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Comparative Analysis of Unit Cost in Road Projects: PPP Vs Public

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ABSTRACT
The optimum utilization of finance for construction of road projects is a key issue in the present world. Considering the increasing need of road connectivity and decreasing availability of funds and land worldwide, has emphasized the need to explore the various alternatives for optimum utilization of the resources.
Present paper highlights the concept of Unit Cost by calculating per unit costs of National Highways of India. Roads are constructed considering a large life span and future increase in demand due to increasing population. Also, funds required for construction of these is large. Limited research is done on unit cost analysis of road infrastructure projects and that such a study will be helpful in area of Infrastructure where in large initial capital funds are necessary. Therefore, the assessment of the profitability of such projects is important. Unit Cost Calculation will help in this assessment. The assessment of performances of PPP and Public road projects will help to identify the economic feasibility using Unit Cost Analysis.
KEYWORDS- Public, PPP, Roads, Unit Cost.

I   INTRODUCTION

The development of national highways in India has been assigned with the National Highways Authority of India (NHAI). The national highways project in 1993 helped expand and upgrade some sections of the national highways in Andhra Pradesh, Bihar, Haryana, Rajasthan and West Bengal. The Indian government had framed a programme for the development of national highways in India called the national highways development project (NHDP) in multiple phases. Phases I and II were launched in 1998. NHDP was expanded further to include Phases III to VII, of which 85% of the projects are being implemented through the PPP route.

PPP in highways were started by the NHDP. The projects under NHDP Phase I and Phase II were chiefly implemented under the engineering procurement and construction (EPC) mode. The PPP mode was also experimented and projects were awarded under it. However, the PPP mode of execution in a larger way started with NHDP Phase III. Currently in India, 24% of the national highways are of four-lane and higher while 52% are of two-lane capacity. The remaining 24% are single-lane.

National Highways are constructed considering a large life span and future increase in demand, due to increasing population. Also, funds required for construction of these is large. Limited research is done on unit cost analysis of road infrastructure projects and that such a study will be helpful in area of Infrastructure where in large initial capital funds are necessary. Therefore, the assessment of the profitability of such projects is important. The Unit Cost Analysis of performances of PPP and Public road projects will help to identify the economic feasibility of the projects.

In the previous studies carried out by the African Development Bank (AfDB) during 2010-11 to analyze road unit costs in road infrastructure projects in Africa, focused to determine unit costs for road infrastructure projects in Africa and also determined the evolution of unit costs since the completion of previous studies[1]. A study on the similar lines done for Indian roads can help identify the extent of unit cost.

Another study conducted for Indian Roads concluded, Public—private partnership (PPP) roads have a longer length, a higher project cost, and lower unit costs than public projects. Regression analysis showed that private-sector investment had a tendency to increase unit costs, lower unit costs were achieved for PPP road projects because developers could take advantage of economies of scale [2]. The extension of this type of study involving more detailed project specific variables is conducted in the current paper.

The further paper comprises of detailed sections of Objectives, Data Collection, Methodology involved, Results and Discussions and finally Conclusion.

II   OBJECTIVES

In recent years, there has been a speedy growth in the number of road projects that are executed in a PPP mode. However, there has been limited research about the cost effectiveness of PPP projects vs. the traditional government model. This paper is an effort to address that gap. Specifically, this study focuses to carry out the Unit Cost Calculations and analyze the performance of the projects.

III   DATA COLLECTION

Data pertaining to road sector projects in India were used for the analysis. Because there was no single source that provided the relevant information for both PPP and Public projects, a data set was developed by compiling project information about various road projects undertaken in India during 1996-2017. The primary sources used for compiling the database were the PPP in India database and the NHAI database of completed projects. Projects were classified across different attributes i.e., according to number of lanes, expressways, cost overrun and time overruns.

The compilation generated a data set of 936 PPP and Public projects with an approximate total cost of Rs 1,70,000 over a period of 21 years. The total number of PPP and Public projects was 487 and 449, respectively. The total length of roads developed from these 936 projects was about 61,000 km. Out of the 9 expressway projects, 2 were from PPP projects and the remaining 7 were from public sector projects. The projects with cost overrun and time overrun were 14 in the PPP sector and 86 in the public sector projects respectively.

