

Experiential Analysis of PPP Finance Model for Metro Rail Infrastructure in India

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Abstract- *Urban planners believe that there is a need of Mass Rapid Transit System (MRTS) in a city once the population crosses one million. Advanced countries generally plan for a metro system when the population of a city exceeds one million and by the time the population reaches the two million mark, a metro is generally in position. In India there are about 54 cities having a million plus population, however only 23 cities have seen various levels of development of MRTS. Metros are now under construction in ten more cities of India after Kolkata and Delhi. By year 2016 India will rank as a developed country and by that reckoning 15 more cities should start planning for their metro systems. Rail-based “Mass Rapid Transit System” has been widely accepted as a solution for most of the traffic and environmental pollution related problems which major cities throughout the world are facing now. Metro rail construction activities are being undertaken in a big way in India, existing metro rail network of the city of Kolkata and Delhi are being expanded, while it is under various stages of construction in cities like Bengaluru, Chennai, Jaipur, Gurgaon, Mumbai, Kochi, Lucknow, Nagpur, Ahmedabad and Hyderabad.*

Keywords- MRTS, PHPDT, HCBS

I. INTRODUCTION

Globally, for the first time in history, more people live in cities than in rural areas. Since these cities contribute significantly to a country's gross domestic product (GDP) and growth, they need high quality infrastructure to facilitate the movement of people and goods and the delivery of basic services to their population.

Investment in infrastructure in India has posed a challenge in the last few years. Not only are there reports of delayed or stalled infrastructure projects¹ but the rate² of growth of gross fixed capital formation (GFCF) have also been disappointing. Inadequate acceleration in private sector projects has been attributed inter alia to unfavorable market conditions, lack of appetite for fresh investment by promoters and delays in obtaining environmental clearances. In the public sector, on the other hand, the slowdown in delivery of projects has been attributed to regulatory decisions, problems in land acquisition and scarcity of funds.

The Union Finance Minister, in his Budget speech of 2015-16, has emphasized the need for increasing public investment in infrastructure. Simultaneously, while referring to the importance of drawing in the private sector³, he emphasized the need for a review of the Public Private Partnership (PPP) model of infrastructure development, which harnesses private investment for providing public assets and services.

Public Private Partnership has been accepted as an important policy instrument for central and state governments in the implementation of commercially viable projects. However, PPPs have played a limited though significant role in the infrastructure delivery mechanism in sectors over the last decade. The Department of Economic Affairs (DEA), Ministry of Finance, with support from the erstwhile Planning Commission of India, has been overseeing the development of public infrastructure through the PPP model across the country.

The rollout of PPPs through these efforts has resulted in a portfolio of PPP projects, at various stages of delivery and operations, which surpasses all other countries today. This has also been accompanied by developments, which were not anticipated by either party in the PPP contract (the "Concession"). These developments have been due to macro-economic factors, sectorial regulatory meso-economic factors and micro-economic factors such as private sector specific. As a result, the DEA has issued a series of guidelines on: (i) building-in the required degree of flexibility in long-term PPP Concessions; and (ii) strengthening public sector management of operational PPPs. However, other aspects remain that need to be addressed by all stakeholders, including the public authorities, lending community and private partners.

As part of the government's efforts to revitalize private investment, a detailed review of risks in PPPs was considered essential to rebalance the allocation of risks, while in no way diluting the essence of a PPP structure. Building upon the strengths of the mature PPP landscape in the country, which has been acknowledged internationally, the government underlined its aim to: (i) rekindle private sector interest and investment to augment public investment; (ii) address all

issues and identify key takeaways, including global best practices; and (iii) review and reorient the PPP model, keeping in mind the interests of all stakeholders. Emphasis was also laid on the need to ensure that government absorbs only those risks that cannot be borne by the private sector.

