# SUCCESSFUL DELIVERY OF PUBLIC - PRIVATE PARTNERSHIPS FOR INFRASTRUCTURE DEVELOPMENT

Synopsis of the thesis submitted in fulfillment of the requirements for the degree of

#### **DOCTOR OF PHILOSOPHY**

By

Ranjan Agrawal



Department of Professional Development

JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY A-10, SECTOR 62, NOIDA, INDIA

**JULY 2010** 

#### **DECLARATION BY THE SCHOLAR**

I hereby declare that the work reported in the synopsis of the Ph.D. thesis entitled "Successful Delivery of Public - Private Partnerships for Infrastructure Development" submitted at Jaypee Institute of Information Technology, Noida, India, is an authentic record of my work carried out under the supervision of Dr. Aayushi Gupta and Dr. MC Gupta. I have not submitted this work elsewhere for any other degree or diploma.

(Ranjan Agrawal)

Department of Professional Development

Jaypee Institute of Information Technology, Noida, India

JULY 2010

#### SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the Ph.D. thesis "Successful Delivery of Public - Private Partnerships for Infrastructure Development", submitted by Ranjan Agrawal at Jaypee Institute of Information Technology, Noida, India is a bonafide record of his original work carried out under our supervision. This work has not been submitted elsewhere for any other degree or diploma.

( Prof. Aayushi Gupta)

Jaypee Institute of Information Technology.

Noida.

**JULY 2010** 

(Dr. MC Gupta)

Former vice-chancellor

RGPV, Bhopal

**JULY 2010** 

### **CONTENTS**

1.	INTRODUCTION	PAGE NO 1-4
2.	METHODOLOGY	4-5
3.	TIME DELAY AND DELAY ANALYSIS	5-10
	3.1 ANALYSIS OF SURVEY	6
	3.1.1 ANALYSIS OF FIRST PART OF SURVEY	6
	3.1.2 ANALYSIS OF SECOND AND THIRD PART OF THE SURVEY	6
	3.2VALIDITY AND RELIABILITY OF QUESTIONNAIRE SURVEY	9
4.	IDENTIFICATION OF CRITICAL SUCCESS FACTORS	10-14
	4.1 AGREEMENT ANALYSIS OF CSF'S IDENTIFIED	12
	4.2 DISCUSSIONS ON TOP FACTORS	12
5.	FINANCIAL STRATEGIES AND GOVERNMENT SUPPORT	14-20
	5.1 RISK ANALYSIS	15
	5.2 GOVERNMENT SUPPORT	18
	5.3 POLICY AND REGULATORY CONSTRAINTS	19
	5.4 RECOMMENDATIONS	20
6.	DECISION SUPPORT SYSTEM FOR RANKING BEST VALUE PROMOTER	20-26
	6.1 REQUEST FOR QUALIFICATION IN INDIA	22
	6.2 SENSITIVITY ANALYSIS	25
7.	RECOMMENDATIONS TO PRACTITIONERS	26
8.	SUMMARY AND FUTURE SCOPE OF WORK	27-28
9.	THESIS LAYOUT	28-30

## SUCCESSFUL DELIVERY OF PUBLIC - PRIVATE PARTNERSHIPS FOR INFRASTRUCTURE DEVELOPMENT

#### 1. Introduction

Civil infrastructure is vital to the nation's economic growth. Infrastructure may be considered to be the skeleton on which the society is built. It includes highways, railways, ports, bridges, hydraulic structures, power plants, tunnels, municipal facilities like sanitation and water supply, and other facilities serving public needs. Adequate funding is required to construct and maintain the requisite infrastructure. The immediate need for such projects coupled with chronic budget shortages experienced by public agencies has encouraged the use of innovative financing [1] [2].

In many countries, particularly, developing countries shortage of public funds have led Governments to invite private sector entities to enter into long term contractual agreements for financing, construction and operation of capital intensive infrastructure projects. A Public Works Financing database of worldwide projects between 1985 and 2004 shows that 1,121 PPP infrastructure projects (road, rail, airport, seaport, water, and building), representing \$450.9 billion worth of investment, were funded and completed with the majority of the projects being in Europe, Asia, and the Far East as shown in Table 1 [3].

**Table 1:** Regional Share of PPP Projects funded and completed between 1985 and 2004

Region	Percentage (%)
Europe	37,8
Asia and the Far East	36.7
North America	15.8
Latin America, Africa, Middle East	9.7
Total (\$450.9 billion)	100

India has seen a rapid increase in private investment in infrastructure since 2001. Its PPP program has grown rapidly in the past five to six years; in 2002–06 more than 150 PPP deals

closed, compared with 66 in the previous seven years (figure 1). This growth was mainly in the transport and urban infrastructure sectors, with road projects accounting for a large share of the increase, particularly in the number of projects [4].

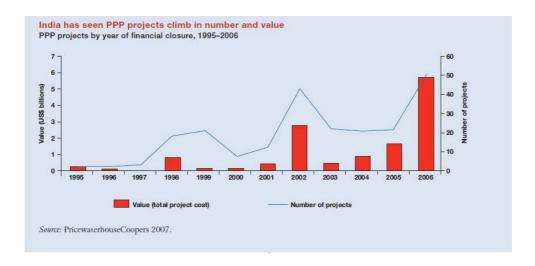


Figure 1: PPP Projects 1995-2006

It is well recognized that, with its present state of physical infrastructure, India will be hard pressed to sustain 7 percent plus annual GDP growth over the medium term. In recent years, efforts have been made by the Government of India (GoI) to step-up investment in infrastructure, and particularly to catalyze greater private investment. As per the report of the World Bank, Table 2 gives the overall financing gaps up to 2010 - 2011[5]

**Table 2:** Overall Financing Gap in Infrastructure up to 2010-11 (Rs. Billion)

Sectors	Investment needed	Financing Gap
Roads	4670	1106
Power	10591	3500
Telecommunications	2143	478
Railways	1242	151
Airports	191	72
Ports	306	236
Total	19143	5542

For the infrastructure development in developed as well as developing countries different types of public private partnerships (PPPs) have been used. On one side, the projects have been successfully developed through this approach whereas on the other side various problems have been encountered in PPPs throughout the world. One problem is the slow progress of the implementation of PPPs resulting in a very small portion of the infrastructure being built by this approach. Many PPP projects have failed and even abandoned causing distress not only to the promoter but also to the lending financing institutions. As such there is an urgent need for an efficient procurement protocol for improved practices in future PPP projects. A number of factors determine the success or failure of an infrastructure project in terms of meeting its objectives of cost, time and quality. The identification of the CSF for these objectives will enable efficient use of available limited resources.

