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Analyzing key success factors in public-private partnership BOT projects: an empirical study on financing influences, insights, and analysis in construction management

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ABSTRACT

The study encompasses various infrastructural amenities such as railways, roads, ports, bridges, tunnels, power plants, hospitals, municipal buildings, and other public-use facilities, which are essential for every country's economic growth. Recognizing the challenges faced by governments in independently providing all infrastructure components, Public Private Partnerships [PPPs] have emerged as a cooperative approach between the public and private sectors. This paper explores the risks, delays, key success factors, contractor selection, and best value selection models in construction project management. In addition, the paper emphasizes the challenges that governments need to address in order to ensure the efficient functioning of the BOT (Built Operate Transfer) network. The challenges in establishing an efficient BOT network are highlighted, and a decision-support system using the .Net framework is developed to aid in the prequalification and rating of BOT marketers. The purpose of this system is to provide the best value to the public procurer by employing regression analysis to rate bidders/applicants and utilizing a composite programming method based on relative weighting.

Keywords: Infrastructure Development; Public-Private Partnerships; Construction Project Management; Risk Assessment; Prequalification Process.

1. INTRODUCTION

The country's economic development depends on its civil infrastructure. Infrastructure may be viewed as the foundation upon which society is constructed. Highways, railways, ports, bridges, hydraulic structures, power plants, tunnels, municipal infrastructure including sanitation and water supply, and other public-use amenities all fall under this category. Building and maintaining essential infrastructure requires long-term financial commitment. The use of innovative finance has been spurred by the urgent demand for such projects, as well as recurring budgetary deficits faced by government agencies [1]. Due to a lack of national fund, many governments, particularly those in developing countries, have asked private sector groups to participate in long-term contractual arrangements for the funding, building, and operation of capital-intensive infrastructure projects. India's transportation and urban development have seen the most significant growth. This boom is largely driven by a surge in infrastructure projects, especially in terms of project quantity [2]. Public-private partnerships (PPP) are seen as crucial for maintaining India's economic growth above 6% annually, considering the limitations of the existing infrastructure. The Government of India (GoI) has undertaken attempts in recent years to increase infrastructure investment, notably to catalyze more private participation [3]. Infrastructure development, on the other hand, usually necessitates a large upfront financial commitment due to the significant capital expenditure necessary during the building stage [4]. Infrastructure projects are fraught with dangers that might result in cost overruns and lower financial returns. The source says that about 1000 infrastructure projects are backlogged among 27% of central government projects, while about 15% have exceeded their initial cost projections [5]. As a result, raising and arranging capital for building infrastructure is a difficult task. The infrastructure funding needs of India vary from US$ 1 to US$ 3 trillion each year. States with high population densities, such as Uttar Pradesh, Maharashtra and Bihar, as well as the Eastern area which has a

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lower population density and steep terrain, are expected to have greater infrastructure requirements. Demand is also anticipated to be driven by infrastructure geared for climate adaptation and adopting smart technology-based solutions. To address the rising infrastructure deficits in the medium term, new sources and methods of finance must be opened [6].

These are three important critical areas that should be considered for effective management:

(i) Accelerating public-private partnerships (PPPs)
(ii) Increasing investments in smart infrastructure solutions; and
(iii) Creating capacity through a "learning-by-doing" strategy to improve infrastructure finance usage.

A Public-Private Partnership (PPP) Project means a project based on an agreement or special privileges contract between a government or statutory entity on the one hand and a private sector company on the other hand, for delivering an infrastructure service on payment of user charges," according to the Government of India's Strategy for Economic Assistance to PPP (Public Private Partnerships) in Infrastructure [7]. There is no generally accepted definition of a public-private partnership (PPP). PPPs are long-term contractual collaborations between public and private sector entities, with the goal of funding, developing, constructing, and running infrastructure facilities and services that are previously supplied by the government [8]. In a Public-Private Partnership (PPP), both participating partners agree to work together to execute, operate, and manage the project. This collaboration is typically formalized through legally binding contracts or other agreed-upon methods [9]. The partnership is established based on the unique skills and expertise of each partner, with the primary objective of meeting specific public requirements by allocating: Incomes, Jeopardies, Recompences, and Responsibilities [10]. These and other aspects of PPP projects, such as implementation details, termination, liabilities, dispute resolution, and payment arrangements, are negotiated and written in formal service contracts signed by all parties involved [11]. In both developed and developing nations, many forms of public-private partnerships (PPPs) are used to create infrastructure. On the one hand, this strategy has resulted in the productive development of projects, but on the other hand, PPPs have faced several problems across the nation. One difficulty is the sluggish speed at which PPPs are implemented, this way of built in infrastructure results in tiny percentage [12]. PPP-projects fail or being abandoned, putting both the proponents and the funding institutions in a financial bind. As a result, an efficient procurement strategy is essential for future PPP projects to enhance standards. A lot of factors impact whether an infrastructure project succeeds or fails in terms of price, time, and quality. The KSF (Key Success Factor) for these goals will be established in order to make the most optimal usage of the limited resources available [13, 14]. The public sector as a whole has a rich history of awarding a contract to the lowest bidder. A low-bid approach, on the other hand, encourages contractors to use cost-cutting tactics rather than quality-improvement measures, making it likely that the contract will be awarded to the best-performing contractors who can provide the best goods [15, 16]. As a result, public shareholders are increasingly seeking methods to include non-price aspects into the procurement process, both qualitative and quantitative, to motivate construction companies to not only enhance their productivity during work but also to add value to the finished items [17, 18]. The goal of this article is to determine Key success factors for BOT projects to contribute towards the development of methodologies and tools that will assist proprietors and/or builders in completing construction projects on time, on budget, and to a predetermined quality standard [19, 20]. It all starts with a thorough review of the literature in order to discover and describe widely held construction management knowledge. This study aims to shift away from traditional risk mitigation, which concentrates on risks, toward strategic decision-making, which focuses on achieving win-win outcomes [21, 22]. The study includes:

1. Perform a field-survey using a questionnaire and one to one discussions to discover the principal reasons for construction delay for both conventional and BOT operations, as well as the perspectives of three important stakeholders: the client, consultant, and contractor.
2. Using SPSS (Statistical Package for Social Sciences) to identify the critical Key success criteria for BOT initiatives based on industry experts' expertise and opinions (SPSS).
3. To identify and debate a variety of issues, such as strategic planning, that government should tackle in order for the BOT process to work well.
4. Using Multi-attribute decision theory, develop a "decision support system" for making appropriate choices for BOT promoters in order to provide excellent value to the public procurer.