II. LITERATURE REVIEW

Sekar and Karthigeyan in 2009 carried out a research in order to improve the public transportation system, the Mass Rapid Transit System (MRTS) has been provided or being planned in various parts of the world. Although most of the developed countries have already provided MRTS in their major cities, the same is lacking in most of the cities in the developing countries, including India. Selection of a public transportation system on a corridor in the city, whether it should be road based (High Capacity Bus Systems [HCBS]) or rail-based (for example, metro rail, mono rail, etc.) primarily depends on the traffic density during the peak hours on that particular corridor. Experiences from Indian cities have shown that under mixed traffic conditions, comprising slow and fast moving vehicles, road-based public transportation system can optimally carry 8,000 Peak hour peak direction traffic (phpdt). When traffic density crosses that mark, traffic and environmental pollution related issues/problems increase; under these circumstances provisions of a rail-based mass transit system (that is, a metro rail system) should be considered. However, it is observed that when the traffic increases beyond 15,000 phpdt on a corridor, introduction of metro rail system becomes unavoidable.

E Sreedharan said that Construction of Metro is not an easy task and encountered several technological difficulties. As metro passes from the historic and old developed areas of the cities, so tunnelling below these areas possess a major challenge, as the building in these areas have weak foundation, Therefore the tunnel has to be construct at a higher depth.(20m in case of Delhi metro project).

12Th five year plan suggested provision for metro rail projects and Rail Rapid Transit System (RRTS). Success of the Delhi metro in transforming the public transport system in NCR region has led to demand of metro rail projects from many cities. Considering the long gestation period of conceptualizing a metro rail project and arranging funds for it, following is recommended as a guideline for making a city eligible to receive central assistance for metro rail project:

- ❖ Peak hour peak direction traffic (PHPDT) of more than 20,000 for at least 5 kms.of continuous length by 2021.
- ❖ Total population of more than 2 million as per 2011 census.

- ❖ Average trip length of more than 7–8 kms for motorized trips.
- ❖ At least 1 million ridership per day on organized public transport.

Ashwin Mahalingam in his study on the topic “PPP Experiences in Indian Cities: Barriers, Enablers, and the Way Forward” said that Public-private partnerships (PPP’s) are believed to be inevitable in the prevailing Indian infrastructure context, given the large sum of money involved as well as the huge amount of infrastructure that is to be built. Job opportunities in urban areas has brought about migration from rural areas, hence there has been a steady increase in population of urban India. Indian city and municipal governments have limited autonomy within their jurisdictions to levy taxes, duties and fees to raise funds. They are effectively dependent on their respective state governments to allocate funds to them for the provision of urban infrastructure and do not possess strong balance sheets and therefore lack the financial resources to develop the infrastructure that they require. Furthermore, they are often either understaffed or staffed with personnel without adequate skills and thus lack the capacity to procure infrastructure services on their own. There are several advantages in engaging with the private sector for infrastructure procurement. Foremost among these are:-

- ❖ The ability of the private sector to finance infrastructure that cash strapped governments are unable to provide and
- ❖ The expectation that a profit-motivated private operator can bring about enhanced operational efficiencies

III. RESEARCH METHODOLOGY

For the interpretation of the research some data has to be collect. This data for the analysis of various factors of empirical research were collected through the questionnaire. The effectiveness and legibility of questionnaire were analysed by the test. The questionnaire focused on PPP model that include both qualitative and subjective question. In responding to the questionnaire, the respondents were invited to respond on effect of the PPP model on the successful implication of Metro Project.

IV. DATA COLLECTION AND ANALYSIS

For the survey through questionnaire, professional from various metro project were reached.

No. of questionnaire sent: - 07

No. of responses received: - 18

No. of professional interviewed:-18

- (1) Whether the Government policies promote Public Private

Partnership in metro rail?

- (2) Whether PPP should be implemented in metro rails?
- (3) Whether the concept of PPP is well known to everyone?
- (4) Whether the project officials are trained in areas such as financial and legal structuring that are key to PPP transactions?
- (5) Whether the project officials are used to the new kinds of contractual arrangements that are typical aspects of PPPs, where risk and responsibility are shared between the private and the public sectors?
- (6) Whether you feel PPP implementation in a metro rail project is beneficial?
- (7) Whether you feel Private sector will voluntarily come for the bidding process?

