

ANALYSIS AND RESULTS

6.1. INTRODUCTION

In the last chapter on pilot study the development of research instrument and its pre-test on select sample of respondents has been explained. For arriving at conclusions with a higher confidence, a survey was planned to validate the critical success factors and the conceptual framework. Having established the reliability and validity of the research instrument, now it was time to administer the same to larger sample for full scale study. This chapter gives step by step procedures followed for analysis of the data collected from opinion survey. Statistical tools used to analyze data to achieve research objectives have been detailed with theoretical perspective in brief for each tool used.

Officials engaged in urban metro either in planning or in execution/operation understand that conceptualizing and implementing a PPP metro on a PPP framework is not a simple and easy task. Different explanations have been provided to understand underlying factors that seem to contribute to a successful PPP project. However, given the way urban metro is taking off in Indian metro cities, critical success factors that contribute to the success of a PPP metro is becoming an area of interest in the recent research work. Researchers and city planners are attempting to explore factors contributing to success of a PPP program leading to creation of metro infrastructure and its operation and maintenance for a reasonably long period leaving precious government resources for other priority areas.

This chapter on analysis and results of opinion survey is based on the experiences of rail/metro sector executives in India, who have worked in any capacity related to the development of a metro project on a PPP framework that enabled them to relate their own experiences to the factors that contribute to the success of such a project. The observations from a questionnaire-based

survey of both private and public sector executives are reported and discussed in this chapter. Some related aspects of the survey such as questionnaire development, its administration, validity; descriptive statistics, etc. have also been discussed in this chapter. Table 6.1, indicates briefly the strategic issues and corresponding research framework.

Table 6.1: Research Framework for CSFs for PPP metro in India

Issues	Research Framework
<p>Critical Success Factors contributing to success of a PPP metro in India.</p>	<p>This is based on survey methodology.</p> <p>The questionnaire after being tested through a pilot study was administered to the prospective respondents.</p> <p>Stratified sampling was used and within strata judgmental/snowball sampling was used.</p> <p>A sample size of 132 was targeted for administering the questionnaire. Since help was taken from a senior executive in selecting respondents within his department/company who fulfill the criteria additional questionnaire sets were sent. A total 198 questionnaires were distributed/mailed and in all 126 filled in responses were received. (a response rate of 63.6 percent).</p> <p>The respondents' profile and demography are also presented in this chapter.</p> <p>Descriptive statistics and the hypotheses of differences are tested and presented.</p> <p>Factor analysis and cluster analysis has been carried out to classify CSFs into few key macros</p>

Development of framework for success in a PPP metro in Indian context	Test for equality of variances was performed on groups emerged through cluster analysis to ascertain that data are homoscedastic. Macro factors grouped through cluster analysis are used to identify relationships among various factors through ISM. The conceptual framework emerging after literature survey was revisited and six experts were consulted to either add or delete a relationship. In all 29 hypotheses were developed and validated through statistical techniques (regression). Validated hypotheses identified the paths
Whether there is any difference in perceptions of private and public sector stakeholders on the CSFs for a PPP metro in India	A test for equality of variances was used to test the absence of heteroscedasticity. Since heteroscedasticity was found to be present, in addition to one way Anova, mood's median test, a non parametric test was also performed to validate the relevant hypothesis

6.2. DESIGN OF THE QUESTIONNAIRE

The research was carried out based on the scientific method using techniques for studying phenomena either for gaining new knowledge or for building on existing knowledge. It comprises collection of observable, empirical, measurable evidence that stand the test of reasoning.

The research uses a “cross-sectional design⁵, suitable for studies that aim to analyze a phenomenon, situation, problem, attitude or issue by considering a cross-section of the population at one point in time. This study employed the survey method, which made use of a questionnaire with a possibility to use either as a mail survey or administered by approaching concerned executives as the means to data collection” (Malhotra,2004). “The questionnaire is “basically a collection of questions that fit the research topic and its objectives, and the answers to which will provide the data necessary to test the hypothesis formulated for the study” (Kothari, 2004), Accordingly, the topic of research and key variables and issues involved were thought of first before attempting to formulate the questions of the research study. It uses the

⁵ “Cross-sectional design involves the collection of information with any given sample of population elements only once “(Malhotra, 2004)

research variables identified through literature review, findings of pilot study and pre-consultation with experienced executives and academicians. Flowchart of the research design for opinion survey is shown in Figure 6.1

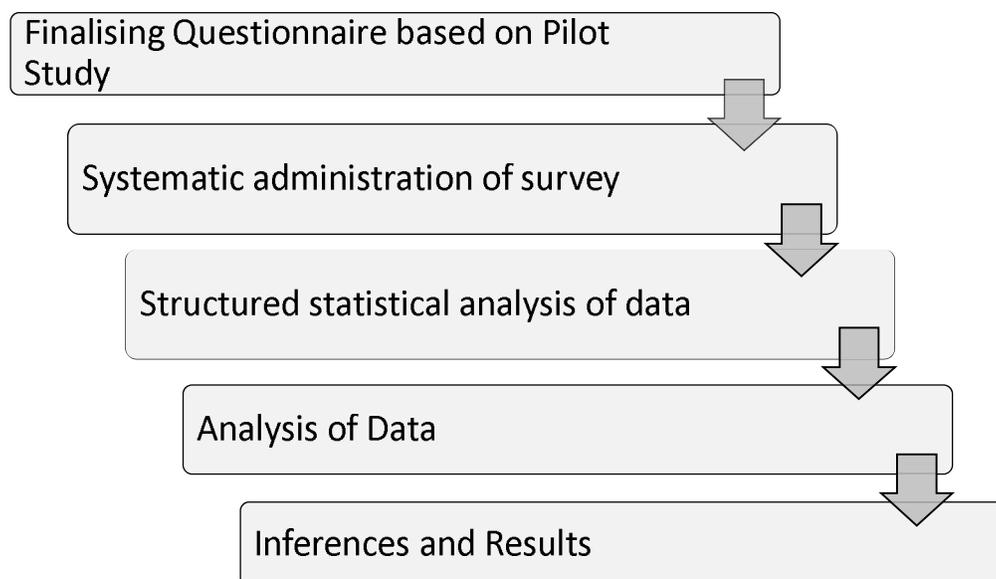


Figure 6. 1 Research Design for Opinion Survey

The questionnaire was developed in English. The structured questionnaire used in this research was divided into two sections; Section A: Critical Success Factors for the success of a PPP metro project and Section B: Respondent's profile. Altogether, it consisted of 27 questions.

“The behavioral measurement scales used to measure attitudes of respondents were treated as interval scales, with an assumption that the difference between two successive numerical measures is fixed.” (Kothari, 2004)

The questionnaire consisted of two sections.

- a) In the first section ‘Section A: Critical Success Factors for the success of a PPP metro project’ respondents were given eighteen parameters that constitute CSFs and were asked to rate these parameters on a five point Likert scale (5: Highly Important, 4: Moderately Important, 3: To some extent Important, 2: Low importance, 1: Least Important) There was provision for respondents to add factors/parameters other than included in the questionnaire.