The majority of public sector has a long tradition of using the lowest bid to award the contract. However a low bid system encourages contractors to implement cost cutting measures instead of quality enhancing measures which makes it less likely that the contract will be awarded to the best performing contractors who will deliver the highest quality products. As such the public owners are increasingly exploring ways to include non price factors, both qualitative and quantitative, in procurement process to motivate contractors not only to improve their performance during construction but also to build value into the end products of the construction.

This thesis attempts to identify CSF's for BOT projects to contribute towards developing some methods and tools which will eventually be useful to the owners and or contractors for timely completion of construction projects at a reasonable cost and of a specified quality. For this purpose it first attempts to critically review the literature to identify and describe generally accepted construction management knowledge. This thesis is therefore an attempt to shift from traditional risk management with a focus on threats, towards a strategic management of uncertainty, creating win-win situations. The specific objectives of this thesis are:

1. To conduct field survey by postal questionnaire and personal interviews of the experts to identify principal causes of delay for both traditional and BOT projects, and the

perceptions of three main participants: owner, consultant and contractor to the factors causing project delays.

- 2. To identify and rank critical success factor for BOT projects based on accumulative knowledge and judgment of experts in the industry using the Analytical Hierarchy Process (AHP).
- 3. To identify and discuss various issues including financial strategies that governments should deal with for BOT mechanism to work smoothly.
- 4. To develop a "decision support system" using Multi attribute decision theory for prequalification of BOT promoters so as to provide best value to the public procurer
- 5. To carry out sensitivity analysis by altering the weights of the attributes on ranking of alternatives

#### 2. Methodology

Research processes included a wide range of survey of published literature in diverse areas of construction management- risk associated with major infrastructure projects, causes of delay, critical success factors, lessons from worldwide BOT practices, selection of a suitable contractor and best value selection models. However, only a small subset of the most relevant references has been included in the synopsis. More work is included in the thesis. Research also includes the analysis of postal surveys conducted to find the extent and factors causing time overruns in construction projects for BOT projects. The survey was followed by interviews with the various stakeholders of the construction projects to get a deeper insight into the factors and reasons for the delay. Two hundred and twenty respondents were contacted out of which 90 responded. Postal survey was also made to identify the critical success factors for the construction BOT projects. The research also included the identification of issues that the government should deal with for BOT mechanism to work smoothly. Finally a procedure was developed for selecting and ranking BOT promoters during prequalification using AHP. The study developed a decision support system to provide best value to the public procurer based on a multi objective decision making methodology.

The sensitivity analysis for ranking of bidders/applicants during prequalification process is built over MS Excel platform. This software implements the composite programming methodology through the relative weighing scheme. The software is validated with the help of a suitable example.

#### 3. Time Delay and Delay analysis

A postal survey was conducted to find the extent and the factors causing time overruns in construction projects. A questionnaire was prepared in three parts.

The first part consists of six important questions that are relevant in forming the opinion on significance of the time for traditional and BOT projects and the degree of time overruns in various organizations. The second and third part of the questionnaire is based on the possible factors causing time-overruns of traditional and BOT construction projects respectively. It included 47 factors which were identified from the literature survey.

The factors considered have been grouped in to the following five categories – Project related; Owner related; Contractor related; Consultant related; and External related. This classification will help in identifying the nature of the problem and can fix the responsibility and remedial measures which could be taken to avoid the time delay. For example the factors concerning the owner, contractor and consultant are attributed to the respective persons directly; the project manager can focus on the problems of project related and external related factors as per the prevalent conditions.

The respondents were asked to give their opinion regarding the extent of time-overrun in part one. In part two the respondents were asked to assess the effect of each factor on the time-overrun of the project separately for traditional and BOT projects, on a scale of 1 to 5 depending upon its effect, 5 being the most important and 1 the least.

#### 3.1 Analysis of the Survey

#### 3.1.1 Analysis of the first part of the Survey

The survey shows that the time overruns occur more than 74% in the traditional construction projects and the relative contribution of the owner; contractor and consultant to time overruns are 60, 35 and 5 percent respectively. The time overruns are independent irrespective of the project size.

The survey also showed that out of the three objectives i.e. cost, time and quality, deemed as important for any BOT or infrastructure project, time of construction is most important followed by quality of construction and cost of course the third priority. The reasons for the same can be attributed from the fact that the revenue inflow in BOT projects occur only after the facility is constructed and is made available for use to the public.

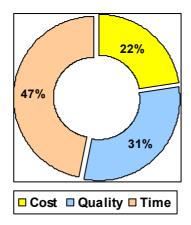


Figure 2: Relative Importance of the Objectives for the BOT Project

Quality has been recognized as the second most important objective for reasons attributing to the degree of maintenance that is required on the facility during the operational period. The cost, however, should be justified but is not that critical as time and quality in BOT projects.

The time delays are mostly not encountered in BOT construction projects during construction. The delays are mostly because of inadequate legal and regulatory framework.

#### 3.1.2 Analysis of the Second and third Part of the Survey

For the second and the third part of the questionnaire, the data was analyzed by Relative Important Index (RII) method to determine the relative effect of each factor in causing the

time-overrun of projects [6]. The relative importance index (RII) was evaluated using the following expression:

Relative importance index =  $\sum W / (A \times N)$ 

Where, W = weights given to each factor by the respondents and will ranges from 1 to 5. A = highest weight (i.e. 5 in this case), and N = total number of respondents. The analysis was done independently for the three categories of the respondents. The category wise ranking and the overall ranking were obtained. The top ten factors affecting the time overrun of the traditional projects are shown in table 3.

**Table 3:** Top Ten Factors Affecting the Time Overrun of the Traditional Projects

Factor	Overall	Contractor	Consultant	Owner
Contractor experience in planning and	1	4	1	1
controlling (contractor related)	1	4	1	1
Delay in approval of design documents	2	1	6	9
(consultant related)	2	1	0	9
Delay in payments by owner (owner related)	3	6	2	2
Speed of decision making involving all project	4	10	3	2
teams (project related)	4	10	3	2
Unforeseen ground conditions (external related)	5	2	4	10
Site management and supervision (contractor	6	3	7	4
related)	O	3	/	4
Variations during construction (owner related)	7	7	9	7
Difficulties in financing project (contractor	8	14	11	4
related)	0	14	11	4
Unrealistic contract duration (owner related)	9	10	12	7
Type of project bidding and award (project	10	21	4	4
related)	10	<u> </u>	+	4

Table 4 presents the top ten factors affecting the time overrun of the BOT projects in India. Such type of study for time overruns in BOT projects are 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.

