

ANALYSIS OF RISK CATEGORIES AND FACTORS FOR PPP PROJECTS USING ANALYTIC HEIRARCHY PROCESS (AHP): A REVIEW

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Abstract: Success of Public Private Partnership projects is greatly influenced by proper management of the risks associated with the project. All projects which are undertaken using conventional procurement method or using a PPP approach have known risks and unknown risks. Risk identification plays an important role in development of PPP framework. The participation and investment of Private sector has been the main stay of the Government of India policy toward infrastructural growth. In this study main risk categories and factors of Public Private Partnership projects have been recognized. The identification of collective influence of risks and its variation over numerous PPP projects is been done. Generally Analytic Hierarchy Process (AHP) is widely used as multi criteria decision making. Normally it is very hard to meet the consistence need of a comparison matrix in analytic hierarchy process. In this study AHP is used to categories the risks of PPP projects in different levels and the impact of those risks on the PPP projects are identified.

Keywords: Analytic Hierarchy Process (AHP), Risk Category, Public Private Partnership (PPP), Risk Factors, Multi criteria decision making (MCDM).

I. INTRODUCTION

Everywhere throughout the world, constrained subsidizing for the improvement and task of framework ventures impels governments to draw in private investment and enter public– private organizations (PPPs). Distinctive sorts of PPPs have been rehearsed in framework advancement in both created and creating nations, with differing results. In spite of the fact that PPPs have numerous favorable circumstances, they include a few complexities in arranging, execution, and observing and control that differ as per explicit undertaking and nation conditions. Advocating the PPP choice likewise relies upon the capacity to distinguish, investigate and allot project hazards enough. Inability to do as such will have money related complications for the open division and additionally the disappointment of the undertaking to accomplish its targets. In this manner, at the project distinguishing proof stage, notwithstanding evaluating the wellsprings of income connected with the reasonableness of the task, the Authority and its counsels need to attempt an expansive appraisal of the dangers that emerge from the undertaking fundamentals so as to oversee them. This can appear as a risk matrix or a risk register.

1.1 Public Private Partnership (PPP):

The term ‘public–private partnership’ seems to have instigated in the U.S, originally concerning to public and private sector’s combined funding for educational programs, but used in broader sense in the 60s to refer to joint ventures of public and private sectors for urban renewals. The term PPP is now generally used for any long-term public and private sector contract to provide public infrastructures and facilities.

However, the emphasis of this study is ‘project-based’ or ‘contract based’ PPPs, a current development. PPPs generally have the following Characteristics:

1. A long-term contract between a public and a private sector;
2. For designing, constructing, financing, and operating public infrastructure or service by the private sector;
3. With payments made to the private sector for the use of the facility either by public sector or public itself;
4. With leaving the facility in public-sector ownership, or giving back the ownership to public-sector at the end of the PPP contract.

Over the past decade, private sector financing through public–private partnerships (PPPs) is becoming very widespread as a mean of procuring and upholding public infrastructure, in various sectors.

1.2 Risk

Risk can be defined as an unplanned activity which results in adverse outcomes, in a PPP it relates to ambiguous consequences which have a direct influence either on the providing of the services or the financial feasibility of the project. In any

way the consequence is a loss in revenue or increased cost which has to be tolerated by somebody, and one of the core elements of PPP structuring is to determine where this loss in revenue or increased cost will lie.

So identifying and mitigating risks in any PPP project is very crucial. Hence risk management is adopted to deal with risks involved in any project.

II. CRITICAL LITERATURE REVIEW:

The following are the earliest research paper review based on risk category identification and classification in PPP projects

2.1 Literature review on Risk Category Identification and Classification in PPP Projects:

Akintola et al. (1998) surveyed 41 people from construction industry to know about their perception on the risk allocation. The respondents tended to rank most highly those risk factors that are paramount to their own business objectives. In General, the 10 significant risk factors were identified as related with design, construction cost, performance, construction delay, cost overrun, commissioning, operation and maintenance, payment and tendering cost. The consistently least important risk factors identified were land purchase risk, debt risk, banker's risks, development risk, changes legislation, project life risk and change of government. [3]