SPSS is often preferred by researchers because of its user-friendly interface and extensive capabilities. RII, is a statistical technique used to assess the relative importance of different variables in explaining a particular outcome. Large number of unknown variables can be analyzed in a fastest and more reliable way, in this case, SPSS nor RII is inherently more reliable than other approaches.

2. METHODOLOGY

Construction project management covers various critical aspects, such as managing risks in large infrastructure projects, dealing with delays, identifying key success drivers, learning from global BOT practices, selecting contractors, and employing best value selection models [23]. These areas are extensively investigated through surveys of peer-reviewed literature. However, the summary provided only includes a small portion of the most significant sources [24]. Additionally, the study includes a postal questionnaire survey to assess the factors that cause delays in BOT projects. Furthermore, interviews are conducted with different construction project stakeholders to gain a better understanding of the fundamental causes of these delays [8]. Out of 520 individuals contacted for a survey on success factors for BOT projects in India, 380 responded (73% response rate). The survey included questionnaires sent via mail to 220 contractors (42%), 170 consultants (33%), and 180 clients (25%) as shown in Figure 1. This statistically significant data provides valuable insights into BOT project construction in India. The study also indicates the obstacles the government must overcome in order for the BOT network to operate properly [25]. This research investigates a novel approach to promoter selection for India's BOT projects within Public-Private Partnerships (PPP), prioritizing public sector value. It proposes a two-fold solution: a comprehensive framework evaluating promoters based on critical project success factors like technical expertise, financial strength, and managerial capabilities. This framework will be complemented by a decision-support system built using the .NET framework. This system will leverage SPSS software and multi-attribute decision-making analysis to improve efficiency in promoter selection, particularly when faced with incomplete information. Ultimately, this approach aims to enhance infrastructure project outcomes.

3. EXPERIMENTAL ANALYSIS

3.1. Analysis of time delay

To assess the extent of time overruns in building projects and identify the contributing factors, researchers conduct a postal survey using a three-part questionnaire. The questionnaire is divided into three parts. The first part focuses on six key factors that influence how important time is in both traditional and BOT (Build-Operate-Transfer) projects. It also explores the extent to which different organizations experience schedule delays. The second and third sections delve into the reasons behind schedule overruns in both conventional and BOT projects.Totally 50 factors are identified through the literature study. The study examines: contractor, consultant and client-related elements. This classification aims to determine the extent of the issue, allocate responsibility, and identify potential actions to mitigate time delays. Variables affecting owners, contractors, and consultants are directly attributed to these professionals, while the construction manager addresses project-related and external-related concerns based on the specific scenario [26]. The Initial part of the poll plots the perception of respondent's abouts their perception of time overrun. For both traditional and BOT projects, respondents will

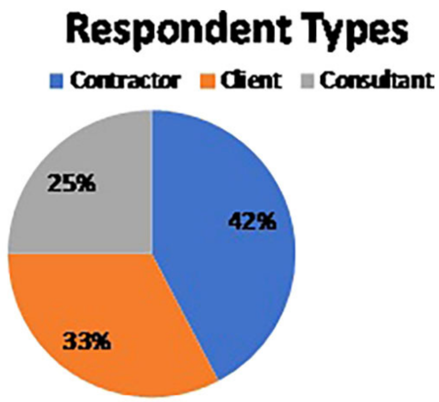

Figure 1: Respondent types.

be asked to determine the relative importance of each attribute on the project's schedule overrun on a scale of 1 to 5, with 5 being the most significant and 1 being the least significant (where 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and 1 = Strongly Disagree).

3.1.1. Analysis of the survey

According to the Preliminary report, time overruns occur in more than 70 percent of typical construction projects, with the owner, contractor, and consultant each contributing 50, 40, and 10% of time overruns, respectively. Regardless of project size, time overruns are unaffected. A survey revealed a surprising prioritization for BOT and infrastructure projects. As shown in Figure 2, completing construction within the planned timeframe is considered the most critical objective, followed by quality. Interestingly, cost comes in last. This prioritization can likely be attributed to the unique cash flow of BOT projects. Since revenue generation typically begins only after the project is operational, timely completion becomes paramount.

The second most critical element is identified as the quality which indicates the need for maintining the facility during the period of operation. On the other hand, cost control should be justified, although it is not as essential in BOT projects as time and quality. Timing delays are infrequently encountered during the construction of BOT projects.. The majority of the delays are due to an insufficient lawful and governing framework. The data is evaluated using the Relative Important Index (RII). To assess the relative importance of each element in creating project time overruns. The following equation is used to calculate the relative importance index (RII):

$$RII = \sum W / (A \times N) \quad (1)$$

Where W denotes the respondents' weights for each element, which vary from 1 to 5. A represents the most significant weight, and N = total number of respondents. The analysis is carried out separately for each of the three types of respondents. The overall rating as well as the ranking by category are determined. The top 10 factors influencing traditional project time overruns are analyzed in Table 1.

The study has therefore listed ten major concerns for delay in BOT Projects across India. Promoter aims to maximize the project's profitability by expediting the building construction process. Jy-Bin Yang discovered delay factors at various phases of BOT projects through two questionnaire surveys based on his perception of BOT participant. Based on the study's findings, the major factors contributing to delays in BOT projects include the negotiation stage of concession contracts leading to the awarding of concessions to contractors, political instability, concerns related to debt, and government-finished goods. Table 2 shows the Factors influencing BOT project time overruns.