Jyh-Bin Yang identified delay causes during various stages of BOT projects as per the opinions of BOT participants using two questionnaire surveys [7]. Their study results Ranjan Agrawal, JIIT, Aug' 2010

Synopsis -7

revealed that the stage of negotiations and signing of concession agreements that is the award of the contract to the contractor, uncertainty of political issues, debt problems and government finished items are the most significant delay causes. These factors also figure in the top ten list of the present study for BOT projects as shown in table 4.

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

Factor	Overall	Contractor	Consultant	Owner
Market risk	1	4	1	1
Political risk	2	1	6	9
Environmental concerns and restrictions	3	9	2	2
Delay in obtaining permissions	4	10	3	2
Financial risk	5	2	4	10
Changes in rules & regulations	6	3	7	4
Severe weather conditions	7	7	9	7
Accident during construction	8	14	11	4
Non-availability of utilities on site	9	10	12	7
Delay in award of contract	10	21	4	4

Comparison of ranking of various factor categories with previous studies is presented in table 5.

**Table 5: Comparison of Ranking of Factor Categories with Previous Studies** 

Factors Categories	Present Study Traditional	Chan & Kumarswamy [8]	Assaf & Al-Hejji (Traditional) [9]	Present Study BOT Projects
Project Related	4	3	5	2
Owner Related	1	4	1	5
Contractor Related	2	1	2	4
Consultant Related	3	5	3	3
External Related	5	2	4	1

The previous studies indicated that owner related and contractor related factors are the most important causes for project delays. However the present study indicates that for the BOT projects, the external related factors are mainly causing the delay in project schedule.

#### 3.2 Validity and Reliability of the Questionnaire survey

The quality of the questionnaire is examined by conducting a validity and reliability analysis. The validity analysis examines whether what is expected to be measured is measured. The ranks of the delay factors have been derived according to overall responses of various participants. It is useful to examine the agreement in the ranking of these factors across various participants.

Okpala provides a quantitative method for rank agreement analysis. In this method, the "rank agreement factor" (RAF) is used [10]. The RAF shows \the average absolute difference in the ranking of the factors between two groups.

For any two groups, let the rank of the  $i^{th}$  item in group 1 be  $Ri_1$  and in group 2 be  $Ri_2$ , N be the number of items, and j=N-i+1.

$$RAF = \frac{\sum_{i=1}^{N} |R_{i1} - R_{i2}|}{N}$$

The RAF is defined as.

The maximum rank agreement factor (RAF<sub>max</sub>) is defined as

$$RAF_{max} = \frac{\sum_{i=1}^{N} |R_{i1} - R_{j2}|}{N}$$

The percentage disagreement (PD) is defined as

PD = 
$$\frac{\sum_{i=1}^{N} |R_{i1} - R_{i2}|}{\sum_{i=1}^{N} |R_{i1} - R_{j2}|} \times 100$$

The percentage agreement (PA) is defined as PA = 100 - PD

The higher the value of RAF is lower the agreement between the two groups. A RAF of zero will mean perfect agreement. It is seen that there is a big agreement in the ranking of delay parameters between all the three groups of respondents that is contractor-consultant, consultant-owner, and contractor-owner indicating that the study done is valid and reliable.

#### 4. Identification of Critical Success Factors

The identification of critical success factors for BOT projects for project success enables appropriate allocation of limited resources. Most of the previous studies did not adopt to cover intangible factors for identifying the CSFs. In present work, a systematic approach has been taken to identify and analyze the CSFs for BOT projects. The analytic hierarchy process (AHP) method has been adopted to solicit consistent subjective expert opinion. A hierarchical model is developed. The model can handle both tangible and intangible factors in a systematic way and provide a structured solution to the decision making problem. A hierarchical model for project success is developed and is shown in figure 3 and table 6.

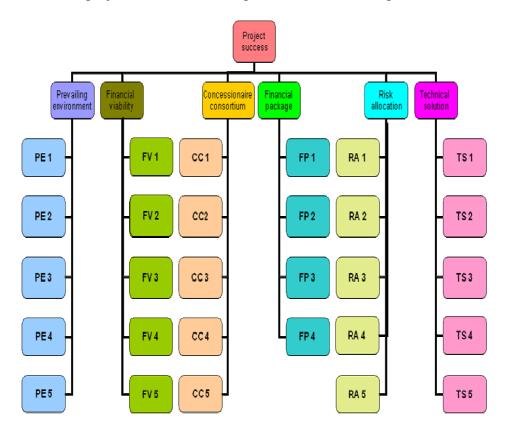


Figure 3: Hierarchical Model for Project Success

Table 6: Success Related Factors Considered for AHP Analysis

CSF Aspects/ category	Success factor
	Public Awareness and support (PE1)
Prevailing Environment	• Government support (PE2)
(PE)	<ul> <li>Fiscal concession and investment policy(PE3)</li> </ul>
	<ul> <li>Environmental impact (PE4)</li> </ul>
	• Stable Government (PE5)
	Sufficient Long-term demand (FV1)
Financial Viability (FV)	• Limited competition (FV2)
	<ul> <li>Sufficient Net Cash Inflow(FV3)</li> </ul>
	• Long-term availability of suppliers needed for the normal
	operation of the project (FV4)
	• Short construction period (FV5)
	<ul> <li>Lead Member of the Consortium(CC1)</li> </ul>
Concessionaire	• Effective project organization structure (CC2)
consortium (CC)	<ul> <li>Strong and capable project team (CC3)</li> </ul>
	• Leading role by a key enterprise or entrepreneur (CC4)
	• Selection procedure of concessionaire (CC5)
	• Financial strategy (FP1)
Financial package (FP)	<ul> <li>Availability of long term debt financing(FP2)</li> </ul>
	• Sufficient exit options to the lender (FP3)
	• Appropriate toll / tariff level(s) and suitable adjustment
	formula (FP4)
	• Concession agreement (RA1)
Risk allocation (RA)	• Shareholder agreement (RA2)
	<ul> <li>Design and construction contract (RA3)</li> </ul>
	• Operation agreement (RA4)
	• Loan agreement (RA5)
	• Cost effective solution (TS1)
Technical solution (TS)	• Robust solution (TS2)
	<ul> <li>Proven technology (TS3)</li> </ul>
	• Innovative solution (TS4)
	<ul> <li>Safety considerations (TS5)</li> </ul>

In the present study 6 main CSFs have been taken each containing success sub factors (SSFs). To validate the AHP methodology the survey was also made by RII method and the results obtained were found to be consistent. The top ten factors identified by the AHP method have

been compared with RII method as well as with the previous studies made globally and are shown in table 7.