Wang et al (2000) distinguished around fifty risks in six classifications, Political dangers, construction dangers, operation dangers, market and income dangers, financial dangers & legal dangers & alleviating measures related by public private partnership control ventures dependent on writing survey and contextual investigations on a few Build Operate Transfer (BOT) extends in China in 1990s, at that point separated the dangers and measures through an unstructured meetings and discourses. From that point forward, a worldwide overview on hazard the executives of BOT extends in creating nations were prepared to assess the critical situation of these dangers, operating a six points rating frameworks. The respondents score decides the position of risk. [22]

Grimsey & Lewis (2002) investigated standards of hazard assessment of public private partnership ventures, utilizing a contextual analysis of waste water cure office in Scotland. In light of the writing audit, nine classes' dangers were abridged, specialized hazard, development chance, working danger, income chance, and monetary dangers, compel majeure chance, administrative/political dangers, natural dangers, venture default. In the water plant the key risk factors were surveyed. The creators evaluated the nature and quantum of hazard from alternate points of view of the significant venture parties, utilizing diverse hazard investigation strategies. Procurer utilized affectability examination, supports favored Monte-Carlo reproduction and bank picking drawback affectability investigation. [9]

Lemos et al (2004) considered two spans situation in Lusoponte Portugal which incorporates a review of undertaking's experience and an investigation of the fundamental hazard classifications expressing both the real dangers experienced and the alleviation measures. Six risk factors were classified namely Legal risk, Social risk, Economic risk, Environmental risk, Political & regulatory risk and technological risk which involved the specialized issues as well as a sensible evaluation of ecological & social hazards. [13]

Li et al (2005) proposed a metaclassification approach based on three dimensions of hazard factors for PPP extends in the United Kingdom full scale level, meso level and small scale level dangers. The full scale level dangers involve dangers outer to the task itself. The meso level dangers incorporate dangers happening inside the outline bounds of the task. The smaller scale level dangers speak to the risks found in the other half connections formed in the obtainment procedure. Under each dimension, the dangers are additionally grouped by the wellsprings of dangers, for example, dangers related with market, characteristic, development, and so on. [14]

Sight and Kalidindi (2006) presented an annuity model in which the given specialist pays the traffic income every year in concession time frame in India to the private division. So as per the risk model, risk factors were characterized into ecological, social, monetary, specialized, & budgetary risk elements. No particular hazard evaluation strategies were presented in this paper. [19]

Yongjian Ke et al. (2011) considered the dangers engaged with China's PPP projects. 46 reactions were gathered and dissected by the Kendal's concordance examination, and the spearman rank relationship test. The Kendal's concordance investigation uncovered predictable rankings of hazard factors. The Spearman rank connection test reflected no importance distinction on the rankings of the likelihood and outcome of dangers identified in the midst of respondents with and without PPP familiarity. The best 10 dangers as per their hazard significance list score were government's impedance, Political basic leadership, financial risk, government's reliability, market demand, corruption, subject assessment, interest rate, youthful juristic framework and inflation. [4]

Nur Alkaf Abd Karim (2011) centers around inspecting the hazard elements of PPP development venture by mapping past research takes a shot at PPP venture the world over. The discoveries from this checked on study is that the hazard factors are bunched into 10 bunches to be specific Political, Construction, Legal, Economic, Operation, Market, Project choice, Project money, Relationship & Natural factor. In the meantime the most successive elements are change in law, delay in venture endorsements and allows land procurement. [16]

Albert et al. (2011) identified that private sector has to suffer mainly from construction, operation, relationship risks, economic risks in the systematic risk category while public sector under systematic risk category that is political, legal, and social risks. There major research findings includes three major risk i.e. government intervention, government corruption, and poor public decision-making process. Among which political risk is most severe risk which act as a barrier for PPP plans in china. [4]

Yongjian et al (2012) inferred that the utilization of hazard the board was deficient. The subjective hazard investigation strategies were liked to quantitative and semi-quantitative techniques and hazard the board utilization in the execution was observed to be a lot higher than in the arranging, reasonable or end organize. The interviewees were new to the majority of the hazard identification and appraisal instruments. Hazard recognizable proof, evaluation and reaction were the frequently utilized hazard the board components than hazard allotment, the executives arranging and documentation. [27]

Hwang et al. (2013) inspected that the basic achievement factors just as the general significance of positive and negative elements affecting the appeal of PPP extends in Singapore, and to recognize the basic hazard factors and favored hazard allotments for PPP extends in Singapore. Real discoveries incorporate Risk distinguishing proof, appraisal and reaction were the frequently utilized hazard the executive’s components. Likewise, hazard the board utilization in the execution stage chance distribution, the executives arranging and documentation was observed to be a lot greater than in the other 3 phases of the task lifecycle, for example arranging, applied or end. [7]

