RISK MANAGEMENT IN BOT PROJECTS

Nandi & Tiwari [5] highlighted that there are a number of problems and difficulties which are permanent in the application of BOT project. It is very important to understand the type of contractual relationships between the parties and the role of each party in order to perform risk management.

Patria & Wibowo [6] Indonesia's experience shows that risk appears significantly in many areas, such as law establishment, land acquisition, tariff, construction, etc. This formed a situation where risks tend to belong primarily to the private sponsor. However, risk analysis was made primarily based on the managers' experience, judgments, and subjective intuitions.

Pathan & Pimplikar [7] assessed the risks involved in BOT by considering a specific case of BOT Road Project, to assess the role of financial durability on the project and the subsequent effect on risks. A BOT project is affected by various options relating to toll revision schedule, the toll structure, extent of the government grant, and the duration of the concession period.

Adnan et al. [8] analyzed that the internal risks that presented the greatest impact to BOT projects are financial, operational problems, technical and design risks.

Mane & Pimplikar [9] investigated the critical risks associated with India's BOT projects. The main conclusions are as follows: (i) they identified critical risks in order of importance are: land acquisition and compensation, delay in approval, change in the law, cost overrun, etc. (ii) The measures for reducing each of these risks have been evaluated.

Bagui & Ghosh [10] carried out the sensitivity analysis to determine the uncertainty of a project. Several graphs/figures may be formed to study various financial parameters like and net present value and financial internal rate of return and measure the risk of the project.

Bakri et al. [11] indicated in his finding that the private sector or promoter of the BOT projects is exposed to many risks. Effective risk management methods and excellent managerial capabilities are required in ensuring the success of the project.

Zayed et al. [12] propose a risk index (F) that performed two functions: to assess the risk and rank of BOT projects. The main areas of BOT projects were identified and analyzed, and a model for calculating the risk index (F) was constructed.

The overall literature review reveals that

a) BOT project consists of several numbers of risks.
b) The government of a country transfers risk to the concessionaire.

c) Major risks are country political and regulatory, force majeure, physical, financial, revenue, developmental, promoting, procurement, construction, and operating risks.

III. RESEARCH METHODOLOGY

The current state of the infrastructure projects has been analyzed during this analysis work. For this purpose, it first makes an attempt to critically review the literature to spot and describe typically accepted construction management information. To spot the basic causes of delay and to understand the perceptions of main participants; owner, consultant, and contractor to the circumstance causing delay field survey have been carried out by questionnaire and private interviews.

Field Survey is finished to review the prevailing surroundings that entail the sphere of uncertainty within the execution of varied phases of a construction project. This survey is completed to possess first-hand data, essential to remember of the issues encountered within the construction projects. The objective of doing a field survey during this study is to validate the findings of the literature review.

For the survey, a questionnaire was prepared in 2 parts. The primary half contains six vital queries that are relevant in forming the opinion on the degree of time overruns in numerous organizations. The second part of the questionnaire is based on the potential factors inflicting time-overruns for BOT projects. The questionnaire consists of 29 factors each which were known from the literature survey. These factors are sorted into 5 completely different categories: i) Project related ii) Contractor related iii) Consultant related iv) Owner related and v) External factors.

The Analytical Hierarchy method (AHP) technique has been adopted during this study to find Critical Success Factors (CSFs) for projects. A hierarchical model for project success was taken supported a typical project environment during which the success-related factors were sorted into the various level of hierarchies.