- b) The second section included questions meant to profile the respondents and nature of their experience.

Questionnaire and covering letter are given in Appendix (Exhibit-1) ⁶

6.3. DATA COLLECTION AND SAMPLING METHODOLOGY

Sampling methodology for collection of data is explained in ensuing paragraphs.data

6.3.1. SAMPLING ELEMENT AND SAMPLING UNIT

Primary data was collected through a structured questionnaire to select sample of respondents. The sampling element and sampling methodology has been detailed in section 4.9 in Chapter-4. The sampling element is defined as persons who are in the executive decision making authority in their respective companies/organizations and have been exposed to public private partnership in railways/MRTS projects. The population for the survey is divided into two broad stakeholders; public sector and private sector.

Respondents were selected from among the individuals or entities engaged in planning, conceiving, advising, executing railways/MRTS projects on PPP basis such as officials in Central Government, State Governments responsible for urban transport planning including MRTS, metro corporations, private firms/consortiums involved in advisory, construction, operation/bidding for concessions including rolling stock suppliers, independent urban transport experts/consultants, urban transport institutes/Centers of Excellence (declared by MoUD) etc.

Attempts were made to select equal respondents from the two strata. Within strata, judgmental sampling/snowball sampling was used where opinion from colleagues, experts, seniors was taken regarding their profile matching the profile of target respondents of our study.

⁶ The questionnaire did not undergo any change after pilot study as the reliability and validity was established and twelve performance indicators and eighteen CSFs were found to be significant. Hence the same letter and questionnaire (without section A for performance indicators) used for pilot study was mailed/sent to respondents with only two sections for opinion survey, Section B and C were however, re-numbered Section A and Section B.

In order to minimize the non- response issue, a request letter addressed to the Head of the department/company was enclosed with a brief on the purpose and with the request for wider participation from the eligible respondents from his department/company.

An explanatory note to the questionnaire was also enclosed. Questionnaire was given in person in majority of cases and in a few cases they were sent over mail, google form. In some organizations for example Icon, Rites, Gurugram rapid metro, a set of questionnaires were handed over to a senior executive of the rank of GM and above. They were explained the purpose of the study and were requested to get the questionnaire filled up by executives who in their opinion have sufficient knowledge and exposure to PPP and railway projects and thus meet the requirements of our target population. Questionnaires were also distributed to audience from different organizations attending a special session on metro organized by IUT in Nov, 15. Out of 126 questionnaires received, 2 were not usable. Hence, 124 usable questionnaires were included for data analysis. Data are assumed to be normally distributed.

Table 6.2 gives the case processing summary for responses obtained from the respondents of opinion survey and Table 6.3 gives profile of the respondents.

Table 6.2: Case Processing Summary for Opinion Survey

Sample Size Planned	132
Actual Sample (Responses received)	126
Responses excluded	2
Reponses considered for analysis	124
<i>Out of which</i>	
Private Sector: Mumbai metro, JVs of Indian Railways, Mumbai Metro One, L&T Metro, Gurugram Rapid Metro, IL&FS, Alstom (Transport), Consultants	55

e.g.UITP, ATKINS, Techniche etc.	
Public Sector: Indian Railways, IUT, MoUD, UMTC, Delhi Metro, RITES, IRCON, Hyderabad metro, MMRDA, Ahmedabad Metro, Jaipur metro, Bangalore metro, Kochi Metro, Lucknow Metro, Academicians e.g. IITM	69

Table 6.3: Profile of Respondents for Opinion Survey

Profile	Private Sector	Government Sector	Total
Consultancy/Transaction Advisor	22	22	44
Infrastructure civil contractor/facility management/ITS	13	10	23
Academician	4	7	11
Metro rolling stock supplier	6	1	7
Rail/Metro Operator/Concessionaire	10	26	46
Policy Planning		3	3
Sub Total	55	69	124

Data received in various forms were compiled, transferred to excel file and analyzed using Minitab.

6.4. DATA ANALYSIS AND RESULTS: OBJECTIVE WISE

A total of four research objectives were set in the beginning of study. While Objective-1 was fulfilled through analysis of pilot study data and is covered in Chapter-5, other objectives i.e. research objectives 2 to 4 are dealt