3.2. The questionnaire survey's validity and reliability

To ensure the questionnaire's quality, the researchers performed a validity analysis (VA) and reliability analysis (RA). VA aimed to confirm whether the questionnaire effectively measured the intended variables. The rankings of delay variables were determined based on the responses from all participants. One interesting aspect of the study was observing how different individuals ranked these delay characteristics [8]. For the rank agreement

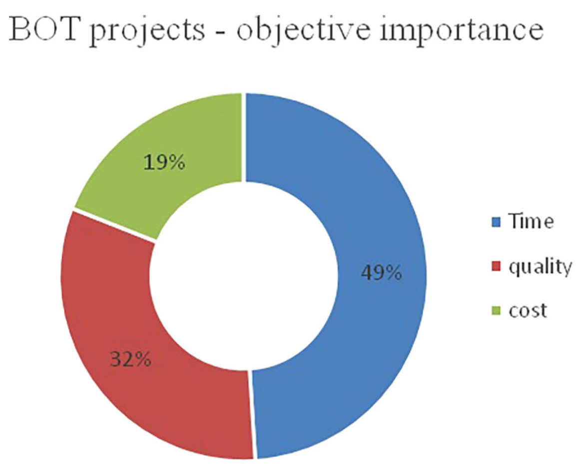

Figure 2: BOT projects (Objective Importance).

Table 1: Factors influencing traditional project time overrun.

Contractor Related	Contractors with monitoring and scheduling experience
	Site monitoring and control
	Difficulties in obtaining funding for a project
Consultant Related	Approval of design documentation is taking longer than expected.
Owner Related	Owner's payment delinquency
	Modifications in the construction process
	Contract period that is absurd
Project Related	All project teams are participating in the development process at the same time.
	Project tendering and awarding types
External Related	Unforeseen site conditions

Table 2: Factors influencing BOT project time overruns.

S.NO	FACTORS
1	Financial risk
2	Political Concern
3	Environmental issues and constraints
4	Permissions are being obtained slowly.
5	Financial hazard
6	Policies and guidelines are changing.
7	Weather conditions that are extreme
8	An accident took place during construction.
9	Utilities are not available on-site.
10	Delay in project allocation

analysis, the researchers employed a quantitative technique introduced by Goh, which utilized the "rank agreement factor" (RAF). Calculation of RAF is the absolute average difference in factor rankings between two groups. This approach helped to assess the level of agreement or disagreement in how delay factors were ranked by different sets of participants. Such analyses are crucial in ensuring the robustness and credibility of the research findings.

If there is two groups, the rank of the i^{th} item be Ri1 (group 1) and Ri2 (group 2), let N be the number of items, and j = N−i + 1.

$$\text{The RAF} = \frac{\sum_{i=1}^{N} |R–R|}{N} \tag{2}$$

The RAF is defined as, RAF = The maximum rank agreement factor (RAFmax) is defined as the percentage agreement (PA) is defined as PA = 100 – PD The lesser the agreement between the two groups, the higher the RAF value. A RAF of zero indicates complete agreement. It can be shown that all three sets of respondents, contractor-consultant, consultant-owner, and contractor-owner, have a high level of agreement in rating of delay factors, showing that the study is legitimate and trustworthy.

3.2.1. Analysis of factors

Factor analysis is a useful technique for identifying crucial elements among various potential causes. In this study, the researchers employed the Kaiser-Meyer-Olkin test and Bartlett's test of specificity for factor analysis. The Kaiser-Meyer-Olkin (KMO) test measures the ratio of quadratic correlation between variables to quadratic partial correlation between variables, ranging from 0 to 1. Higher KMO coefficients close to one indicate more reliable and compact relationships among variables. In this research, factors with KMO values greater than 0.50 were considered, resulting in 29 out of 45 factors being examined, while the other 16 factors were excluded due to their lack of meaningful associations with other variables. The correlation matrix, confirmed by Bartlett's test with a significance value of 0.001, indicated high interconnections among variables. Principal component analysis was then employed to reduce the highly connected factors into a smaller number of essential elements. With a minimum starting eigenvalue of 1.0, five main components were extracted, explaining 71.30 percent of the total variance. To assess the agreement among respondents on the element rankings, Spearman's rank correlation was used. Higher correlation values imply greater agreement between respondents. The results showed substantial connections between the three pairs of respondents (Client, Consultant, and Contractor) in rating the factors, with significant loadings of 82 percent, 78.1 percent, and 73.5 percent, respectively (Table 3).

Table 3: Analysis of factors.

FACTOR AND ATTRIBUTE DESCRIPTIONS	LOADING FACTOR	EXPLANATION OF VARIANCE	AGGREGATE PERCENTAGE
Factor 1: Present Situation			
support Programs and awareness campaigns	0.951	21.20%	21.20%
Assistance from the govt	0.953		
Policy of fiscal retrenchment and investment	0.844		
The effect on the environment	0.837		
Government that is reliable	0.831		
Factor 2: Stability in terms of finances			
Long-term demand is sufficient.	0.937	17.20%	37.50%
Competition is scarce.	0.944		
A sufficient inflow of net cash	0.652		
Construction is completed in a timely manner.	0.694		
Making responsible decisions	0.56		
Factor 3: Partnership of private operators			
Partnership's managerial member	0.934	12.50%	51.00%
A well-organized project framework	0.891		
A skilled and strong project team	0.837		
A significant business or entrepreneur takes the lead.	0.816		
Concessionaire selection procedure financial package	0.702		
Factor 4: Financial planning			
Long-term debt funding is available.	0.862	10.60%	58.90%
Enough exit possibilities for the lender	0.839		
Appropriate toll/tariff level(s), as well as any necessary formula adjustments	0.751		
Factor 5: Allocation of risk			
Agreement on concessions	0.951	7.90%	65.30%
An agreement between the shareholders	0.802		
Contract for design and construction	0.674		
An agreement on the operation	0.619		
Loan contract	0.655		
Factor 5: Solution based on technology			
A low-cost alternative	0.842	9.10%	61.00%
A dependable option	0.718		
Technology that has been successfully implemented	0.653		
A fresh approach	0.671		
Concerns about security	0.728		