ANALYTICAL HIERARCHY PROCESS

The Analytical Hierarchy process (AHP) is a decision-making methodology developed by Saaty. It directs at quantifying relative priorities for a given set of options on a quantitative relation scale, supported the judgment of the choice maker and stresses the importance of the intuitive judgments of a decision-maker as well because of the consistency of the comparison of the alternatives within the decision-making process. Decision-maker's base judgments on data and skill, so build selections consequently. The AHP approach agrees well with the behavior of a decision-maker. The subsequent steps were applied to investigate the info: [15]

1. Define the matter and verify its goal.
2. Structure the hierarchy from the highest (the objectives from a decision maker's viewpoint) through the intermediate levels (criteria on that sequent level depend on) to the lowest level that sometimes contains the list of alternatives.
3. Construct a collection of pair-wise comparison matrices (size n x n) for every of the lower levels with one matrix for every component within the level immediately on top of by using the relative scale measure shown in Table 3.1. The pair-wise comparison is completed in terms of that component dominates the other.
4. There is n (n-1) judgments needed to develop the set of matrices in step 3. Reciprocals are automatically indicated in every pair-wise comparison.
5. Hierarchical synthesis is then applied to weight the eigenvectors by the weights of the model and therefore the sum is taken all weighted eigenvector entries similar to those within the next lower level of the hierarchy.
6. Having created all the pair-wise comparisons, the consistency is decided by using the eigenvalue, λmax, to calculate the consistency index, CI as follows: $CI = (\lambda max - n)/(n-1)$, wherever n is the matrix size. Judgment consistency is often checked by using the consistency ratio (CR) as CI/RI, taking the suitable value of CI from Table 3.2. The CR is suitable if it doesn't exceed 0.10. If it's more, the judgment matrix is inconsistent. To get a uniform matrix, judgments ought to be reviewed and improved.
7. Steps 3-6 are performed for all levels of the hierarchy.

Table 1: Pair-wise Comparison Scale for AHP Preferences

Level of Importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Very strong or demonstrated importance
9	Absolute Importance
2, 4, 6, 8	Intermediate values between adjacent scale values

Table 2: Average Random Consistency (RI)

(N)	1	2	3	4	5	6	7	8	9	10
(RI)	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

IV. RESULT AND DISCUSSION

The data was investigated by Relative Important Index (RII) methodology to work out the relative result of every factor in inflicting the time-overrun of projects. The five-point scale mentioned earlier was transformed to relative importance indices for every issue, to determine the ranks of the various factors. These rankings made it possible to check the relative importance of the factors as perceived by the 3 groups of respondents, namely, contractor, consultant, and owner. The relative importance index (RII) was calculated utilizing the subsequent expression [15]:

Relative importance index = Σ W / (A x N)

Where, W = weight age given to every factor by the respondents and can vary from 1 to 5. A = highest weight age (i.e. 5 in this case), and N = the total number of respondents. The value of Relative Important Index can vary between 1/A (=0.20) and one.

The analysis was performed independently for the respondents to get the ultimate ranking of those factors, the overall average of the three different classes was taken. It's calculated using the subsequent explanation:

Overall Average = [N_1 x RII of contractor + N_2 x RII of owner] / Total number of respondents

Where, N_1 = number of contractors responded and

N_2 = number of owners' respond

Table 3 the relative importance index and ranking of the factors inflicting time overruns of the BOT projects. The last column of the table indicates the overall average of relative importance index and also the final ranking of every factor.

Table 3: Relative Important Indices (RII) and Ranking of Factors Causing Time- Overruns in BOT Projects