**Table 7:** Comparison of Top Ten CSFs with Previous Studies

Present Study by AHP	BY RII	Zhang (2005)	Tiong (1996) Gupta & Narsihma (1998)
Concession agreement	√	√	√
Short construction period	√		√
Selection procedure of concessionaire	√		√
Sufficient long term demand	4	√	$\sqrt{}$
Sufficient net cash inflow	√	$\sqrt{}$	
Financial strategy	√	√	
Loan agreement	√	$\sqrt{}$	
Leading role by a key enterprise		$\checkmark$	$\sqrt{}$
Robust solution			
Government support	√	√	V

#### 4.1 Agreement Analysis of CSF's Identified

The ranking of critical success factors for BOT projects is calculated independently, based on the responses to the two questionnaires developed specifically for the purpose, by two different methods, Relative Importance Index method and Analytical Hierarchy Process.

In view of the difference in the ranking of CSFs identified, it is imperative to measure the agreement in the ranking of these factors analyzed by the two different methods. The percentage agreement (PA) for the CSFs identified by the two methods is 80.3%. Therefore, there is a good agreement (> 80%) in the ranking between the RII and AHP methods which indicates the consistency of the questionnaire survey.

#### **4.2 Discussion On Top Factors**

The **concession agreement** has been ranked as the top success factor. A concession agreement can be defined as "An arrangement whereby a private party leases asset for service provision from a public authority for an extended period and has responsibility for financing specified new fixed projects during the period. The new assets revert to the public

sector at expiration of the contract." The objective of Concession Agreement is to secure value for public money and provide efficient and cost effective services to the users. A proper concession agreement provides a regulatory and policy framework and is therefore, a prerequisite for attracting private investment with improved efficiencies.

**Short construction period** will not only ensure the early use of the facility by the user but also an early cash inflow which will enhance the profitability of the project. Short construction period has been included as a sub factor of the critical success factor – Technical solution by Tiong [11]. Gupta and Narasimham considered this factor as extremely critical for the success of BOT projects [12]. Zhang has not included this factor directly in his study, but has taken into account a factor naming sufficient profitability of the project to attract investors [13]. Table 8 shows that by crashing the duration of a BOT project there is an appreciable increase in the profitability.

**Table 8:** Summary of Results

S.No.	Duration	Break-even	Amount available at the end of 12 <sup>th</sup> year Rs. (millions)
1	Normal (6 year)	11 years	68174
2	Crashed by 1 year (5 years)	10 years	96868
3	Crashed by 2 years (4 years)	9 years	130026

The **repayment of the debt** and dividend to the promoter are to be paid only from the revenue generated from the project. The project can therefore be bankable only when it has sufficient long term demand and sufficient net cash inflow.

The financing of a BOT project depends on the anticipated financial performance of the project as project earning are the only source of the repayment. A major component of risk mitigation in BOT projects is the selection of the appropriate **financing strategy**. Through **the loan agreements** the project sponsors try to achieve a debt structure in which the long term debt is maximized to minimize the refinancing risk.

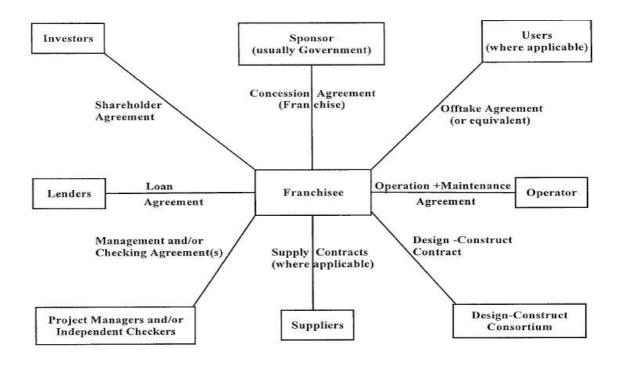
A promoter with a strong managerial capability is required who should play a leading role of a key entrepreneur to provide good relationships with host government authorities and should have experience in international BOT project management. He should be capable of managing multidisciplinary participants and should create a strong project team.

A **robust solution** would provide requisite flexibility to the concessionaire in evolving and adopting cost effective designs without compromising on the quality of service for users. Cost efficiencies would occur because the shift to output based specifications would provide an opportunity to innovate and optimize the designs.

#### 5. Financial strategies and Government support

Project sponsors face many risks when undertaking large infrastructure projects particularly BOT projects. If one or more of the risks are not properly addressed it will lead to failure of the project. Much of the risk of a PPP project comes from the complexity of the arrangement itself in terms of documentation, financing, taxation, technical details sub agreements etc involved in a major infrastructure venture, while the nature of the risk alters over the duration of the project.

For example, the construction phase of the project will give rise to different risks from those during the operating phase [14]. The risks can be broadly classified into: (1) elemental risks comprising physical, design, construction, operation and maintenance, technology, finance and revenue generation risks and (2) global risks, comprising political, legal, commercial and environmental risks [15]. The literature review further indicated that it is easier to handle elemental risk than the global risk. Figure 4 typically illustrates the relationships between principal participants in BOT-type procurement. [16]



**Figure 4:** Typical relationships between principal participants in build operate transfer type procurement.

Most of these risks are common to any project financing activity, and apply with more or less force depending on the project concerned and can be evaluated using much the same basic techniques. The critical question, as always, is whether revenue streams can cover operating costs, service debt finance and provide returns to risk capital.

#### 5.1 Risk Analysis

There are three principal participants in BOT-type procurement – (1) Procurer usually Government; (2) Franchisee/ Sponsor and (3) Lenders. Fig.5 provides a flow chart of risk evaluation chart of the analytical approach from the perspectives of the main parties of the project.