3.2.2. Regression analysis

The study of the connection among variables is known as regression analysis. The control variables are organized into five categories, as indicated in Table 4, and the dependent variables are cost, quality, and time, all of which are related to project completion. To assess the quantifiable impacts of the components, regression analysis models are created, and the performance is tested in equation 1 [27].

$$Y_i = \beta_0 + \beta_1\alpha_{1i} + \beta_2\alpha_{2i} + \ldots + \beta_j\alpha_{ji}\,\varepsilon_i \quad (3)$$

Where Y represents the value of the dependent variables, β0 represents the constant, β1 to βj represents the regression coefficient, α1 to αn represents the values of the independent variables, and εi represents random error. The Spearman correlational analysis (SCA) was used to see if there was a link between the elements that influence formwork system selection. The SCA is employed to identify the independent variable that exhibits a significant correlation with the three criteria of cost, quality, and time. In the regression analysis, the independent factors are individually examined against the outcome variables of quality, cost, and time [28]. The model is chosen based on correlation strength, which is a measure of the model's quality of fit. When additional independent variables are introduced, the value of R^2 changes, and the model's modified R^2 is calculated.

3.3. Identification of key success factors (KSF)

Previous studies on Build-Operate-Transfer (BOT) projects often overlooked non-physical factors when identifying key success elements (KSFs) is shown in Figure 3. This research addresses this gap by proposing a systematic method to identify and analyze KSFs, encompassing both tangible and intangible aspects.The method leverages expert opinions through a well-established approach to ensure consistency [29]. This comprehensive model empowers better decision-making for BOT initiatives by considering all relevant factors, not just physical ones.

In this study, six key success factors (KSFs) are identified, each comprising various sub-factors (SFs) [30]. Validating the SPSS methodology, a questionanaire survey is conducted using the Relative Importance

Table 4: Regression analysis.

VARIABLE	B COEFFICIENT	SE	t-VALUE	SIG.(p)	(R^2)/ADJUSTED R^2
Time Factor					
Constant	2.256	0.311	2.687	0.001	0.3492/0.3754 F = 6.589 P = 0.0001 Durbin Watson = 1.758
Delay in project allocation	0.459	0.019	2.548	0.055	
Unforeseen site conditions	0.425	0.021	1.678	0.052	
Permissions are being obtained slowly.	0.381	0.123	1.196	0.032	
Cost Factor					
Constant	2.294	0.243	2.351	0.001	0.3557/0.3614 F = 7.512 P = 0.0001 Durbin Watson = 1.798
Owner's payment delinquency	0.451	0.225	1.839	0.051	
Difficulties in obtaining funding for a project	0.467	0.245	2.201	0.03	
Financial risk	0.411	0.022	2.197	0.041	
Quality Factor					
Constant	2.705	0.252	2.488	0.001	0.3678/0.361 F = 7.711 P = 0.0001 Durbin Watson = 1.845
Site monitoring and control	0.471	0.251	2.205	0.017	
Approval of design documentation is taking longer than expected.	0.479	0.022	2.024	0.029	
Modifications in the construction process	0.384	0.024	1.674	0.037	
Contract period that is absurd	0.457	0.236	1.761	0.028	

Index (RII) approach, and the obtained results are consistent. The extracted ten factors in the Table 10 by SPSS approach are compared to those identified by the RII method and also to earlier research conducted worldwide (Table 5).

3.3.1. KSF'S agreement analysis

The ranking of KSF's for BOT projects is determined using two independent approaches, the RII method and the SPSS methodology, based on responses to two surveys created specifically for the purpose. Given the variance in KSF rankings discovered, determining the amount of understanding between the two methodologies' rankings of these factors is crucial. The percentage of agreement (PA) for recognizing KSFs between the two techniques is 84.5 percent. As a consequence, the ranking between the RII and SPSS techniques has a high level of agreement (>85%), showing that the survey questionnaire is consistent in Table 6.

3.4. Discussion on top factors

The cornerstone of a successful project is a well-crafted concession agreement. This contract outlines a public entity leasing an asset to a private company for extended service provision. The private party also agrees to fund additional fixed projects during the lease. This structure aims to optimize public spending while delivering efficient and cost-effective services to users. A strong concession agreement acts as a legal and policy roadmap, attracting private investment and promoting efficiency. A short construction timeframe is crucial, not only for early user access but also for faster revenue generation, ultimately boosting project profitability. While a brief construction period is a vital element within the broader technical solution, it wasn't explicitly mentioned in Zhang's research. However, his focus on adequate project profitability to attract investors aligns with this concept. For Build-Operate-Transfer (BOT) projects, financial success is paramount as project revenue solely funds debt repayment and promoter dividends. Long-term user demand and positive cash flow are essential for a project to be considered financially viable by lenders. The financing strategy significantly impacts risk mitigation in BOT projects, as project income is the sole source of repayment. Project sponsors often utilize loan agreements to optimize long-term debt and minimize refinancing risks. Strong leadership with expertise in foreign BOT