Table 1. Five point Likert scale

OPTION	SCORE
Almost Always	5
Usually	4
Occasionally	3
Usually not	2
Almost never	1

4.1.1 DATA ANALYSIS TOOL

Data was analysed by using SPSS statistics 20 program and MS-Excel. Both Parametric and non-parametric tests were performed on the data. The data was collected using five point Likert scale (Table 1). Firstly, Non-Parametric Kolmogorov-Smirnov test was performed. It is used to determine normality of collected data, the results showed that the collected data was normally distributed and it is viable to make parametric tests.

4.1.2 NON PARAMETRIC TEST

KOLMOGOROV-SMIRNOV TEST

The one sample Kolmogorov-Smirnov test is used to test whether a sample comes from a specific distribution. We can use this procedure to determine whether a sample comes from a population which is normally distributed.

Hypothesis Testing

Let x_1, \dots, x_n be an ordered sample with $x_1 \leq \dots \leq x_n$ and define $S_n(x)$ as follows:

$$S_n(x) = \begin{cases} 0, & x < x_1 \\ k/n, & x_k \leq x < x_{k+1} \\ 1, & x \geq x_n \end{cases}$$

Now suppose that the sample comes from a population with cumulative distribution function $F(x)$ and define D_n as follows:

$$D_n = \max_x (F(x) - S_n(x))$$

Observation: It can be shown that D_n doesn't depend on F . Since $S_n(x)$ depends on the sample chosen, D_n is a random variable. Our objective is to use D_n as a way of estimating $F(x)$.

The distribution of D_n can be calculated, but for our purposes now the important aspect of this distribution are the critical values. These can be found in the Kolmogorov-Smirnov Table.

If $D_{n,\alpha}$ is the critical value from the table, then $P(D_n \leq D_{n,\alpha}) = 1 - \alpha$. D_n can be used to test the hypothesis that a random sample came from a population with a specific distribution function $F(x)$. If $\max_x (F(x) - S_n(x)) \leq D_{n,\alpha}$ then the sample data is a good fit with $F(x)$.

Also from the definition of D_n given above, it follows that $(1 - \alpha) = P(D_n \leq D_{n,\alpha}) = P(\max_x (F(x) - S_n(x)) \leq D_{n,\alpha}) = P(S_n(x) - D_{n,\alpha} \leq F(x) \leq S_n(x) + D_{n,\alpha} \text{ for all } x) = P((F(x) - S_n(x)) \leq D_{n,\alpha} \text{ for all } x)$

Thus $S_n(x) \pm D_n, \alpha$ provides a confidence interval for $F(x)$

$$F(x) = \sqrt{\frac{2}{x}} \sum_{k=1}^{\infty} \frac{e^{-(2k-1)^2 \pi^2}}{(8x^2)}$$

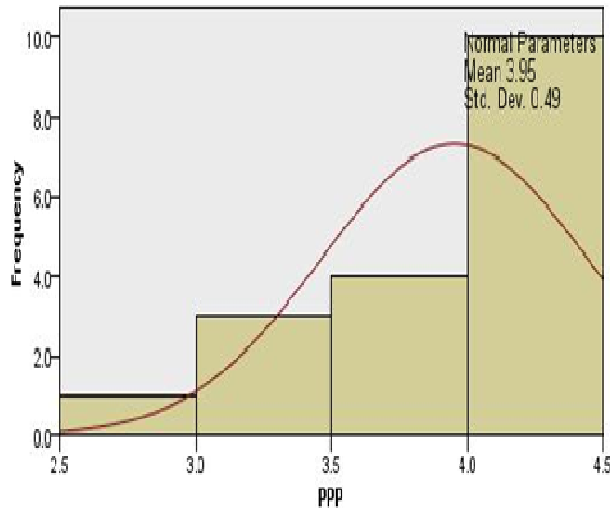
4.1.3 RESULT

Kolmogorov-Smirnov Test

The results of the Kolmogorov-Smirnov Test showed that, as expected all the factors have normal distribution and thus qualify to be tested with statistical parametric tests. Based on the results we decide to retain the null hypothesis thus depicting all the five factors impact the metro rail projects.