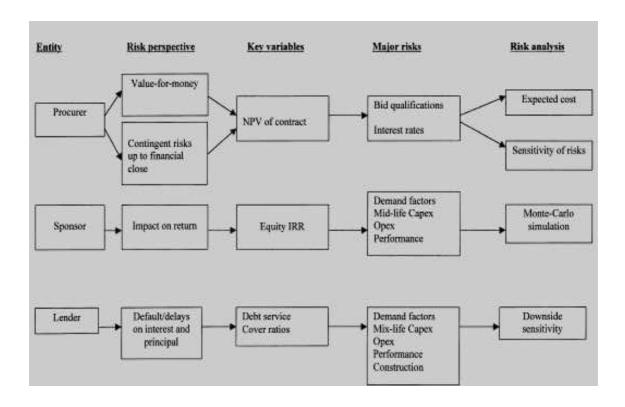


Figure 5: Flow Chart of Analytical approach

From the viewpoint of Government the money should be spent economically, efficiently and effectively. The government i.e. the public procurer seeks to utilize private sector money and expertise and thereby achieve value for money which may come from the private sector innovation and skills in design, construction and operation of the project. Even though the Government transfers keys risks in design, construction delays, cost overruns and finance etc. to a private sector entity, however, risk transfer may be misleading. The project sponsor in PPP forms a highly geared special purpose company (SPC) for the project vehicle and consequently, a reliance on revenues to pay for operating cost cover debt financing, giving the requisite return on the risk capital. PPP projects are viable only if continuous long term revenue is assured otherwise it is the greatest risk to the viability of the project.

As the straight equity participation is very low in PPP projects, the risk is borne by lenders which provide finance or financial guarantees. The providers of finance look the cash flow of the project as the source of funds for repayment as the financing is without recourse to sponsor companies.

In most of the infrastructure projects particularly, the highway sector, project assets do not constitute adequate security for lenders. It is project revenue streams that constitute the mainstay of their security. Lenders would, therefore, not only require adequate cash inflow but also require assignment and substitution rights so that the concession can be transferred to another company in the event of failure of the Concessionaire to operate the project successfully.

Based on the analysis of case studies reported in the literature a decision model is presented in which a project promoter can select an appropriate financial strategy depending on the possible risk to be faced during the project life cycle. The decision depends on the estimated quantum of financial, political and market risk and is shown in table 9. [17]

**Table 9:** Appropriate Financial Strategy Depending On the Possible Risk

Risk Conditions	Financing strategies
	Use high debt to equity ratio for maximum leverage and maximum return on
	invested equity
Low Risk	Establish minimum contingency credit facilities to minimize financing cost.
	Use capital markets to procure debt financing to reduce interest cost.
	Procure long term financing early to reduce financing costs.
	Involve International firms or organizations to create leverage with local
	government authorities.
High political	Seek assistance from influential individuals or organizations who have
risk	rapport with local government authorities.
TISK	Seek local government support and guarantees.
	Procure insurance from government organizations
	Establish contingency credit facilities.
	Obtain loans from international lending institutions
	Use fixed rate or standardized rate debt financing
High Financial	Denominate loans in local currency
risk	Structure debt financing in the same currencies as anticipated revenues
	Structure revenues in both local and foreign currencies
	Seek government support and guarantees.

	Insert revenue escalation provision into the contract.
	Establish a contingency credit facility to cover unanticipated expenses.
High Market Risk	Finance early phases with equity and temporary loans and refinance during the operation phase with lower cost long term debt  Structure the debt repayment schedule to start low and escalate during the initial years of operation  Negotiate contract terms that allow increases in user fees.  Establish a contingency credit facility to cover unanticipated revenue shortfalls.  Restructure debt, if necessary, to solve cash flow problems during the concession period.

#### 5.2 Government Support

The commercial and technical risks are being allocated to the private sector but all direct and indirect political risks are assigned to the government. Government support in providing a favorable environment is pre-requisite to the success of the BOT project.

Government of India has introduced several innovative Schemes aimed at promoting PPPs. While encouraging PPPs, six constraints have been identified:

- 1. Policy and regulatory gaps, specially relating to specific sector policies and regulations;
- 2. Inadequate availability of long term finance (10 year plus tenor) both equity and debt:
- 3. Inadequate capacity in public institutions and public officials to manage PPP processes;
- 4. Inadequate capacity in the private sector both in the form of developer/investor and technical manpower; and
- 5. Inadequate shelf of bankable infrastructure projects that can be bid out to the private sector.
- 6. Inadequate advocacy to create greater acceptance of PPPs by the public.

#### 5.3 Policy and regulatory constraints

- 1. Weakness in enabling policy and regulatory framework. Political and regulatory risks are still perceived to be significant by the private sector. Slow and fragmented approval processes create risk as a delay increase the overall cost of the bidder. There should be specialized and efficient dispute resolution and arbitration mechanism. Documentation of best practices and quicker assimilation and dissemination of the practices to various levels of the Government is needed. There is a limited systematic compilation analysis and transfer within the public sector and knowledge between PPP projects, sectors and different govt.; to the extent that there is a lack of confidence in civil servants to undertake PPPs [5].
- 2. Adequate instruments and capacity to meet long term equity and debt financing is not available. The government of India has recently setup a corpus fund titled India infrastructure project development fund (IIPDF) for supporting the development of credible and bankable PPP projects. This is a welcome step robust evaluation mechanism is needed to ensure that PPP programs are delivering value for money. The PPP projects financed by investment bank should be properly monitored and evaluated. Techno economic and financial appraisals made by the investment banks are useful to the promoter, commercial bankers, and the concessionaires.
- 3. Lack of shelf of credible, bankable infrastructure projects. During a survey made by World Bank 16 projects were found abandoned, mainly because the projects were not bankable. This is mainly because of lack of capacity in public institutions and official to manage the PPP process. Further, on one hand, the development is done where the user can pay and on the other side because of the economical condition of the user the projects are not bankable. For the overall development of the country the implementation of such types of projects is utmost important. This could be achieved by making suitable packages of two or more than two projects consisting of a bankable and an unbankable project so that the total package becomes bankable.

#### 5.4 Recommendations

To address these constraints perceived in the implementation of PPP projects the following are recommendations:

- 1. Fiscal benefits in terms of tax holiday to infrastructure projects and tax incentives to investors may be provided.
- 2. Approval mechanism including environmental clearance should be streamlined.
- 3. Systematic compilation, analysis and experiences should be made available and the same be provided on the website which has been recently launched by the government to exclusively devoted to PPPs. This will facilitate quicker assimilation and dissemination of best practices to various levels of govt.
- 4. Preparation of standard documents such as model concession agreement, prequalification and procurement processes.
- 5. A specialized and efficient dispute resolution and arbitration mechanism may be created.
- 6. Institutions may be created solely for the purpose of promoting PPP projects at the central and state level.
- 7. A robust transparent evaluation mechanism may be provided to ensure that PPP program are delivering value for money.
- 8. Facilitating equity financing by improving exit policy and better corporate governance.