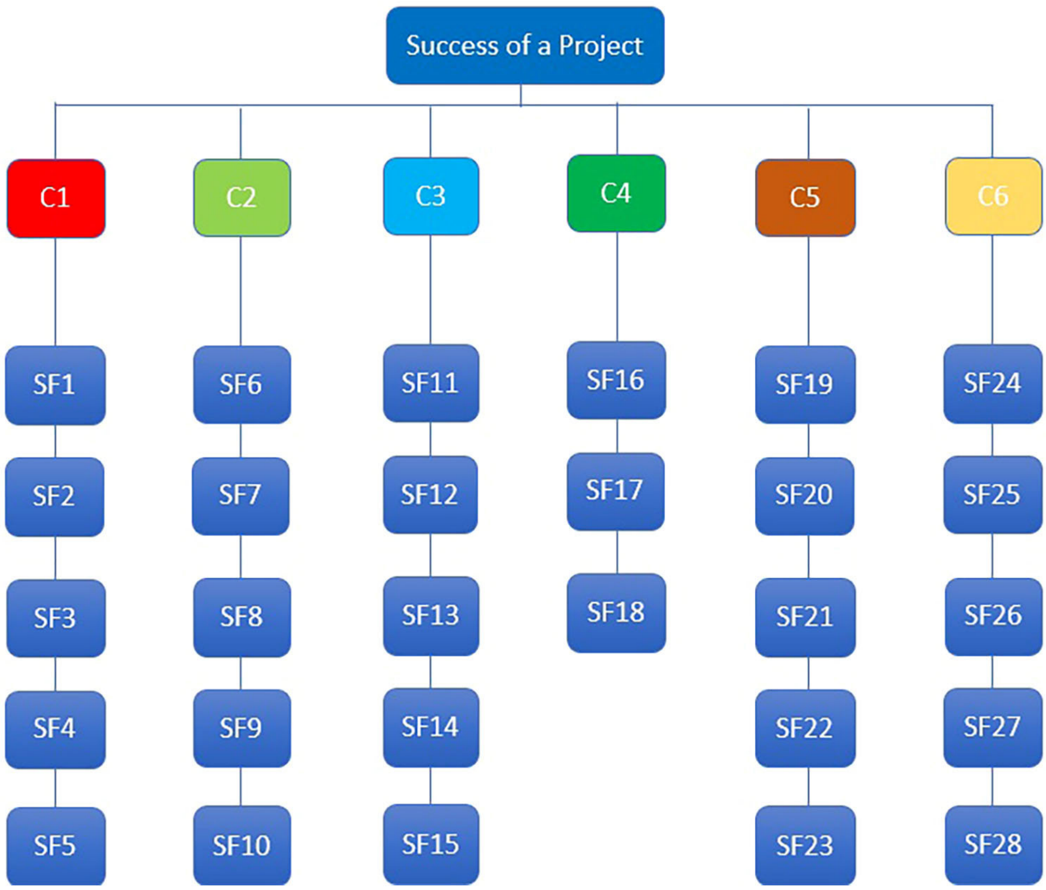

Figure 3: Success of the project using a hierarchy model.

Table 5: Success factors taken for SPSS analysis.

CATEGORY OF KSF	SUCCESS FACTOR
C1 – Present Situation	SF1 – support Programs and awareness campaigns
	SF2 – Assistance from the govt
	SF3 – Policy of fiscal retrenchment and investment
	SF4 – The effect on the environment
	SF5 – Government that is reliable
C2 – Stability in terms of finances	SF6 – Long-term demand is sufficient.
	SF7 – Competition is scarce.
	SF8 – A sufficient inflow of net cash
	SF9 – Construction is completed in a timely manner.
	SF10 – Making responsible decisions
C3 – Partnership of private operators	SF11 – Partnership's managerial member
	SF12 – A well-organized project framework
	SF13 – A skilled and strong project team
	SF14 – A significant business or entrepreneur takes the lead.
	SF15 – Concessionaire selection procedure financial package
C4 – Financial planning	SF16 – Long-term debt funding is available.
	SF17 – Enough exit possibilities for the lender
	SF18 – Appropriate toll/tariff level(s), as well as any necessary formula adjustments
C5 – Allocation of risk	SF19 – Agreement on concessions
	SF20 – An agreement between the shareholders
	SF21 – Contract for design and construction
	SF22 – An agreement on the operation
	SF23 – Loan contract
C6 – Solution based on technology	SF24 – A low-cost alternative
	SF25 – A dependable option
	SF26 – Technology that has been successfully implemented
	SF27 – A fresh approach
	SF28 – Concerns about security

Table 6: Top factors.

S. No.	Top Factors
1	Agreement on concessions
2	Construction is completed in a timely manner.
3	Concessionaire selection procedure financial package
4	Long-term demand is sufficient.
5	A sufficient inflow of net cash
6	Long-term debt funding is available.
7	A dependable option
8	A significant business or entrepreneur takes the lead.
9	Loan contract
10	Assistance from the government

project management is crucial. The concessionaire needs a capable leader with a proven track record and good relationships with government officials. A well-defined concession agreement should provide flexibility for the concessionaire to innovate and implement cost-effective designs without compromising service quality. This flexibility can lead to cost savings through innovative designs driven by output-based requirements.

3.5. Government aid and financial schemes

Large infrastructure projects, especially those financed through Build-Operate-Transfer (BOT) agreements, expose sponsors to a multitude of challenges. These risks, if not carefully mitigated, can lead to project failure. The inherent complexities of PPP projects, encompassing aspects like documentation, funding, taxes, technical specifications, sub-contracts, and other large-scale project intricacies, contribute significantly to the overall risk profile. Additionally, the nature of these risks evolves throughout the project lifecycle. For instance, risks encountered during the construction phase differ from those faced during the operational phase. Broadly, these risks can be classified into two categories: elemental risks and global risks. Elemental risks, encompassing aspects like physical risks, design flaws, construction issues, operation and maintenance challenges, technological disruptions, financial constraints, and revenue generation shortfalls, are generally considered more manageable than global risks [5]. Global risks, on the other hand, encompass political, legal, commercial, and environmental factors that can significantly impact project outcomes. Literature suggests that effectively managing elemental risks is essential for BOT projects, given the intricate relationships between the involved parties. While many of these risks are common across various project financing endeavors, their severity varies depending on the specific project. Fortunately, established methodologies can be applied to assess these risks. A critical challenge lies in ensuring that the project's revenue streams are sufficient to cover operational expenses, service debt obligations, and provide returns on invested capital.

3.5.1. Menace analysis

A BOT procurement typically involves three key parties: 1. The public entity initiating the project, often a government agency. 2. The private company or consortium financing, building, and operating the project for a set period. 3. The financial institutions lending money for the project's development. Typical relationship between principal participants in BOT type procurement is shown in Figure 4.