Factor Category	Contractor		Owner		Overall	
	RII	Rank	RII	Rank	RII	Rank
Project-related factors						
Project construction complexity	0.659	21	0.600	20	0.653	21
Speed of decision making involving all project teams	0.881	8	0.867	5	0.879	7
Communication among various parties	0.896	5	0.933	1	0.899	4
Type of project bidding and award	0.629	22	0.533	25	0.619	23
Insufficient penalty for delay	0.740	18	0.733	12	0.739	18
Shortage of equipment	0.504	27	0.600	20	0.514	27
	4.309		3.666		4.303	
Contractor-related factors						
Contractor experience in planning and controlling	0.955	1	0.933	1	0.953	1
Site management and supervision	0.874	9	0.867	5	0.873	8
Difficulties in financing project	0.904	3	0.800	8	0.894	5
Construction methods adopted	0.629	22	0.667	18	0.633	22
Delay in award of contract	0.755	17	0.733	12	0.753	17
Shortage of labour	0.467	29	0.533	25	0.474	29
	4.584		4.533		4.580	
Owner-related factors						
Delay in payments by owner	0.800	14	0.733	12	0.793	14
Financial risk	0.770	16	0.800	8	0.773	16
Variations of during construction	0.667	20	0.667	18	0.667	20
Suspension of work	0.844	11	0.733	12	0.834	11
	3.081		2.933		3.067	
Consultant-related factors						
Inadequate experience	0.926	2	0.867	5	0.921	2
Delay in approval of design documents	0.904	3	0.933	1	0.907	3
Project design complexity	0.607	24	0.600	20	0.606	24
Inadequate details in drawings	0.778	15	0.800	8	0.780	15
Delay in producing design documents	0.889	6	0.933	1	0.893	6
	4.104		4.133		4.107	
External factors						
Market risk	0.533	26	0.533	25	0.533	26
Environmental concerns and restrictions	0.837	12	0.733	12	0.827	12
Delay in obtaining permissions	0.859	10	0.800	8	0.853	10
Severe weather conditions	0.689	19	0.600	20	0.680	19

Non availability of utilities on site	0.548	25	0.533	25	0.546	25
Accident during construction	0.496	28	0.333	29	0.479	28
Changes in rules and regulations	0.837	12	0.600	20	0.813	13
Political risk	0.889	5	0.733	12	0.873	8
	5.688		4.865		5.604	

Table 4 presents the top ten factors affecting the time overruns of the BOT projects in India. Such type of study for time overruns in BOT projects is not reported in the literature directly this is because of the facts that in the BOT projects the time of construction is also included in the concession period and therefore the promoter would like to complete the construction at the earliest to enhance the viability of the project.

Table 4: Top Ten Factors Affecting the Time Overrun of the BOT Projects

Factor	**Overall**	**Contractor**	**Owner**
Contractor experience in planning and controlling	1	1	1
Inadequate experience	2	2	5
Delay in approval of design documents	3	3	1
Communication among various parties	4	5	1
Difficulties in financing project	5	3	8
Delay in producing design documents	6	1	6
Speed of decision making involving all project teams	7	8	5
Political risk	8	5	12
Site management and supervision	9	9	5
Delay in obtaining permissions	10	10	8

V. IDENTIFICATION OF CRITICAL SUCCESS FACTORS

The BOTs involve varied types of risks which will emerge at completely different stages within the lifecycle of a project. The BOTs are not simply a vehicle for governments to develop infrastructure projects by transferring all the risks to the private sector and therefore shedding of all their responsibilities. Rather, they need acceptable allocation and management of risks. Moreover, private finance initiatives don't automatically result in flourishing infrastructure projects. The bot schemes should be structured. Otherwise, resources may be wasted and depleted.

The relative importance (RI) at the project success level is obtained by the following equation.

RI at success level = RI at group level x RI of CSFs “prevailing environment”

For example, RI of government support” at success level = RI of “government support” at group level x RI of CSF “prevailing environment”.

Data was gathered through a questionnaire and CSFs were graded using the Analytical Hierarchy process (AHP). The respondents were asked to make pairwise comparisons of the success factors on the basis of the level of importance on a scale of 1 to 9 as shown in table 3.1. The respondents were asked to fill 07 matrices by pairwise comparisons. The duly filled form was returned by every respondent.

The ranking of critical success factors and also the weights for every of the six success aspects are combined so as to form an overall priority ranking of success factors to achieve the goal of bot project success as shown within the last column of table 5.

RI of “government support” = 0.51 x 0.37 = .0188

Similarly, the RI at success level of all the twenty-nine success factors is found. The ranking of the success factors alongside the RI at success level is shown in table 5.24.