#### 6. Decision support system for ranking best value promoter.

In most of the public sector contracts including the BOT contracts, the selection of the contractor/concessionaire is based on open competitive bidding and the contract is awarded solely based on lowest price. The low bid while promoting the competition may not result in selecting the best performing contractor who will deliver the best quality project. There is a need to evolve a procurement process where price and other key factors are considered in the evaluation process to minimize impacts and enhance the long term performance and value of construction. Based on the above concept the best value model is developed. Figure 6 shows the decision model for awarding the contract.

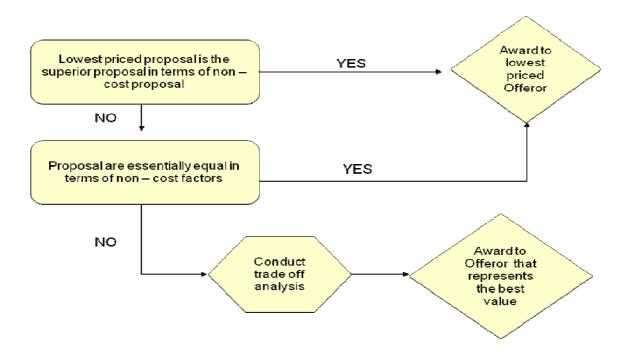


Figure 6: Decision Model for Awarding the Contract

In India and many other countries, the selection of concessionaire is based on an open competitive bidding. All project parameters such as the concession period, toll rates, price indexation and technical parameters are to be clearly stated upfront and short listed bidders will be required to specify only the amount of grant sought by them. The bidder who seeks the lowest grant should win the contract. In exceptional cases, instead of seeking a grant, a bidder may offer to share the project revenues with the Authority. The above procedure ensures that the tender evaluation is not partial, equitable and thorough.

Therefore, the primary tool available to the owners to counter act cost cutting incentives inherent in a low bid system is through the process of prequalification. Prequalification process is therefore very crucial to select capable potential bidders and thus ensure the success of the construction projects. As a general practice detailed submissions are not sought in initial responses to an invitation to develop a major infrastructure project.

#### 6.1 Request for Qualification in India

In India, pre-qualification process is adopted to shortlist eligible bidders for the BOT projects. The criteria of evaluation along with the schedule of bidding process are described in the RFQ document [18]. Most of the central government departments such as NHAI, Railways, Ministry of Surface Transport and various state government departments such as Housing Boards, Municipal Corporations, State Road Development Authorities etc. and various public sector undertakings are using this route to develop their infrastructure facilities.

The document includes (i) project brief, (ii) instructions to applicant, (iii) criteria for evaluation and evaluating methodology, (iv) Schedule of bidding process, (v) formats for application giving eligibility details.

For developing an integrated township project under PPP concept the applicant's competence and capability has to be established based on the following parameters:

- (i) Technical experience
- (ii) Financial capability in terms of
  - (a) Net worth
  - (b) Net cash accruals
  - (c) Annual income

These traditional methods tend to ignore other criteria like management skills, entrepreneurship and leadership. During that stage of selecting the contractor much inexact, uncertain, incomplete information about the project and contractors/promoters is available and the decisions are to be made based on that incomplete or qualitative information by the decision maker. Saaty provides a useful tool to deal with decision making in which the information is imprecise and vague [19]. Based on AHP and multi attribute decision making analysis, the thesis presents the frame work to solve construction contractor prequalification which includes developing a decision support system wherein the linguistic variables can also be processed.

The problem of evaluation of applicants reduces to that of a problem of multi attribute decision-making where there could be conflicting objectives having different importance

(weights) to the owner. The methodology organizes the problem in the following sequential format:

- Step 1: Define basic criteria
- Step 2: Group basic criteria in to progressively fewer groups to ultimately form a single criteria.
- Step 3: Rank the applicants.
- Step 4: Sensitivity Analysis. The sensitivity analysis is made to see the effect of altering the weights of the criteria on the ranking of the alternatives.

A four package criteria set for evaluation of the applicants is generalized and its hierarchy is shown in table 10 and figure 7.

- Financial package consisting of five basic criteria
- Technical package consisting of five basic criteria
- Managerial Entrepreneur package consisting of four basic criteria
- Managerial Environment package consisting of three basic criteria

**Table 10:** Evaluation Packages For Short Listing

		Managerial package		
Financial Package	Technical package	Entrepreneural package	Environmental package	
FP1 net worth	TP1 Experience of doing similar projects	IFP1 Leadership and entrepreheurship	EP1 Qualifications/ experience of safety, health and environmental personnel	
FP2 Average Annual turnover	TP2 Experience of other projects	EP2 Project management skills	EP2 Past health and safety performance	
FP3 Annual Income	TP3 Plants and equipments owned	EP3 Risk management system	EP3 ISO 14000 Certifications	
FP4 Loan Agreement	TP4 Strong and capable project team	EP4 Contractual relationships among participants		
FP5 Equity - debt ratio	TP5 Project organization structure			

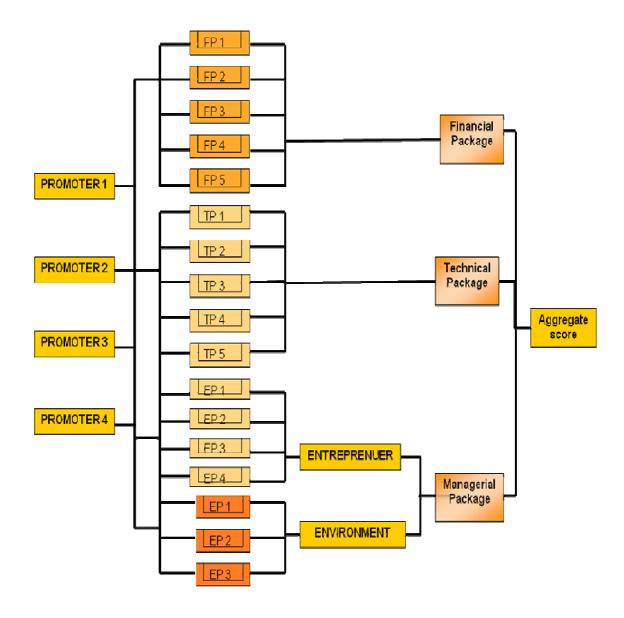


Figure7: Hierarchy Model for Evaluation Packages

The relative importance of various promoters with respect to various basic criteria at level 5 are compared by pair wise comparison matrix and their preferences with respect to promoters (alternatives) are obtained.