From the perspective of the project's major stakeholders, the flow diagram of the project risk graph of the analytical approach is examined is shown in Figure 5. In the government's view, spending should be optimized. They aim to get the most value by involving private companies. This could involve private sector expertise in planning, building, and running the project, all under government oversight. However, transferring risks like design flaws, delays, and cost increases to private companies can be an illusion. Public-Private Partnerships (PPPs) often rely on a specially created entity to manage the project. This entity depends on future revenue to cover costs and debt, ensuring a return for the private investor. However, long-term income is crucial for PPP success. Without it, the project might fail. Since individual ownership in PPPs is rare, lenders bear the risks. They rely on project cash flow for repayment, with no recourse to the original companies. In infrastructure projects, especially transportation, the assets themselves often don't provide enough security for lenders. Cash flow becomes their primary source of protection. Ideally, lenders would want not just sufficient cash flow, but

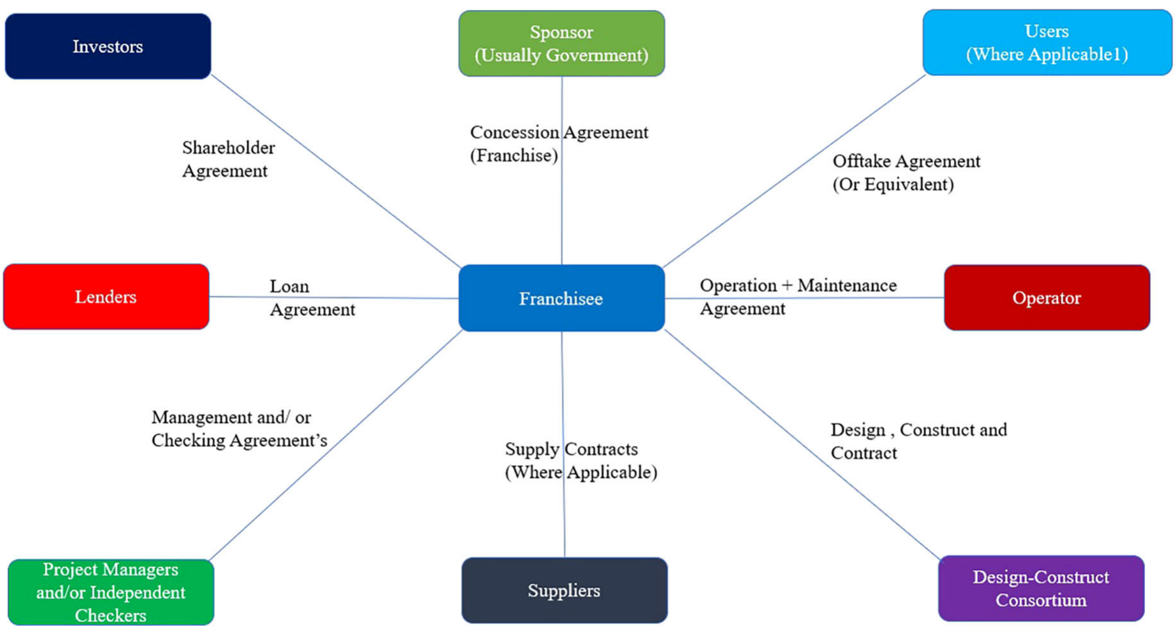

Figure 4: Typical relationship between principal participants in BOT type procurement.

also the ability to transfer the concession (operating rights) to another company if the current operator fails. Researchers have proposed a decision model based on case studies, which can help project sponsors choose a financial strategy based on the expected risks over the project's lifespan. This model considers the predicted level of financial, political, and market risks, as detailed in Table 7.

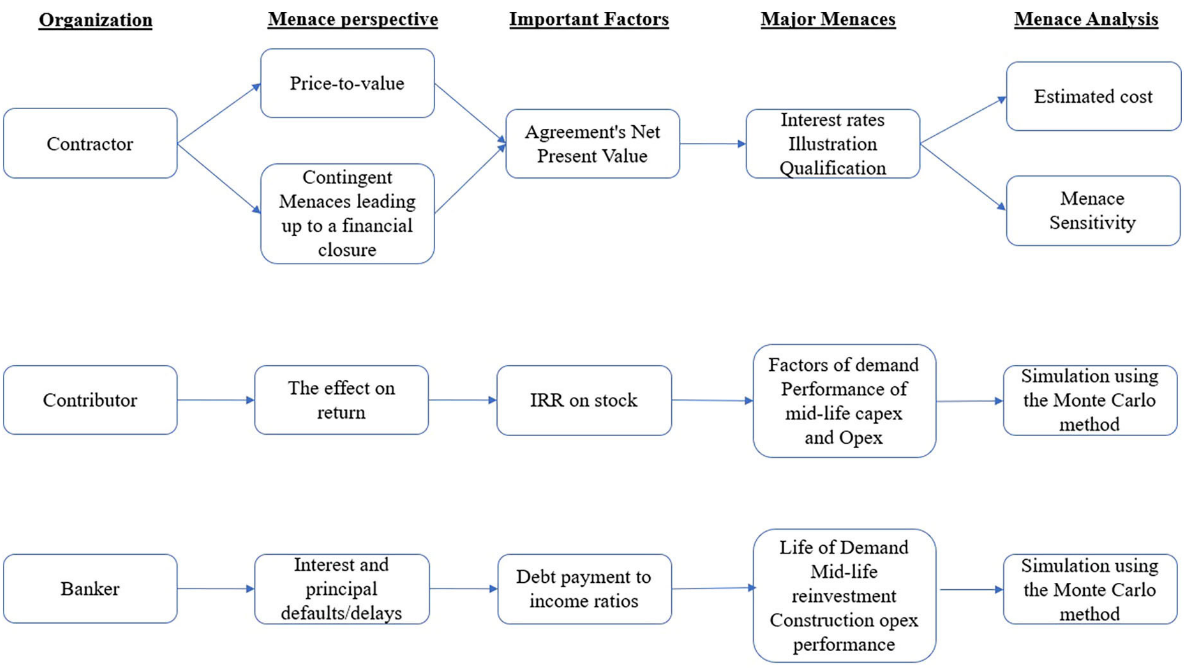

Figure 5: Analytical approach flow chart.