Table 2 - Kolmogorov-Smirnov Test for Government Policies

S.No	Null Hypothesis	Test	Significance	Decision
1	The distribution of PPP is normal with mean 3.95 and standard deviation 0.49.	One-Sample Kolmogorov-Smirnov Test	.183	Retain the null hypothesis.



Total N		13
Most Extreme Differences	Absolute	.207
	Positive	.165
	Negative	-.207
Test Statistic		.877
Asymptotic Sig. (2-sided test)		.425

Figure 1 - Kolmogorov-Smirnov Test for Public Private Partnership

4.1.4 Parametric Test

In statistics **Cronbach's alpha** is used as a (lower bound) estimate of the reliability of data. Cronbach's alpha is a

measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability.

Suppose that we measure a quantity which is a sum of K components (K -items or test lets):

$$X = Y1 + Y2 + \dots + YK$$

Cronbach's α is defined as:

$$\alpha = \frac{K}{K - 1} \left(1 - \frac{\sum_{i=1}^k \sigma^2 y_i}{\sigma_x^2} \right)$$

Where,

σ_x^2 is the variance of the observed total test scores,

$\sigma_{y_i}^2$ the variance of component i for the current sample of persons

K is the total number of questions in the particular section

Alternatively, Cronbach's α can be defined as:

$$\alpha = \frac{k \bar{c}}{(\bar{v} + (K - 1)\bar{c})}$$

Where,

K is as above

\bar{v} The average variance of each component (item)

\bar{c} The average of all covariance between the components across the current sample of persons (that is, without including the variances of each component).

Table 3 – Criteria for Cronbach's Alpha

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent (High-Stakes testing)
$0.7 \leq \alpha < 0.9$	Good (Low-Stakes testing)
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

4.1.5 RESULT

CRONBACH'S ALPHA

The reliability values (alpha values) for all the factors were computed and found to be in good and acceptable range of values. Cronbach's alpha was calculated using Ms-Excel.

Table 4 – Cronobach’s Alpha For Public Private Partnership

S.No.	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12		
	Public Private Partnership							Su m	Avera ge
1	4	5	3	4	4	4	5	29	4.143
2	4	4	3	3	2	3	4	23	3.286
3	4	4	4	3	4	3	4	26	3.714
4	2	2	4	3	4	2	3	20	2.857
5	4	5	4	4	4	5	5	31	4.429
6	5	4	2	5	2	3	2	23	3.286
7	4	4	3	3	3	4	5	26	3.714
8	5	2	4	4	4	2	3	24	3.429
9	4	5	4	3	4	4	5	29	4.143
10	4	5	4	3	4	5	5	30	4.286
11	4	5	4	3	4	4	4	26	3.714
12	5	5	3	4	4	5	5	31	4.429
13	5	5	4	4	4	4	4	30	4.286
14	5	5	3	4	4	5	5	31	4.429
15	5	5	3	4	4	5	5	31	4.429
16	5	5	4	4	4	4	4	30	4.286
17	4	5	4	3	3	4	4	27	3.857
18	5	5	3	4	4	5	5	31	4.429
Sum	78	78	63	65	66	71	77	498	
Variance	0.556	1.000	0.361	0.349	0.444	0.941	0.756		

V. CONCLUSION

Metro rail systems have become the spine of cities transport infrastructure, with lowest level of environmental pollution and highest level of power efficiency. Metro rail not only facilitates travelling in the city by reducing travel time but also develops the business along its corridors. It has a very high carrying capacity to cater to huge passenger demands thus drastically reducing land acquisition for the same load. It requires much less space to carry same number of passengers. In this study the various aspects of metro rail projects were investigated. Data reliability was established and according to Regression analysis results, a positive and excessive influence of Government Policies was found on Public Private Partnerships, thus the implementation of Public Private Partnerships in a metro rail project is beneficial for such

projects. Government should frame policies for Public Private Partnerships, and these policies must be enshrined as laws.

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