After obtaining the relative importance matrix of applicant promoters with respect to the various attributes and their relative weights at level 4, level 3 and level 2, the aggregated score of each promoter is calculated.

Through the aggregation process the alternatives have been prioritized as shown in Table 11. The promoter P2 having the highest aggregate score is ranked at number 1.

**Table 11:** Ranking of Applicant Promoters

S.NO	PROMOTER NAME	AGGREGATE SCORE	RANK
1	PROMOTER 1	0.26	3
2	PROMOTER 2	0.29	1
3	PROMOTER 3	0.27	2
4	PROMOTER 4	0.17	4

#### 6.2 Sensitivity analysis

The owner/governments may wish to know as to how the ranking of applicants will change, if the weights assigned to criteria at various levels are altered. The sensitivity analysis is made by altering the weights of criteria at level 2 and level 3. By keeping one of the weights as constant (say management package and its sub packages), the weights of the other criteria are varied from 0.1 to 0.8. The variation of aggregated value of promoters can be obtained and a graph can be plotted for each constant value of management package weight and changing the weights of financial package and technical package. The score values of promoters for different values of weights of financial package and technical package and value of management package changing from 0.1(sub package value 0.067 and 0.033) to 0.8 (sub package value 0.536 and 0.264) respectively and is shown in table 12.

The graph showing the variation of aggregate score values with respect to one of the values of the weights is shown in Figure 8. MS-Excel has been used for the sensitivity analysis.

**Table 12:** Score values of promoters for different values of weights of Financial, Technical and Managerial Packages

weight for managerial Package EP1 - 0.067 and EP2 - 0.033								
weight for financial package	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
weight for Technical								
package	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10
Promoter 1	0.39	0.36	0.34	0.31	0.29	0.26	0.24	0.21
Promoter 2	0.21	0.22	0.24	0.26	0.27	0.29	0.31	0.33
Promoter 3	0.18	0.20	0.22	0.24	0.25	0.27	0.29	0.31
Promoter 4	0.22	0.21	0.20	0.19	0.18	0.17	0.16	0.15

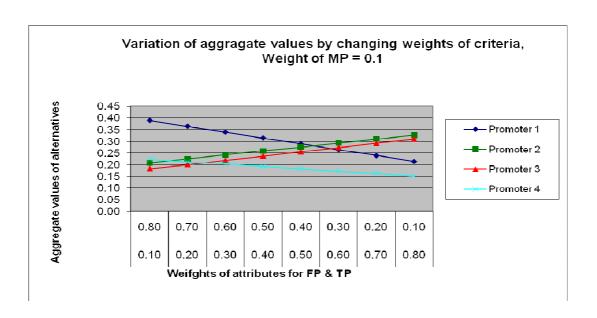


Figure 8: Variation of Aggregate Score Values

#### 7. Recommendations to practitioners

- 1. The identification and ranking of CSF's will help owners, professionals and governments to provide more attention to them so that the scarce resources are optimally utilized for successfully completing the project.
- 2. The causes of delays identified can be managed so as to avoid time overruns of the project.
- 3. The model developed for short listing the BOT promoter can help owner, government to prepare a ranked list of various applicants so that the time required during the prequalification process can be reduced.
- 4. The best value method will provide the owners to incorporate non price factors also while selecting the contractor who will provide the best value to the owner.
- 5. By crashing the project duration the owner/ promoter can increase his profit margins as well as the facility is available to the public earlier creating win-win situations.
- 6. The guidelines and recommendations provided can be used by the government, promoters and the lenders for a win-win strategy in BOT projects.
- 7. Sensitivity test will help the owners/ govt. to ensure that the results would be sufficiently robust and will not be easily altered due to slight variations in one or more weighting factors.

#### 8. Summary and future scope of work.

The present study has been made to suggest and develop some tools which will eventually be useful to the governments, financial institutions, owners and/or contractors for timely completion of large infrastructure projects at reasonable cost and of a specified quality.

The factors responsible for time overruns were identified through a postal survey. The relative importance and significance of these factors was investigated. The results were then compared with earlier studies been done internationally. A hierarchical success model for identification of critical success factors is developed. Analysis of the data collected from experts is done by AHP and RII method separately. The results are compared with the result of previous studies. To validate the results agreement analysis was made.

The effect of short construction period of a project on its profitability has been studied in this research work by varying the total construction period. It is observed that even spending more for reducing the construction time the overall profitability of the project enhances significantly.

The various types of risk encountered in BOT projects were analyzed from the perspective of various key participants. Based on the study of the literature survey infrastructure BOT projects in North America, Asia including India were analyzed. The project risks that were determined to be most significant were political, financial and market risk. A decision model is presented that can be used by BOT promoters in selecting appropriate financial strategies.

The low-bid method fails to serve the public interest because the lowest offer may not result in the lowest overall cost to the public. Best-value contracting strategy aims at using price and other key factors in the evaluation and selection process to enhance the long-term performance of projects. A new concept of best-value modeling that is unique and tailored to each project is discussed. Primary parameters that impact contractor selection are identified and analyzed based on which best-value concessionaire selection model is designed

In India and many other countries the selection of concessionaire is based on an open competitive bidding. All project parameters such as the concession period, toll rates, price indexation and technical parameters are to be clearly stated upfront and short listed bidders will be required to specify only the amount of grant sought by them. The bidder who seeks the lowest grant should win the contract. In exceptional cases, instead of seeking a grant, a bidder may offer to share the project revenues with the Authority.

The prequalification process adopted in India and in other developed and developing countries to shortlist the eligible bidders for the BOT projects is presented in the thesis. In most of the cases it is the screening of the contractors by owners based on set of criteria. Infrastructure project promoter qualification is not only very crucial for project success but is a complex multi attribute decision making problem under uncertain environment. A framework based on AHP is proposed for ranking various applicants depending upon the specific project characteristics. The framework includes selection of basic criteria and the assessment of their weights, systematic aggregation and finally to rank the applicants for prequalification.