Table 7: Possible financial menace strategy.

MENACE CONDITIONS	FINANCIAL STRATEGIES
Political Menace	Involve international companies or groups to gain power with local government officials.
	Seek aid from powerful persons or groups with connections to local government officials.
	Seek the backing and assurances of the local government.
	Create emergency credit facilities.
	Obtain insurance from government agencies.
Financial Menace	Borrow money from foreign lending institutions.
	Use debt financing with a set or standardised interest rate.
	Loans should be denominated in local money.
	Debt financing should be structured in the same currency as projected revenues.
	Revenues should be structured in both domestic and international currencies.
	Seek government assistance and assurances.
Market menace	Include a revenue escalation clause in the contract.
	Create a contingency credit arrangement to cover unexpected expenditures.
	Financing early phases using equity and short-term loans, then refinancing with low-cost long-term debt throughout the operating phase
	Structure the loan payback plan such that it begins slowly and gradually increases throughout the first few years of operation.
	Negotiate contract conditions that allow for fee hikes.
	Create a standby term loan to meet any unexpected income deficits.
	If required, restructure debt to alleviate cash flow issues throughout the concession term.

3.6. Decision model for granting the contract

Public sector contracts, including those involving Build-Operate-Transfer (BOT) agreements, often rely on open competitive bidding to choose a contractor or concessionaire. This method prioritizes the lowest price, which can encourage competition but doesn't guarantee the selection of the best contractor for the job quality. To reduce effects and improve long-term performance and value of construction, a procurement strategy that considers pricing and other critical elements in the assessment process is required. Based on the aforementioned premise the optimal value model is produced. The decision model for granting the contract is examined is shown in Figure 6.

Awarding concessions in India and elsewhere often follows a transparent bidding process. All project details, such as the duration, toll fees, price adjustments, and technical requirements, are clearly outlined upfront. Shortlisted bidders then simply state the amount of financial support they require. The project is awarded to the bidder seeking the least subsidy. In rare cases, a bidder might propose revenue sharing with the awarding body instead of a grant. This structure ensures unbiased, fair, and thorough evaluation of bids. However, to counter potential cost-cutting measures associated with low-bid systems, project owners often rely heavily on prequalification. This prequalification stage becomes critical in selecting qualified bidders and guaranteeing the success of construction endeavors. In many cases, initial responses to invitations for significant infrastructure projects do not necessitate extensive presentations.

3.7. Promoter selection using .net framework

To identify potential bids for BOT projects in India, a pre-qualification procedure is used. The RFQ document describes the assessment criteria as well as the bidding process timetable. Many government agencies, including national departments like the National Highways Authority of India (NHAI) and the Ministry of Surface Transport, as well as state-level bodies like Housing Boards and Road Development Authorities, are utilizing public-private partnerships (PPPs) for infrastructure development. However, selecting suitable partners for these complex projects requires a more holistic approach than traditional methods. While technical expertise and financial strength (net worth, cash flow, and earnings) are crucial, factors like managerial skills, entrepreneurial spirit, and leadership are often undervalued. Unfortunately, the contractor selection process is often hampered by limited or incomplete information about both the project itself and the potential partners. This necessitates decision-making based on imperfect data, requiring a more nuanced evaluation. The handy technique is analyzed for dealing with imprecise and ambiguous information when making decisions. The paper proposes a framework for solving construction contractor prequalification based on SPSS and multi-attribute decision-making analysis, which involves constructing a decision support system that can also handle language factors. The difficulty of evaluating candidates is reduced to a problem of multi-attribute decision-making, in which the owner may have competing objectives of varying priority (weights). The problem is organized in the following order by the methodology. • Step 1: Establish fundamental requirements • Step 2: Break down core criteria into smaller groupings, eventually becoming a single criterion. • Step 3: Sort the applicants into groups.

In the fourth step, we conduct a .NET Framework analysis. This analysis examines how adjustments to the criteria weights impact the ranking of potential options (alternatives). A pairwise comparison matrix is

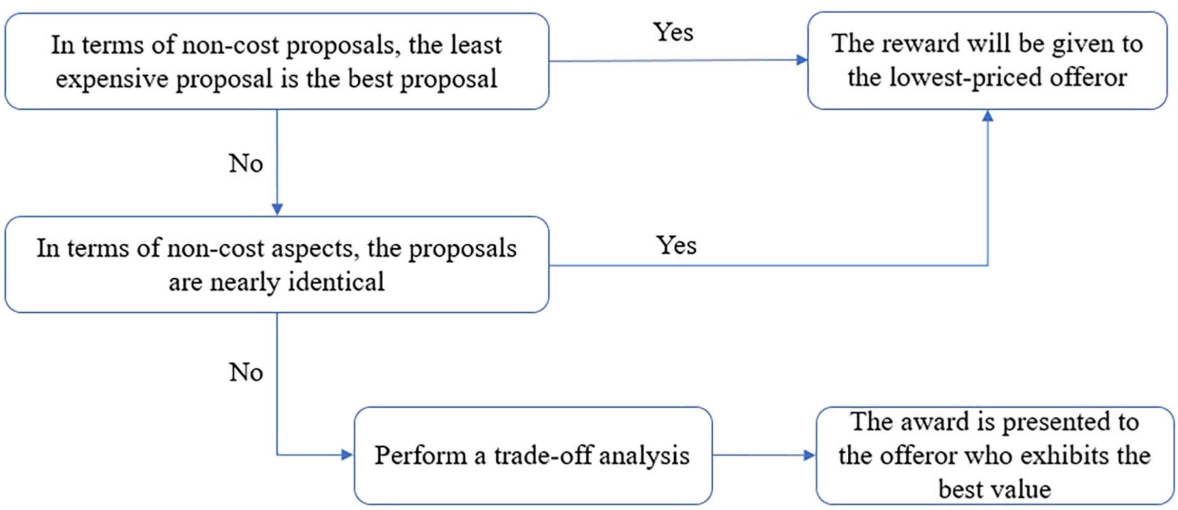

Figure 6: Decision model for granting the contract.