Research Methodology for Opinion Survey

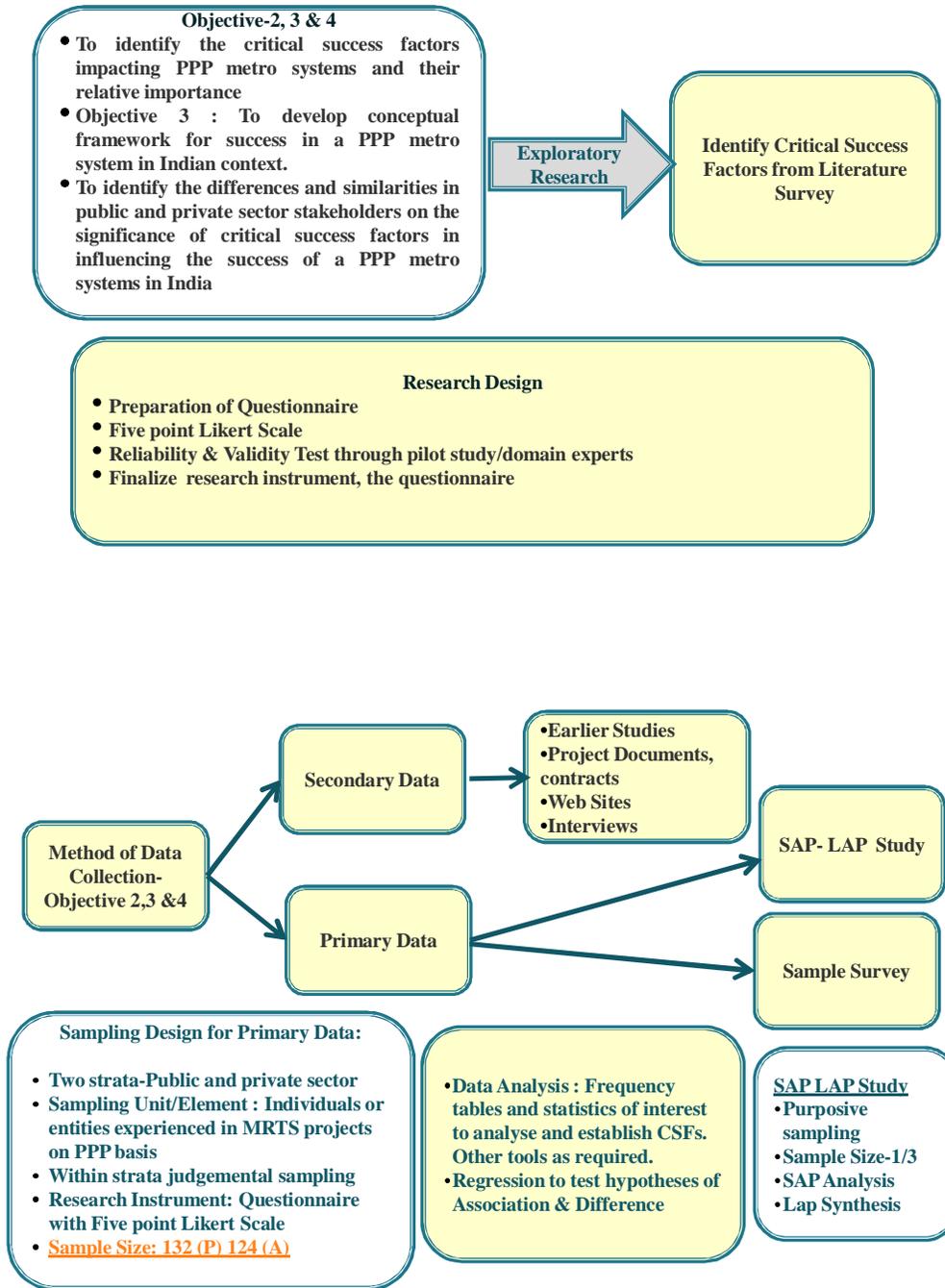


Figure 6. 2 Research methodology for Opinion Survey

with here in this chapter. While a road map of research methodology was given in Chapter-4, research methodology followed for research objectives 2-4 is schematically presented in Figures 6.2 & 6.3.

6.5. DATA ANALYSIS AND RESULTS FOR OBJECTIVE-2

Objective-2 : To identify the critical success factors impacting PPP metro systems and their relative importance.

Data Analysis commenced with Descriptive Statistics to calculate the locational parameters and standard deviations of all constructs and objective indicators.

6.5.1. UNIVARIATE ANALYSIS FOR MICRO VARIABLES

The analysis was carried out separately for both private and government sector for all 124 respondents to analyze each of micro variables in terms of descriptive statistics viz. mean, standard deviation etc.

Locational parameters (mean) for all eighteen parameters for both public and private sectors are 4 or more (Table-6.4), suggestive of significance of parameters. Standard deviation of these parameters also does not vary much suggestive of consistency in data.

Though there is no significant difference in parameters, yet relative importance of parameters is shown in Bar Chart in Figure-6.3 which shows that contract agreement and Government support have been rated as the two most significant parameters.

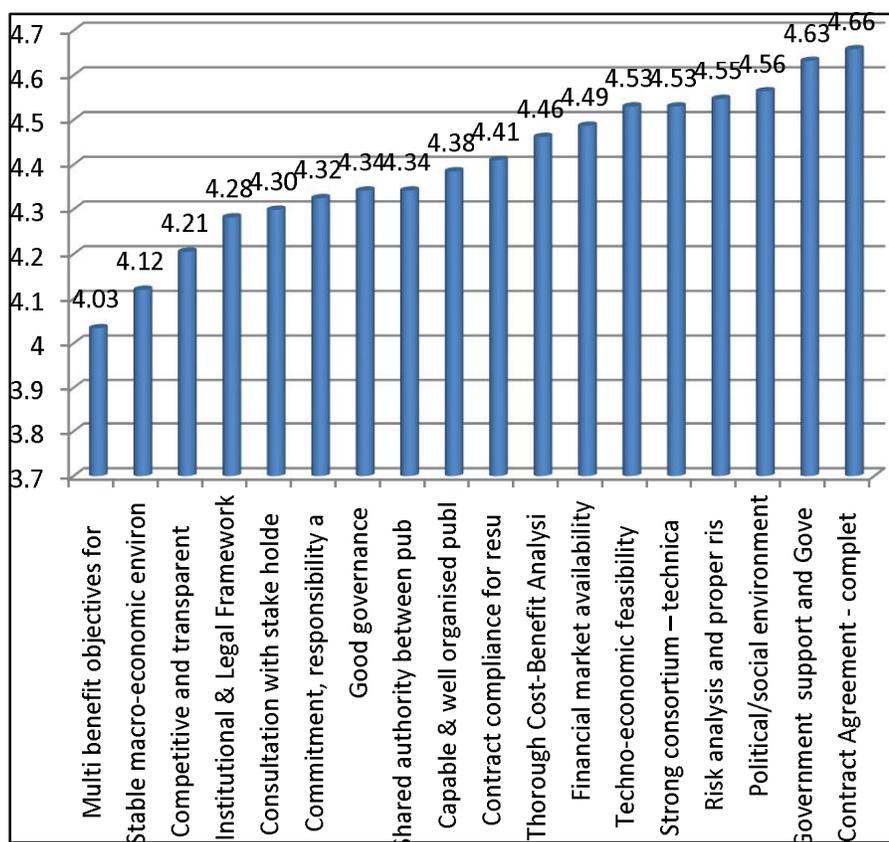


Figure 6. 3: Stacked Mean of 18 CSFs

Table 6.4: Descriptive Statistics of Micro Variables across Two Sectors

S. No	Micro Research Variables (Critical Success Factors)	<i>Public Sector</i>		<i>Private Sector</i>	
		<i>Mean</i>	<i>S.D</i>	<i>Mean</i>	<i>S.D.</i>
1	Political/social environment/ support	4.5735	0.6537	4.5636	0.6314
2	Stable macro-economic environment	4.0147	0.7226	4.182	0.796
3	Institutional & Legal Framework	4.2500	0.7605	4.2727	0.6792
4	Financial market availability	4.4925	0.5607	4.4909	0.5400
5	Capable & well organized public agency	4.3382	0.5887	4.4364	0.6013
6	Good governance	4.2353	0.7354	4.5091	0.6047

7	Consultation with stake holders	4.1940	0.7228	4.4182	0.5991
8	Multi benefit objectives for all stake holders from the project	3.971	0.828	4.0556	0.6845
9	Thorough Cost-Benefit Analysis of the project	4.4118	0.5791	4.5091	0.6047
10	Techno-economic feasibility of project	4.4559	0.5842	4.6182	0.6233
11	Competitive and transparent procurement process	4.2388	0.7802	4.182	0.748
12	Strong consortium – technically, financially competent with experience and project management skills	4.6176	0.4896	4.4182	0.5991
13	Government support and Government Guarantee for the project	4.5294	0.6101	4.7636	0.6075
14	Risk analysis and proper risk allocation in a PPP project	4.5000	0.6348	4.5636	0.6314
15	Contract Agreement - completeness with respect to roles and responsibilities of partners, risk allocation and sharing, methods of risk mitigation, provisions for contingency situations etc.	4.6029	0.6020	4.6909	0.6047
16	Contract compliance for results-monitoring by public agency for execution and performance standards in accordance with contract	4.3433	0.6641	4.4364	0.6314
17	Commitment, responsibility and defined role of partners	4.3235	0.6334	4.3273	0.6102
18	Shared authority between public and private agency	4.264	0.7652	4.4074	0.7142

6.5.2. CHI-SQUARE TEST

Theoretical Concept. “The chi-square test is an important test among the several tests of significance. Chi-square symbolically written as χ^2 is a

statistical measure used to judge the significance of population variance” i.e., whether a random sample has been drawn from a normal population with mean μ and with specified variance σ^2 . (Malhotra,2004) The test has been used to test the significance of population variance.