The model has been implemented using Microsoft excel. A simple procedure is developed to get the sensitivity analysis of the problem to study the variations because of change in the values of input parameters.

Further supportive research is required for the analysis of various risk factors and uncertainties involved in BOT projects. Sensitivity analysis can be applied considering all the criteria at the lowest level.

#### 9. Thesis layout.

Present study is presented in eight chapters. A brief outline of the various chapters is as follows:

In **Chapter 1**, the objectives and scope of the research work has been defined. A brief outline of various chapters has also been presented in this chapter.

In **Chapter 2**, a critical survey of work happening globally as existing in the literature for the success of construction projects is presented.

In **Chapter 3** overall methodology of the research work has been presented.

In **Chapter 4**, background of BOT projects and its variations has been presented. The current status of PPPs in India is described and the comparison is made with other countries. PPP projects are targeting towards financing, designing, implementing and operating infrastructure facilities and services that were traditionally provided by the public sector. The role and relationships between various participants and stake holders in a BOT project are enumerated. The financing needs for the required infrastructure in various sectors have been shown.

In **Chapter 5**, the results of field surveys for time delays in traditional and BOT projects are presented. The postal survey was conducted to determine the causes of delay and their importance according to each category of project participant. In this Chapter, the factors causing time overruns in construction for both traditional and BOT projects in India are identified and their relative importance and significance is established. The results obtained are then compared with other researchers' results. Project delivery method of Built-Operate-Transfer (BOT) can increase the speed of construction. Although many BOT projects have been implemented worldwide, some projects have encountered major obstacles. Study results reveal that the political and the government issues are the most significant delay causes.

In **Chapter 6**, systematic approach has been taken to identify and analyze CSFs for BOT projects. Through literature survey and initiatives of experts and practitioners in India certain factors were initially identified which were considered to be the critical for the success of BOT projects. In the first step, a questionnaire based on the success factors of BOT projects was developed in which the respondents were asked to give the importance of the factors on a scale of 1 to 5. The analysis of data obtained was made by Relative Importance Index method and the important CSFs as identified were further sent to the experts for a second survey. The Analytical Hierarchy Process (AHP) method has been adopted in the second survey to solicit consistent subjective expert judgment.

The analysis and results of the survey made to identify CSFs are presented in this chapter. Top CSFs identified are compared with previous study. The results of the survey are validated through Agreement analysis. The main CSFs identified in the study except transparent selection procedure are discussed in detail in this chapter.

In **chapter 7**, a transparent, multi-attribute decision support system has been developed for addressing the pre-qualification issues such as the decision criteria analysis, weights assessment and decision model development. A best value procurement model is developed to select the private sector partner which provides a balance between the consideration of price and qualifications so as to provide the best value to public procurer. Sensitivity analysis has been applied which will help the owners/governments to ensure that the results would be sufficiently robust and due to a slight variation in one or more weighting factors.

The final chapter, **chapter 8**, is devoted to results and conclusions. The recommendation to practitioners is made. This chapter also discusses scope for further research.

#### **REFERENCES**

- [1] Zhang X. Q., and Kumaraswamy M. M. "Hong Kong experience in managing BOT projects" Journal of Construction Engineering and Management, ASCE, 127(2), pp. 154–162, 2001.
- [2] Zhang X., "Concessionaire selection: methods and criteria", Journal of Construction Engineering and Management, ASCE, 130 (2), pp. 235-244, 2004.
- [3] Federal Highway Administration, "Synthesis of public private partnership projects for roads, bridges and tunnels from around the world 1985–2004", U.S. Department of Transportation, Washington, D.C., 2005.
- [4] Harris and Tadimalla, "Financing the boom in public-private partnerships in Indian infrastructure Trends and policy implications." PPIAF, Gridlines, 2008.
- [5] World Bank Report, "Building Capacities for Public Private Partnerships" pp. 1-64, 2006.
- [6] Shash A. A., "Factors considered in tendering decisions by top UK contractors", Construct. Manage. Economics, 11(2), pp. 111-118, 1993.
- [7] Jyh-Bin Yang, Chi-Cheng Yang, Chih Kuei Kao, "Evaluating schedule delay causes for private participating public construction works under the Build-Operate-Transfer model" International Journal of Project Management, 2009.
- [8] Chan D. W. M., and Kumaraswamy M. M., "A comparative study of causes of time overruns in Hong Kong construction projects" International Journal of Project Management, 15(1), pp. 55–63, 1997.
- [9] Assaf S.A. and Al-Hejji S., "Causes of delay in large construction projects", International Journal of Project Management, 24, pp. 349-357, 2006.
- [10] Okpala D. C., and Aniekwu A. N., "Causes of high construction costs in Nigeria." Journal of Construction Engineering and Management, ASCE, 114(2), pp. 233–244, 1988.
- [11] Tiong R. K., "CSFs in competitive tendering and negotiation model for BOT projects." Journal of Construction Engineering and Management, ASCE, 122(3), pp. 205–211, 1996.
- [12] Gupta M. C., and Narasimham, S. V., "Discussion of 'CSFs in competitive tendering and negotiation model for BOT projects' by R.L. K. Tiong." Journal of Construction Engineering and Management, ASCE, 124(5), pp. 430, 1998.

- [13] Zhang X.-Q., "Concessionaire's Financial Capability in Developing Build-Operate-Transfer Type Infrastructure Projects." Journal of Construction Engineering and Management, ASCE, 2005.
- [14] Grimsey D. and Lewis M. K., "Evaluating the risks of public private partnerships for Infrastructure Projects", International Journal of project management, 20(2002), pp. 107-118, 2002.
- [15] Merna A., and Smith N. J., "Guide to the preparation and evaluation of build-own-operate-transfer (BOOT) project tenders", Asia Law & Practice, Hong Kong, 1996.
- [16] Kumaraswamy M. and Morris D., "Build-operate-transfer-type procurement in Asia megaprojects." Journal of Construction Engineering and Management, ASCE, 128 (2), pp. 93–102, 2002.
- [17] Schaufelberger and Wipadapisut, "Alternate Financing Strategies for build operate transfer projects" Journal of Construction Engineering and Management, ASCE, pp. 205 213, 2003.
- [18] Rail Land Development Authority, "Grant of least for development of plot at Gola Ka Mandir, Gwalior", Request for Qualification (RFQ) Document, pp. 1-32, 2007.
- [19] Saaty T. L., "The analytic hierarchy process: planning, priority setting, resource allocation." McGraw-Hill, London, England, 1980.