Chan et al. (2015) said that numerous issues from fruitless hazard the executives have been experienced in PPP applications that have in the long run prompted venture disappointment. They recognize and assess normal dangers with the assistance of writing audit, a Delphi study, and eye to eye interviews related with public private partnership extends in the Chinese water supply segment. Finally there were sixteen critical factors of risk in water PPP extends in china. This discoveries uncovered that consummation hazard, expansion, and value change chance highly affect Chinese water PPP ventures, though government defilement, a flawed law and management framework, and an adjustment in market requirement have lesser influence on areas of water supply. This assistance venture partner to concentrate on privatization in open works in Chinese water advertise by PPP mode. [5]

2.1 Risk Factors

The determination of risk factor before the risk is assigned. In order to achieve this step. The risk factor was generated based on Yongjian [27], Abednego [1], Li [11], Shen [18], Ibrahim [10], Yuan [28], Yelin [26], Aspin [6], Xiao [25], Zhang [29], Singh [19], Wibowo [23], Ng and Loosemore [15] and VDTF [20]. Accordingly, there are 7 groups in which risk factors are divided namely: Political, Regulation Social and Legal, Construction, Financial, Commercial, Partnership, and Operation (See Table 1). The main purpose is to map inn order to obtain the ranking of the factors considered for PPP projects. By studying various literature the frequency of these risk factors are compiled in Table 1. Among all the group, the highest frequency is observed in political groups and construction groups. The factors in these groups with most frequency are change in the law, delays in approving projects and permits and land acquisition.

Table 1: Risk Factors identified in different research papers

Sr. no	Risk Attributes from Public Private Partnership	Yongjian et al.	Abednego et al.	Li et al.	Shen et al.	Ibrahim et al.	Yuan et al.	Yelin et al.	Aspin et al.	Xiao et al.	Zhang et al.	Singh et al.	Wibowo et al.	Ng et al.	VDTF et al.	Frequency
1	Political Risk															
	Due to law change	*			*		*	*			*	*	*	*	*	9
	The project approvals and permits are delayed	*	*	*	*	*				*		*		*	*	9
	Unstable Government			*		*					*					3
	Poor public Decision making process	*		*	*	*	*	*								6
	Government intervention	*						*								2
2	Regulation Social & Legal Risk															
	The regulation in tax change.	*	*	*		*		*								5
	Due to corruption & absence of respect for law	*				*	*	*			*					5
	Inconsistencies or change in legislation.			*		*		*		*	*					5
	Environmental clearance	*	*	*		*	*	*								6
3	Construction Risk															

	Land acquisition	*	*	*	*	*	*	*			*	*	*	9	
	Availability of labor /material	*		*		*	*	*				*	*	*	8
	Availability of finance			*	*	*	*			*	*		*	*	8
	Construction cost overruns	*		*	*	*	*			*	*		*	*	8
	Construction time delay	*		*	*	*	*			*	*	*			8
	Completion risk						*						*	*	3
	Quality risk												*	*	2
	Contractual Variation	*		*	*	*	*			*	*				8
	Natural Calamity	*	*	*		*	*	*			*	*			8
4	Financial Risk														
	Unavailability and high cost of financing	*		*		*				*					4
	Lack of suitable economic conditions		*				*	*				*			4
	Foreign exchange rate fluctuations	*					*						*		3
5	Commercial Risk														
	Traffic/level of demand risk	*				*									2
	Lack of demand /slow economic development of the country			*		*	*								3
	Delay by govt. Notification									*	*				2
6	Partnership Risk														
	The working methods between partners are different	*		*	*	*				*	*				6
	Lack of familiarity in PPP projects			*	*	*	*				*				5
	The commitment from public or private partner is lacking	*		*		*				*					4
	Due to organized and coordinated risk			*	*	*	*								4
7	Operation Risk														
	Operation Cost Overrun	*		*		*	*	*			*		*		7
	Cost of maintenance is higher than imagined.			*		*	*	*						*	4
	Operation productivity is low			*		*	*	*							3
	Quality of Operation												*	*	2

III. APPLICATION OF AHP IN PPP PROJECTS

AHP was made by Saaty (1980) to manage basic leadership issues in complex and multicriteria circumstances. AHP helps with settling on choices that are portrayed by a few interrelated and regularly contending criteria, and it sets up needs among choice criteria when set inside the setting of the choice objective. A key viewpoint is that choice criteria are surveyed regarding their relative significance so as to permit exchange offs between them.