The test is based on “ χ^2 -distribution. If we take each one of a collection of sample variances, divide them by the known population variance and multiply these quotients by (n-1), where n means the number of items in the sample, we shall obtain a distribution. Thus $\sigma_s^2 (n-1) / \sigma_p^2 = \chi^2$ (d.f.) would have the same distribution as χ^2 -distribution with n-1 degree of freedom”. (Kothari,2004)

Observations Chi-Square for Observed Counts in Variable was carried out to test the hypothesis as defined below:

For Critical Success Factors Bi (where i=1, 2, 3.....18)

H0: There is no significant difference between ratings for critical success factor Bi given by respondents.

Ha: The rankings given by respondents for Bi are significantly different.

Chi Square test was done for all B1.....B18 individually for each parameter to test all eighteen hypotheses.

Table 6.5: Chi Square Test for Performance Indicators

CSF	Total Count for rating 1 to 3	Total Count for rating 4 & 5	p value	CSF	Total Count for rating 1 to 3	Total Count for rating 4 & 5	p value
B1	8	116	0.000	B10	8	116	0.000
B2	22	102	0.000	B11	19	104	0.000
B3	18	106	0.000	B12	1	123	0.000
B4	3	120	0.000	B13	7	117	0.000
B5	7	117	0.000	B14	7	117	0.000
B6	13	61	0.000	B15	8	116	0.000
B7	15	108	0.000	B16	9	114	0.000
B8	30	93	0.000	B17	10	113	0.000
B9	7	117	0.000	B18	15	108	0.000

Inferences

At 95% confidence p values are less than 0.05 for all parameters (Table-6.5). Therefore at 95% confidence level we reject null hypothesis that there is no significant difference in ratings by respondents. Hence we conclude that the ratings have significant difference and the performance indicator parameters are significant parameters

On the basis of above analysis and inferences we conclude that the eighteen factors identified through literature survey and as given in table 2.4.in Chapter-2 are significant factors which impact the success of a PPP metro in Indian context.

6.6. DATA ANALYSIS AND RESULTS FOR OBJECTIVE-3

Objective 3 : To develop conceptual framework for success in a PPP metro system in Indian context.

Through an extensive literature review six macro and eighteen micro variables have been identified. The micro variables' relationship analysis was carried out by opinion survey in order to identify the driver power and the dependence of the variables used.

6.6.1. FACTOR ANALYSIS

“The goal of factor analysis is to reduce the number of factors or in other words resolve a set of measured micro variables into relatively few macro variables. This analysis helps the researcher to group variables into factors based on correlation between variables. Researcher can use his judgment to attach meaning and name to these new variables.” (Kothari,2004)

The number of factors in factor analysis is same as the number of variables. Each factor represents a proportion of the overall variance in the observed variables which form the basis of rankings of the factors. The eigenvalue is a measure of how much of the variance of the observed variables a factor explains. (Malhotra, 2004)

Factor analysis on micro variables needed to explain variability in data are shown in Table 6.6 in terms of percentage variation and Scree Plot obtained is depicted in Figure 6.4.

Inferences

As may be seen, the proportion of variability explained by the first factor is 23.5%. It seems to be significant but not sufficient to cover major portion of variability. We needed more factors to cover at least 90% of the variability in data. To cover 90% of the total variability, it is observed that 13 factors will be covered leaving behind 5 factors (28% of the total number of

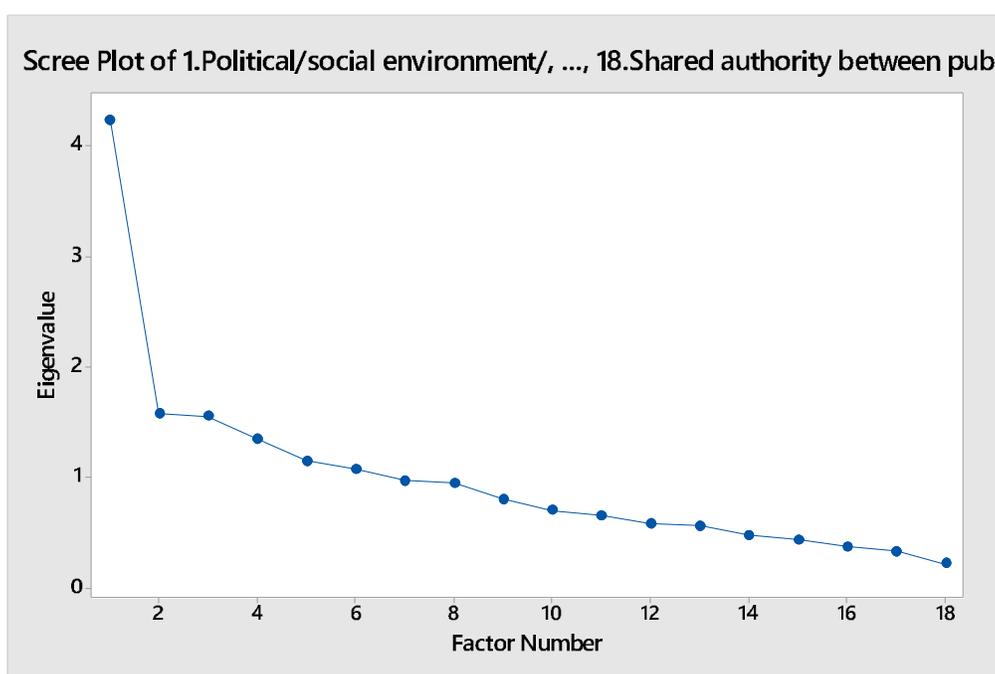


Figure 6. 4 Scree Plot

Table 6.6 Total Variance Explained

S. No.	Critical Success Factors	Total	% Variance	Cumulative
1	Political/social environment/ support	4.2280	23.5	23.5
2	Stable macro-economic environment	1.5804	8.8	32.3
3	Institutional & Legal Framework	1.5533	8.6	40.9
4	Financial market availability	1.3479	7.5	48.4

5	Capable & well organised public agency	1.1490	6.4	54.8
6	Good governance	1.0754	6.0	60.8
7	Consultation with stake holders	0.9719	5.4	66.2
8	Multi benefit objectives for all stake holders from the project	0.9469	5.3	71.5
9	Thorough Cost-Benefit Analysis of the project	0.8036	4.5	76
10	Techno-economic feasibility of project	0.7038	3.9	79.9
11	Competitive and transparent procurement process	0.6543	3.6	83.5
12	Strong consortium – technically, financially competent with experience and management skills	0.5824	3.2	86.7
13	Government support and Government Guarantee for the project	0.5633	3.1	89.8
14	Risk analysis and proper risk allocation in a PPP project	0.4777	2.7	92.5
15	Contract Agreement	0.4361	2.4	94.9
16	Contract compliance for results	0.3722	2.1	97
17	Commitment, responsibility and defined role of partners	0.3301	1.8	98.8
18	Shared authority between public and private agency	0.2236	1.2	100

factors) representing 10% of the variability. Factor analysis is therefore not found of much help in our study and cluster analysis is carried out to group micro variables into groups.