IV   METHODOLOGY

Unit cost is the total expenditure for one unit of the product or service.In road projects, unit cost is the total project cost divided by the total length of the respective project.

$$\text{Unit Cost} = \frac{\text{Total project cost}}{\text{Length (in kms)}} \quad \ldots (2)$$

The medians compared for PPP and Public were different in number of sample sizes and had non normal distribution values, therefore non parametric Kruskal Wallis test was conducted for comparative analysis of the medians.

The Kruskal—Wallis test is a nonparametric method for testing the equality of population medians among groups. It is similar to a one-way analysis of variance with the data replaced by their ranks. Because it is a nonparametric method, the Kruskal—Wallis test does not assume a normal population.The test statistic is given by

$$K = \frac{12}{N(N+1)} \sum_{i=1}^{g} n_i r_i^2 - 3(N+1) \quad \ldots (3)$$

Table 1 Comparison of Medians by Kruskal Wallis Test				
PPP	PUBLIC	K Statistic	K Critical	P Value
1.89	1.52	17.71	3.84	<0.0001

where ni = number of observations in group i;
ri = average rank of all the observations in group i;
and N = total number of observations across all groups [3].

V   RESULT AND DISCUSSIONS

The **Table 1** shows the comparison of medians by non-parametric Kruskal Wallis Test. Results indicated that there was significant between the two types of projects i.e., PPP and Public road projects.

Table 2shows that, for overall projects, Public sector road projects generated lesser median value of unit cost than the PPP projects. While similar trends exist in 4 and 6 Lane road construction, where Public sector yielded a lower median value than PPP. Contradicting to this, 2 Lane contributed lesser value in PPP projects than in Public sector road projects.

The generalized reasons for lesser Public sector Unit Cost are due to PPP projects due to high tendering costs, lack of standard model concession agreement,inadequate distribution of responsibilities and risk between public and private sector, delay in land acquisition and delay in annuity payment.

While the reasons for PPP projects having lesser Unit Cost in the 2 Lane projects are due to appropriate project identification and necessity of expressway, support from state and central government, large capacity and experience of the concessionaire, proper arrangement of funds, strong and capable private consortium, thorough and realistic assessment of cost and benefits, trained staff for maintenance of road.

VI   CONCLUSION

The results of this study indicate that there are significant differences between PPP and public-sector road projects in India. Public sector road projects are preferred for 4 and 6 Lane construction is because it becomes difficult for private sectors to

handle situations like public resistance to project, delay in land acquisition, force majeure risk [4].

The trend of less Unit Cost in 2 lanes can be explained as following. First, the construction of two lane roads is a basic necessity to connect important places. For this, the PPP performs better in conditions where there is public awareness and support acceptable toll and tariff system for 2 lane roads, acquisition of land prior to commencement is easy for 2 lanes and less environmental impact. In case of bigger projects, the PPP perform better due to appropriate project identification and necessity of expressway, support from state and central government, large capacity and experience of the concessionaire, proper arrangement of funds, strong and capable private consortium, thorough and realistic assessment of cost and benefits, trained staff for maintenance of road [5].

For all types of road construction works, during the initialization of phase, alternatives are available to the government for awarding it to private contractors for PPP, in case of insufficient availability of funds. To finalize on whether the projects are feasible to be executed by PPP or by Public, a proper standardized comparison technique should be established. For this, calculation of Unit cost forms a basis for comparison and choosing the proper projects. This paper is limited to study on Indian road projects i.e. National Highways only. Such Unit Cost calculations can be done for roads other than National Highways like State Highways, Village Roads and Other District Roads for optimum allocation of funds.

Table 2 Comparison of Medians Lane-wise

DESCRIPTION	PPP	PUBLIC
Overall	1.89	1.52
2 Lane	3.44	3.71
4 Lane	6.88	4.96
6 Lane	9.82	6.55

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