Abudayyeh et al. (2007) has used AHP to create a decision making instrument for the pricing of the contractor. Especially, the technique has helped in finding relative weight of pre described criteria, which further helped in classifying contractors to select the given contract for the project. [2]

Lin et al. (2007) said that it is troublesome for leaders to express relative inclination because of impediment of 9 esteem size of Saaty. Notwithstanding the manner in which that Saaty proposed a framework to think about the consistency of pairwise examinations, no altered instrument exists for improving the consistency for AHP. This work proposes adaptable AHP approach (A^3) that utilizes a delicate figuring plan, Genetic Procedures, to recuperate the genuine number weightings of the different criteria in AHP and gives a capacity to regularly improving the consistency degree of pairwise connections. The work exhibits a versatile AHP approach (A^3) to improve the customary AHP strategy for tackling MCDM issues from three points of view: (1) cost viability (42.6% reserve funds in worker hours were accomplished for the situation consider); (2) timeliness — (For the situation contemplate, 68% decrease in information accumulation time was achieved), allowing eminent MCDM issues been unraveled in time; (3) choice quality been improved. [24]

Li et al. (2011) proposed that a fuzzy AHP as risk calculation method to simulate the ambiguity of human judgment and to improve the evaluation precision. Moreover, a correlation was made between the projected fuzzy analytic hierarchy process and straight

analytic hierarchy process in this examination. This examination introduced a strategy for hazard evaluation in a PPP exp. way venture by utilizing the fuzzy AHP procedure. The evaluation consequence of the case venture demonstrated that it is reasonable to utilize fuzzy AHP to survey and rank the hazard variables of PPP ventures. The examinations of proposed fuzzy and straight analytic hierarchy process demonstrate that fuzzy AHP can progress the hazard evaluation precision and diminish the respondent's subjectivity. [11]

Wakchaure and Jha (2012) utilized AHP to tackle the issue of bridge maintenance with constrained assets. Specifically, AHP was utilized to decide the general significance of extension segment loads as an initial phase in building up a scaffold condition file. This record can be utilized by partners to recognize spans that need adjusting and to best designate bridge maintenance resource. [21]

Fengwei et al. (2013) observed that AHP approach has been generally utilized in MCDM. It is tough to meet the uniformity necessity of a CM in analytic hierarchy process. The creators investigate purposes behind conflicting CM in analytic hierarchy process & suggest an improved analytic hierarchy process (IAHP) to improve comparison matrix consistency by utilizing an arranging and positioning procedure. The consequences of conflicting analytic hierarchy process & improved analytic hierarchy process with the help of MATLAB reproduction demonstrate that improved analytic hierarchy process progressively reasonable for tackling MCDM issues when the quantity of components or elements is at least 5 in MCDM. Thus, the accompanying proposals are noted: conventional analytic hierarchy process technique is suggested when the quantity of the components is 3 or 4; improved analytic hierarchy process & the comparing modified survey ought to be received out when the quantity of the components is at least 5. [8]

IV. CONCLUSION

Based on critical literature review, the following conclusion is drawn

1. PPP has been used in many countries as an attaining technique for giant scale construction projects.
2. Risk categories and factors are been identified on the basis of literature review in order to obtain successful PPP projects.
3. The upsides of AHP regarding its target estimation make it reasonable for efficiently survey the risk in PPP infrastructure ventures.
4. In order for risk allocation, the risk factor identification is most important stage.
5. The discoveries from this assessed examination is that the hazard classifications are bunched into principle seven gatherings Political, Construction, Regulation Social and Legal, Financial, Partnership, Commercial, Operation factor. The most recurrent risk factors among the risk categories are change in the law, delay in projects due to approval & permit and land acquisition.
6. This evaluation work will be the starting point to create the questionnaire for compelling the view from several consultant in order of significance. The assessment suggest that AHP can help researchers and consultants address a variety of decision making complications that matter.
7. It is advisable that construction researchers, consultants and institution should consider AHP applications when there is necessity to analyze MCDM in construction management areas.

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