6.6.2. CLUSTER ANALYSIS

“Cluster analysis is a multivariate method which aims to classify a sample of subjects (or objects) on the basis of a set of measured variables into a number of different groups such that similar subjects are placed in the same group.

Cluster analysis consists of methods of classifying variables into clusters. Technically, a cluster consists of variables that correlate highly with one another and have comparatively low correlations with variables in other clusters. The basic objective of cluster analysis is to determine how many mutually and exhaustive groups or clusters, based on the similarities of profiles among entities, really exist in the population and then to state the composition of such groups”. (Kothari, 2004)

Cluster analysis has no mechanism for differentiating between relevant and irrelevant variables. Therefore the choice of variables included in a cluster analysis must be underpinned by conceptual considerations. This is very important because the clusters formed can be very dependent on the variables included.

“There are number of different methods that can be used to carry out a cluster analysis; these methods can be classified as follows:

Hierarchical methods

- Agglomerative methods, in which subjects start in their own separate cluster. The two 'closest' (most similar) clusters are then combined and this is done repeatedly until all subjects are in one cluster. At the end, the optimum number of clusters is then chosen out of all cluster solutions.
- Divisive methods, in which all subjects start in the same cluster and the above strategy is applied in reverse until every subject is in a separate cluster. Agglomerative methods are used more often than divisive methods.

Non-hierarchical methods (often known as k-means clustering methods)”

For this study *Agglomerative type hierarchical clustering* was used as this method groups variables that are close to each other. The grouped variables are called clusters. “Technically, a cluster consists of variables that correlate highly with one another and have comparatively low correlations with variables in other clusters. The main purpose of cluster analysis is to determine how many mutually and exhaustive groups or clusters exist in the population, based on the similarities of variables and then to derive the composition of such clusters. Various groups to be determined in cluster analysis are not known in advance.” (Kothari,2004)

Steps in cluster analysis:

- “The first step consists in finding out the highest correlation in the correlation matrix and the two variables involved (i.e., having the highest correlation in the matrix) form the nucleus of the first cluster.
- Then one looks for those variables that correlate highly with the said two variables and includes them in the cluster. This is how the first cluster is formed.
- To obtain the nucleus of the second cluster, we find two variables that correlate highly but have low correlations with members of the first cluster. Variables that correlate highly with the said two variables are then found. Such variables along the said two variables thus constitute the second cluster.
- One proceeds on similar lines to search for a third cluster and so on.”
(Minitab)

Final Partition

Cluster 1

1. Political/social environment/ benefit objectives for 7. Consultation with stake holders 8. Multi benefit objectives for

Cluster 2

2. Stable macro-economic environment 3. Institutional & Legal Framework 4. Financial market availability

Cluster 3

5. Capable & well organised public 6. Good governance

Cluster 4

9. Thorough Cost-Benefit Analysis 13. Government support and Governance

Cluster 5

10. Techno-economic feasibility 17. Commitment, responsibility and

Cluster 6

11. Competitive and transparent 12. Strong consortium - technical

Cluster 7

14. Risk analysis and proper risk 15. Contract Agreement - complete

Cluster 8

16. Contract compliance for results 18. Shared authority between public

Figure 6. 5 : Final Cluster Partition

“Variable and distance matrix is used to perform the hierarchical clustering of variables. Linkage method determines how the distance between two clusters is defined”. Complete linkage method was used in the study as “it ensures that all items in a cluster are within a maximum distance and tends to produce clusters with similar diameters. The results can be sensitive to outliers” (minitab) The final partition from Minitab cluster analysis output is shown in Figure 6.6.

6.6.3. TEST FOR EQUAL VARIANCES (TO ASCERTAIN ABSENCE OF HETEROSCEDASTICITY)

Before using clusters as macro research variables in the development of framework and to test the model through regression, we performed a test for equal variances to test the equality of variances between populations or in other words to confirm homoscedasticity of data. Equal variances across samples is called homogeneity of variance or absence of heteroscedasticity. The Levene test was used to verify this assumption since

this test is less sensitive than the other available method Bartlett test to departures from normality.

Leven’s test p values (Figure 6.7) show p values > 0.5 . Hence we accept null hypothesis that variances are equal and conclude that data are homoscedastic (absence of heteroscedastic). (Nist/Sematech, 2012)

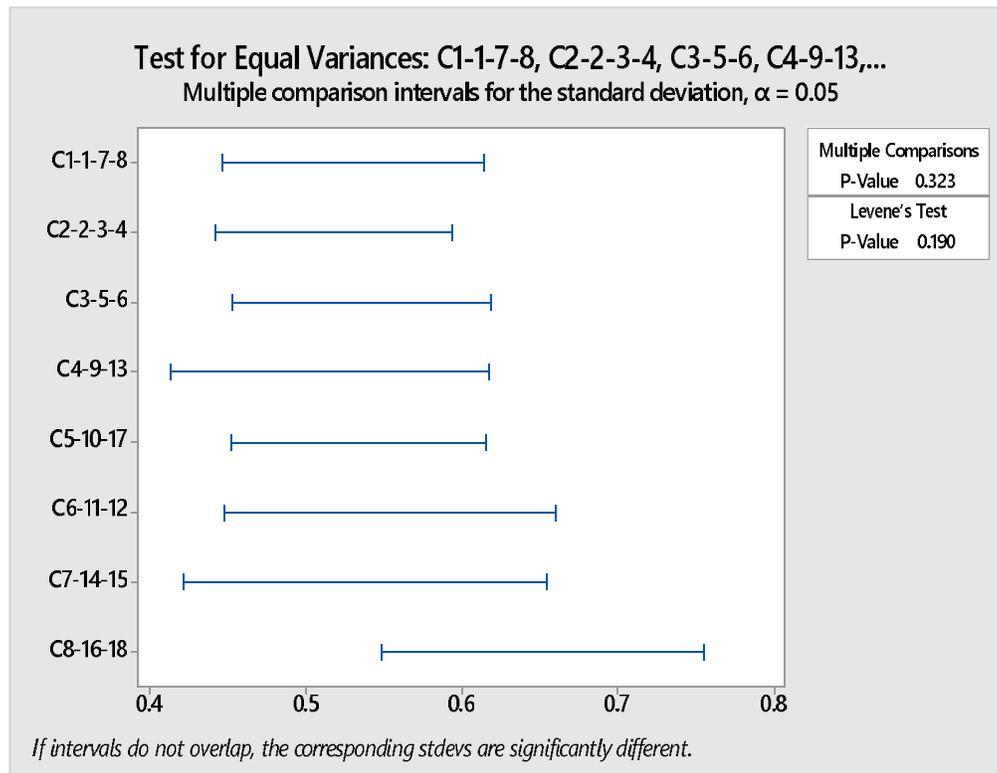


Figure 6. 6 : Test for Confirming Homoscedasticity of data (Test for equality of variances)

Dendrogram. “When carrying out a hierarchical cluster analysis, the process can be represented on a diagram known as a dendrogram. This diagram illustrates which clusters have been joined at each stage of the analysis and the distance between clusters at the time of joining” (Kothari,2004). Dendrogram is depicted in Figure 6.7.