Table 5.23: Ranking of Success Factors

Sr. No.	Critical Success Factor	R.I. of "government support" at group level	R.I. of CSF	R.I.	Rank
1	Long-term availability of suppliers	0.75	0.34	0.255	1
2	Sufficient long-term demand	0.74	0.34	0.2516	2
3	Public awareness and support	0.67	0.37	0.2479	3
4	Fiscal concession and investment policy	0.64	0.37	0.2368	4
5	Government support	0.51	0.37	0.1887	5
6	Lead member of the consortium	0.79	0.22	0.1738	6
7	Limited competition	0.43	0.34	0.1462	7
8	Financial strategy	0.82	0.14	0.1148	8
9	Sufficient net cash inflow	0.31	0.34	0.1054	9
10	Effective project organization structure	0.45	0.22	0.099	10
11	Strong and capable project team	0.35	0.22	0.077	11
12	Environmental impact	0.19	0.37	0.0703	12
13	Stable Government	0.19	0.37	0.0703	12
14	Concession agreement	0.73	0.09	0.0657	14
15	Availability of long term debt financing	0.44	0.14	0.0616	15
16	Short construction period	0.18	0.34	0.0612	16
17	Cost effective solution	0.81	0.05	0.0405	17
18	Design and construction contract	0.41	0.09	0.0369	18
19	Sufficient exit options to the lender	0.25	0.14	0.035	19
20	Leading role by a key enterprise	0.12	0.22	0.0264	20
21	Selection procedure of concessionaire	0.12	0.22	0.0264	20
22	Robust solution	0.52	0.05	0.026	22
23	Shareholder agreement	0.26	0.09	0.0234	23
24	Operation & maintenance agreement	0.26	0.09	0.0234	23
25	Proven technology	0.4	0.05	0.02	25
26	Appropriate toll / tariff level(s)	0.13	0.14	0.0182	26
27	Loan agreement	0.16	0.09	0.0144	27
28	Innovative solution	0.17	0.05	0.0085	28
29	Safety considerations	0.17	0.05	0.0085	28

VI. CONCLUSION

The present study has been conducted to suggest and develop some tools which can eventually be helpful to the governments, financial institutes, owners and/or contractors for timely completion of huge infrastructure projects at a reasonable price and of a given quality. BOT projects are targeting towards funding, designing, implementing and operational infrastructure facilities and services which were traditionally provided by the general public sector.

The factors accountable for time overruns were identified through a survey. The relative importance and significance of these factors were studied. Delay during a construction contract is one in every of the foremost common issues within the construction of projects. Within the BOT projects delay is general throughout the negotiation and signing of concession agreement instead of the actual construction part. Contractor expertise in designing and controlling is the most vital issue that affects the time overrun of the projects. In fact, finishing a project on schedule realistically depends on the contractor's expertise and skill to regulate the site operations and to optimally assign the resources.

The various kinds of risk encountered in BOT projects were analyzed from the perspective of varied key participants. Based on the knowledge of the literature survey infrastructure BOT projects in India were analyzed. The project risks that were determined to be most vital were political, monetary and market risk.

In India and lots of different countries, the choice of concessionaire relies on an open competitive bidding. All project parameters like the concession amount, toll rates, price monitoring and technical parameters are to be clearly declared direct and shortlisted bidders are needed to specify solely the amount of grant wanted by them. The bidder who seeks the lowest grant should win the contract. In exceptional cases, rather than seeking a grant, a bidder could provide to share the project revenues with the Authority. Infrastructure projects promoter qualification is not only very crucial for project success however an excellent multi-attribute decision-making obstacle under unsure environment is. A framework supported AHP is planned for ranking varied applicants depending upon the specific project features. The framework includes a selection of basic criteria and therefore the assessment of their weights, systematic aggregation and eventually to rank the applicants for prequalification.

RECOMMENDATIONS TO PRACTITIONERS
(Owner, Promoter, Public, Financial institutions)

1. The identification and ranking of CSF's can help owners, professionals, and governments to provide a lot of attention to them in order that the scarce resources are optimally utilized for successfully finishing the project.
2. The causes of delays known may be managed so as to avoid time overruns of the project.
3. By crashing the project length, the owner/ promoter will increase his profit margins also because the facility is accessible to the general public earlier making win-win things.
4. The guidelines and recommendation provided may be employed by the govt., promoters and also the lenders for a win-win strategy in BOT project.

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