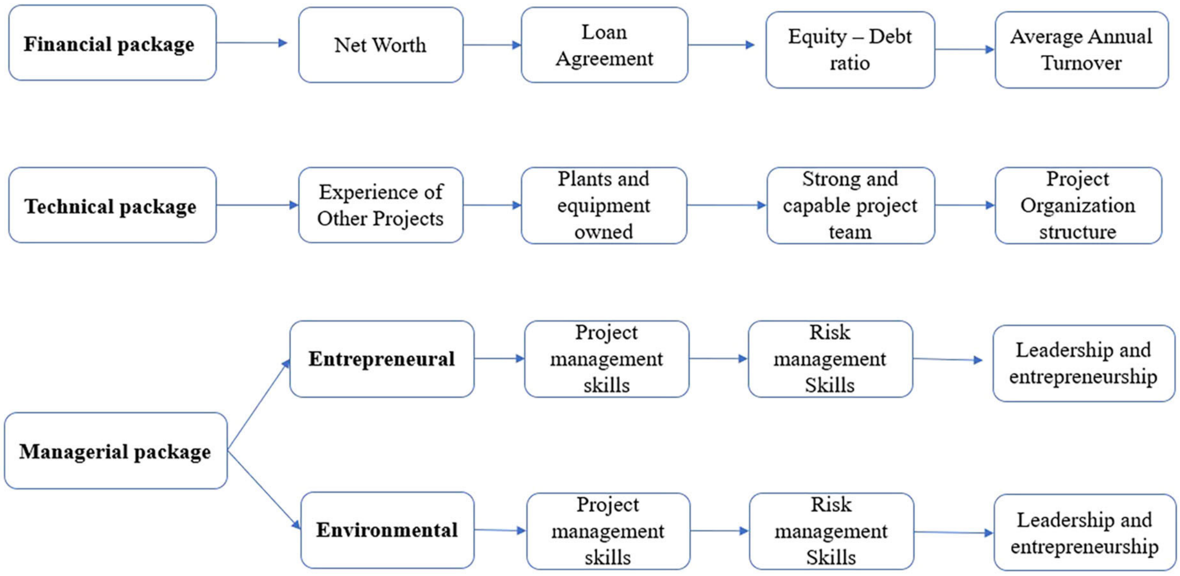

Figure 7: Evaluation package list.

used to assess the relative importance of various promoters across multiple key criteria at level 5. This helps determine the decision-makers' preferences for these promoters. The final score for each promoter is calculated by considering the relative importance matrix of applicant promoters against various features, along with their corresponding weights at levels 4, 3, and 2.

.Net Framework Analysis is a popular MySQL management tool, particularly for web hosting provider. PHP is an HTML-enabled server-side programming language. It's used to handle dynamic content, databases, track sessions, and even develop full e-commerce sites. To interpret PHP script instructions, a processor must be installed in order to generate generic HTML result that can be delivered to a web browser. This will be accomplished by asking a few extra questions of the application's end user. Figure 7 shows the hierarchy of a four-package set of criteria for evaluating applications. This system will determine which sort of Promoter is appropriate for the build based on the user's input. Software Requirement - Front End: local host, Back End: Php my admin, OS: Windows XP, 7, 8, Hard Disk: 20 GB (Min), RAM: 512 MB (Min)

4. CONCLUSION

The goal of this study is to recommend and implement specific methods that will be beneficial to governments, financial institutions, owners, and/or contractors in successfully completing massive infrastructure projects on time, on budget, and to a high standard. To identify the elements causing time overruns, a postal survey is utilized to study the relative relevance and significant factors. Findings are compared to Past research works. A hierarchical success model is built for identifying essential success variables. The SPSS and RII methods are used to analyze the data obtained from experts individually. The findings are compared to those of earlier research. An agreement analysis is performed to validate the results. By altering the entire construction length, the influence of a project's short construction term on its profitability is investigated in this study effort. It has been noticed that even if more money is spent to reduce construction time, the project's total profitability improves dramatically. From the perspectives of many important parties, the various forms of risk experienced in BOT projects are examined. Political, financial, and market risk are considered to be the most important project risks. This report explores how BOT (Build-Operate-Transfer) project promoters can select the most cost-effective financial approach. While a simple low-bid strategy might seem appealing, it can overlook the bigger picture. To ensure the project's long-term success, a best-value contracting approach is recommended. This method considers not just price, but also other critical factors during the evaluation and selection process. A unique best-value modelling concept is introduced, allowing for a customized approach for each project. This model identifies and analyzes the key criteria that influence choosing the best concessionaire. In India and many other countries, selecting a concessionaire follows a transparent competitive bidding process. All project details, including the concession period, toll rates, pricing adjustments, and technical requirements, are clearly communicated beforehand. Shortlisted bidders then only need to submit their desired grant amount. The contract should go to the bidder that requests the smallest grant. In extreme circumstances, a bidder may offer to split project income with the authority rather than requesting a grant. The paper describes the prequalification method used in India and other developed and developing nations to choose suitable bidders for BOT projects. In most cases, owners carefully assess bidders using established criteria. Selecting qualified sponsors for infrastructure projects is a complex process that considers multiple factors and requires careful evaluation due to the ever-changing environment. According to the unique project parameters, an SPSS-based framework for rating diverse applications is presented. The framework entails the identification of basic criteria and the weighting of those factors, as well as methodical aggregation and, eventually, the ranking of candidates for prequalification. The model is implemented to analyze the variations caused by changes in the values of input parameters, a simple approach is created to provide a regression analysis of the problem. For the examination of numerous risk factors and uncertainties associated with BOT projects, more research is needed. At the most basic level, regression analysis may be used to assess all of the criteria.

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