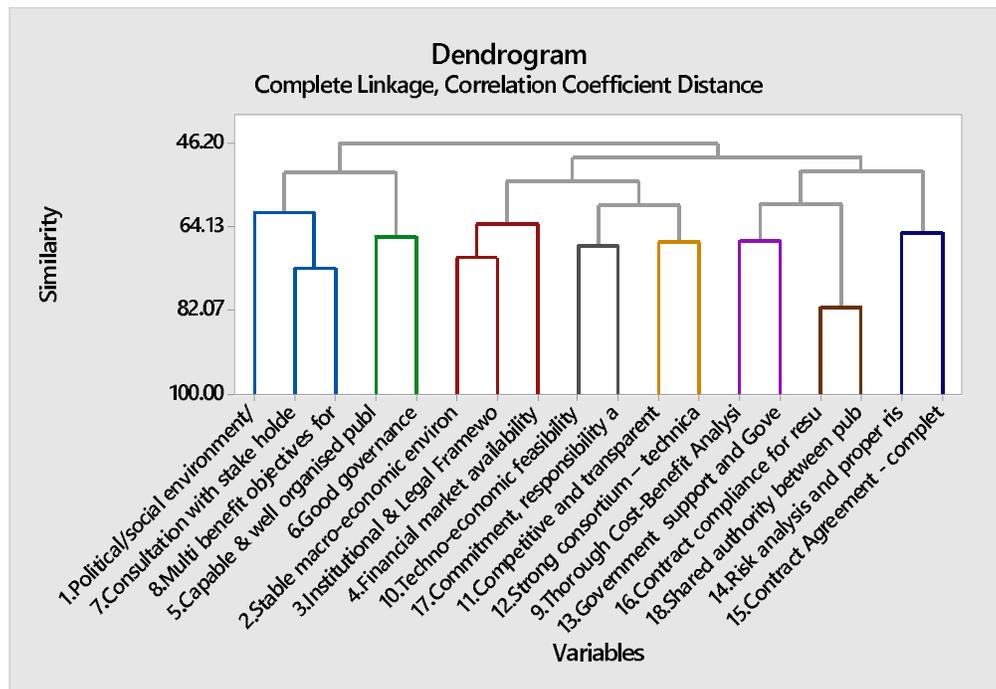


Figure 6. 7 : Dendrogram

On the basis of final partition given by cluster analysis which partitions micro variables into eight groups as shown in Table 6.7, we revisit our macro critical factors (refer Table 2.5 in Chapter-2). The eighteen micro factors are reclassified into seven new macro factors based on our insight and understanding from the study so far as shown in Table 6.8.

Table 6.7 Final Partition of Micro Variables by Cluster Analysis

Clust er No	Final Partition of Micro Variables	Macro Factors Named by Researcher
1	Political/social environment/ support	Socio-Political-Environment
	Consultation with stake holders	
	Multi benefit objectives	
2	Stable macro-economic environment	Stable macro-economics & Institutional legal framework
	Financial market availability	
	Institutional legal framework	
3	Capable & well organized public agency	Good Governance
	Good Governance	
4	Thorough cost-benefit assessment	Government Support
	Government Support & Guarantee	

5	Techno-economic feasibility of project	PPP Implementation Process
	Commitment, responsibility and defined role of partners	
6	Competitive and transparent procurement	Effective Procurement
	Strong consortium	
7	Appropriate risk Allocation and sharing	Well Structured PPP Project
	Contract Agreement	
8	Contract compliance for results	PPP Implementation Processes
	Shared authority between public and private	

6.6.4. DEVELOPMENT OF FRAMEWORK

Literature survey did not reveal relationships between micro and macro factors in a way so as to develop a comprehensive framework. PPP Framework given in World Bank's PPP reference guide (Figure 2.3 in Chapter-2) is too generic. Binary relationships and at best one factor leading to enablement of 2-3 factors could be observed in some of the studies such as;

- “Improvement of the enablers is collective; development of one enabler inevitably involves that of another”. (PPIAF,2009)
- “There is no absolute measure for progression of PPP enablers and the achievement of an enabling environment for PPP”. (PPIAF,2009)
- “It is necessary for governments in developing countries to create stable economic and financial supports with a view to inducing confidence in both local and foreign PPP investors”.(Babatunde,et al.2014)
- “The State is responsible for creating conducive political, legal and economic environment for building individual capabilities and encouraging private initiative”.(Gupta,R.N.2013)
- “Social and cultural norms within a nation are significantly alter the behaviours of people, and ultimately affecting the PPPs operation and

Table 6.8 Macro Factors Revisited

S. No	Macro Variables	Micro Variables	Type of Factors
1	Socio-Political-Environment	Political/social environment/ support	External
		Consultation with stake holders	
		Multi benefit objectives	
2	Stable macro-economics & Institutional legal framework	Stable macro-economic environment	
		Financial market availability	
		Institutional legal framework	
3	Government Support	Thorough cost-benefit assessment	
		Government Support & Guarantee	
3	Good Governance	Capable & well organized public agency	
		Good Governance	
5	Effective Procurement	Competitive and transparent procurement	
		Strong consortium	
6	Well Structured PPP Project	Appropriate risk Allocation and sharing	
		Contract Agreement	
7	PPP Implementation Processes	Techno-economic feasibility of project	Internal
		Commitment, responsibility and defined role of partners	
		Contract compliance for results	
		Shared authority between public and private	

structures, and public opposition has led to many cancellations, both before and after the concession award. Some of the social barriers are public opposition, cultural impediments, societal discontent against the private sector, public resentment due to tariff increases, lack of confidence and mistrust in PPPs.” (Babatunde & etal, 2014)

Based on the references wherever available in World Bank and other literature resources and based on findings of SAP-LAP analysis, an attempt

was made to define directional relationships of macro variables where it is implied that certain macro variables lead to enablement of some other macro variables.

The developed framework was shown to six experts (profile of experts at Exhibit-2). The experts were explained the background and findings of the study and were asked to give consent for each relationship (or path in the framework). They were also given freedom to delete or add any relationship if considered necessary. Table 6.9 shows the matrix of each response variable and its predictor (relationship, path) and the support it finds in World Bank, literature survey or SAP-LAP as well as each of the experts. Figure 6.8 shows the framework emerging after this exercise. Each relationship was validated through test for hypothesis of association.

6.6.5. TEST FOR HYPOTHESES OF ASSOCIATION

Based on the literature survey, SAP-LAP study and expert opinion, directional relationships have been defined in the hypotheses of association, where it is implied that certain macro variables lead to enablement of some other macro variables, as explained in different hypotheses of association.

Hypothesis for macro variables

Null Hypothesis: *no* macro research variable is a predictor of any other macro research variable.

Hypothesis Alternative: *At least* one macro research variable is a predictor of the other macro variable

Results of test for hypotheses of association by the regression analysis are shown in the form of p values in Table 6.9 with last column showing the validated path number. The validated conceptual framework is shown in Figure 6.9. Table 6.10 gives the interpretative matrix of the relationship among macro variables.

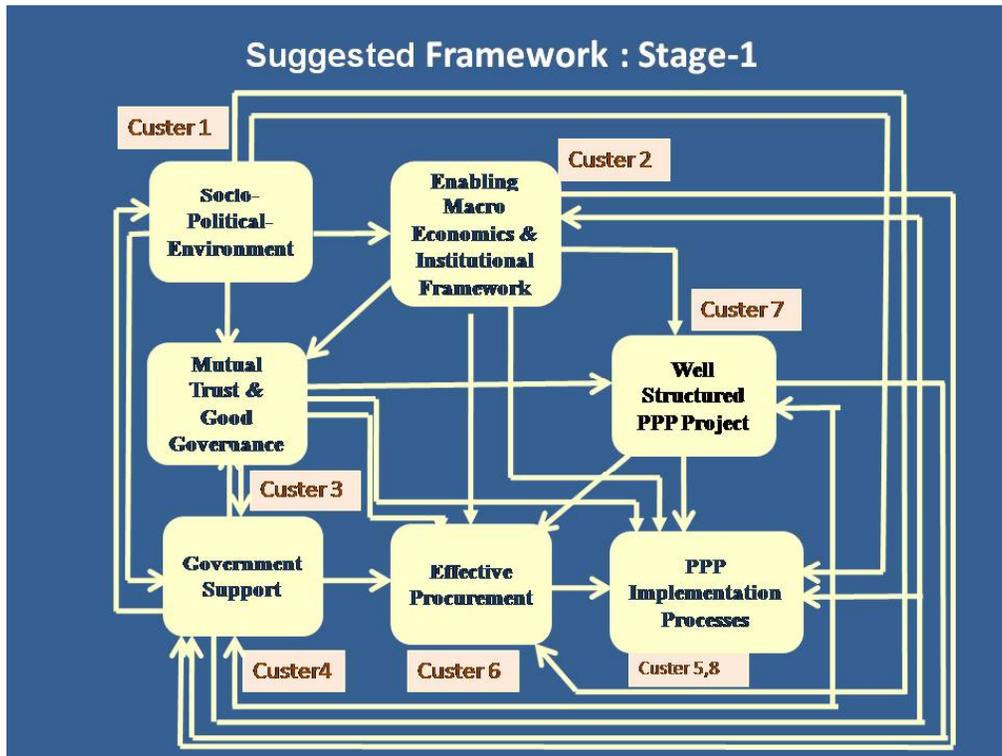


Figure 6. 8 : Suggested Framework for PPP Metro System

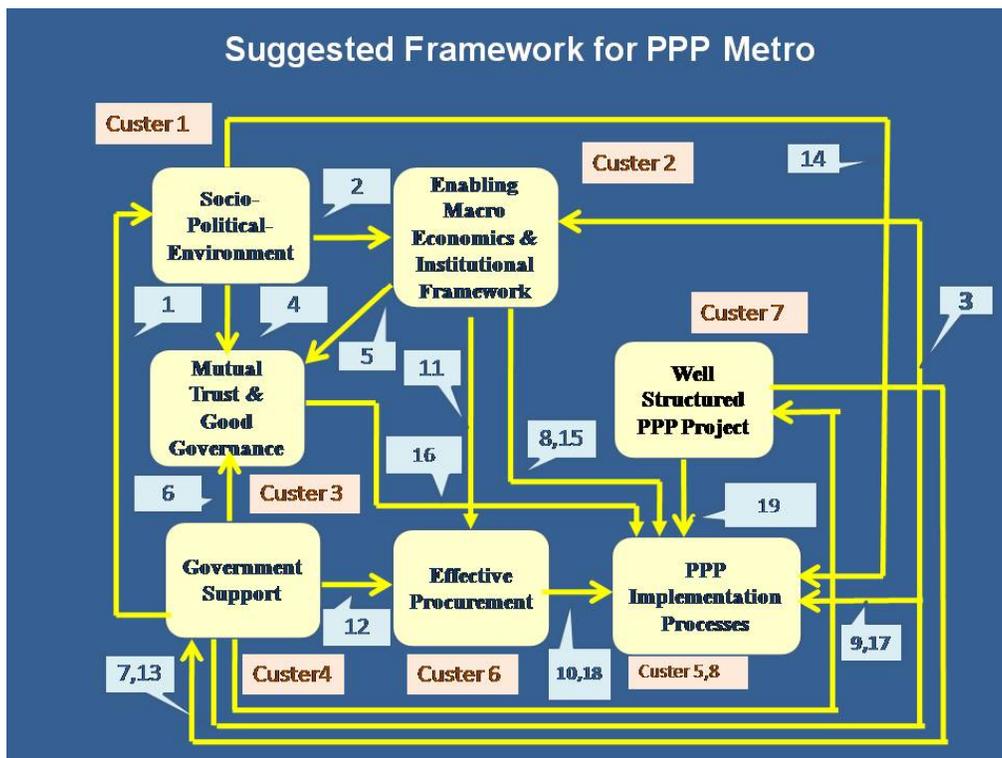


Figure 6. 8 : Validated Framework for PPP Metro System

Table 6.9 Development of framework-Validation of Hypotheses suggested by various resources

Null Hypothesis (Ho)	Supported By										Validation		
	WB	LS	SAP	E-1	E-2	E-3	E-4	E-5	E-6	P value	Inference	Path	
Cluster 1 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.022	Ho is accepted	1	
Cluster 2 is predicted by Cluster 1				Y	Y	Y	Y			0.05	Ho is accepted	2	
Cluster 2 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.056	Ho is accepted	3	
Cluster 3 is predicted by Cluster 1					Y			Y	Y	0.037	Ho is accepted	4	
Cluster 3 is predicted by Cluster 2	Y			Y	Y	Y	Y	Y	Y	0.028	Ho is accepted	5	
Cluster 3 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.093	Ho is accepted	6	
Cluster 4 is predicted by Cluster 1				Y	Y		Y			0.186	Ho is not accepted		
Cluster 4 is predicted by Cluster 2	Y			Y	Y			Y		0.14	Ho is not accepted		
Cluster 4 is predicted by Cluster 7				Y	Y	Y	Y		Y	0.014	Ho is accepted	7	
Cluster 4 is predicted by Cluster 3				Y				Y		0.372	Ho is not accepted		
Cluster 5 is predicted by Cluster 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.008	Ho is accepted	8	
Cluster 5 is predicted by Cluster 3	Y	Y	Y		Y	Y			Y	0.113	Ho is not accepted		
Cluster 5 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0	Ho is accepted	9	
Cluster 5 is predicted by Cluster 6	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.006	Ho is accepted	10	
Cluster 5 is predicted by Cluster 7		Y	Y	Y	Y					0.19	Ho is not accepted		
Cluster 6 is predicted by Cluster 1			Y	Y			Y			0.266	Ho is not accepted		
Cluster 6 is predicted by Cluster 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.027	Ho is accepted	11	
Cluster 6 is predicted by Cluster 3			Y		Y					0.815	Ho is not accepted		
Cluster 6 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.002	Ho is accepted	12	
Cluster 6 is predicted by Cluster 7			Y		Y	Y		Y		0.649	Ho is not accepted		
Cluster 7 is predicted by Cluster 2				Y	Y	Y				0.148	Ho is not accepted		
Cluster 7 is predicted by Cluster 3		Y	Y	Y	Y		Y	Y		0.834	Ho is not accepted		
Cluster 7 is predicted by Cluster 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.007	Ho is accepted	13	

Table-6.10 : Interpretive Matrix – Relationship Among Macro Variables

Macro CSFs	PREDICTORS							
	Corresponding Cluster(s)	A Socio-Political-Environment	Stable macro-economics & Institutional legal framework	Government Support	Good Governance	Effective Procurement	Well Structured PPP Project	PPP Implementation Processes
A Socio-Political-Environment	1				X			
Stable macro-economics & Institutional legal framework	2	X			X			
Government Support	4	X	X		X			
Good Governance	3							X
Effective Procurement	6		X		X		X	
Well Structured PPP Project	7				X			
PPP Implementation Processes	5,8	X	X	X	X		X	

Note : 'X' denotes if macro in the row is predicted by a macro in column

6.6.6. INTERPRETATION OF RELATIONSHIPS AMONG MACRO CSFs BASED ON THE VALIDATED FRAMEWORK

A close examination of paths in the validated framework reveals the relationship among different macros. Role of government in supporting a PPP program is most significant predictor. The government has to create a conducive socio-political-economical environment for PPP projects where private sector participates in infrastructure development. It has to establish institutional and legal framework to support PPP programs. Good governance as can be seen in the validated PPP framework is a derivative of all the three macro factors; government support, socio-political environment and enabling macro-economics and institutional, legal structure.

A Stable macro-economic environment & Institutional & legal framework will influence prevailing socio-political environment in a state which in turn will promote good governance.

While government support is required to well structure a PPP program and the underlying concession agreement, the reverse is also true i.e. if a PPP project is structured well, it would help in obtaining support of the government. For example, the new government of Telangana supported PPP metro in Hyderabad city because the project was well structured.

Government support, prevailing macro-economic environment and enabling institutional and legal framework will lead to effective procurement processes essential for selection of a good consortium.

All the above macro factors will lead to effective PPP implementation processes resulting in making a metro project successful.

6.7. Data Analysis and results for Objective-4

Objective-4 ;To identify the differences and similarities in public and private sector stakeholders on the significance of critical success factors in influencing the success of a PPP metro systems in India

6.7.1.TEST FOR EQUAL VARIANCES (TO CONFIRM ABSENCE OF HETEROSCEDASTICITY)

In the study a test for equal variances was used to test the equality of variances between populations. Other statistical procedures used in this study such as “ANOVA and regression analysis assume that while different samples can come from populations with different means, they have the same variance. Equal variances across samples is called homogeneity of variance or absence of heteroscedasticity. The Levene’s test was used to verify this assumption since this test is less sensitive than the other available method Bartlett test to departures from normality”. (Nist/Sematech, 2012)

The objective was to test the hypothesis that the group variances are equal. We reject the null hypothesis at the 0.05 significance level since the value of the Levene test p value is less than the = 0.05. We conclude that variances are significantly different and heteroscedasticity indeed exists. Minitab output is shown in Figure 6.10

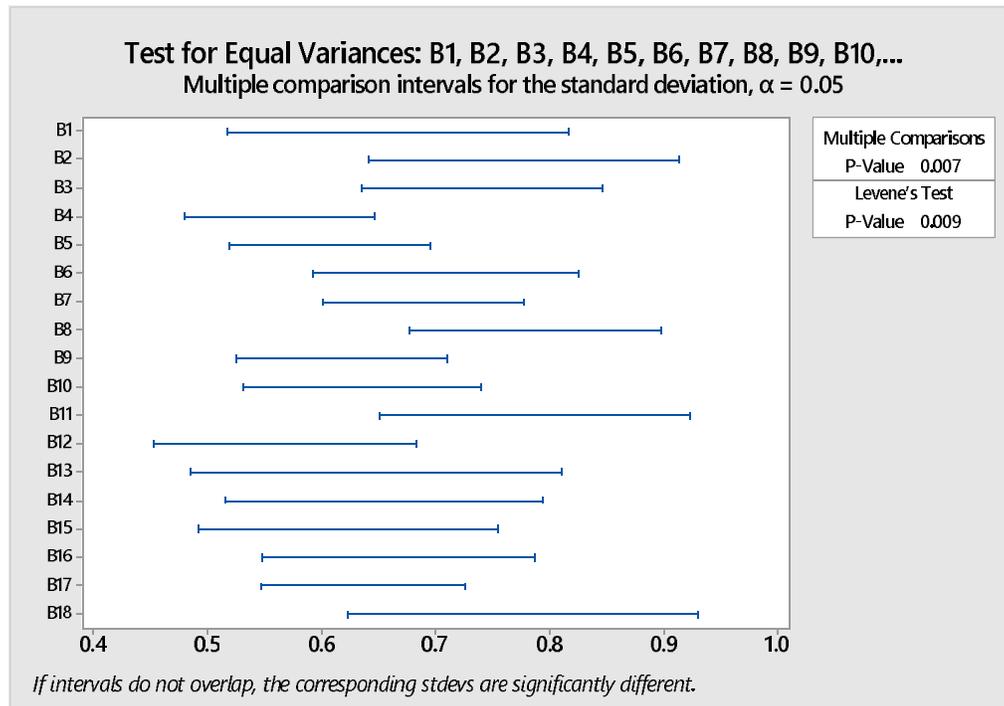


Figure 6. 9 : Test for Equality of Variances (Test for heteroscedasticity)

6.7.2. MOOD’S MEDIAN TEST

“When comparing the average of two or more groups with the help of hypothesis tests, the assumption is that the data is a sample from a normally distributed population. That is why hypothesis tests such as analysis of variance (ANOVA) are also called parametric tests.

Nonparametric tests do not make assumptions about a specific distribution. If assumptions do not hold, nonparametric tests are a better safeguard against drawing wrong conclusions.”

Since we observed presence of heteroscedasticity in our data we therefore, used Mood’s median test which is a nonparametric test to test the equality of medians from two or more populations. The hypotheses tested are:

- H_0 : the population medians are all equal
- H_a : the population medians are not all equal

Results of Mood’s median test are tabulated alongwith results of Anova in Table 6.11

6.7.3. TESTS FOR HYPOTHESES OF DIFFERENCE

To test hypotheses of difference, one-way ANOVA test was used, as it is the most commonly used method, to evaluate the difference in means between more than two groups. Theoretically, the test can be used even if sample size is small, provided there is high degree of normal distribution in variables of each group and the variation of scores in two groups is not reliability different.

The analysis of variance (ANOVA) is a flexible statistical procedure that can be used when the researcher wishes to compare differences between two and more means respectively. “The end result of an ANOVA is an F-ratio to help us answer the question ‘Is the variance between the means of two populations significantly different?’ The P value is the probability of getting a result at least as extreme as the one that was actually observed, given that the null hypothesis is true. The p value is a probability, while the f ratio is a test statistic, calculated as:

F value = variance of the group means / mean of the within group variances”

Hypotheses of Difference amongst Micro variables

The hypothesis of difference compares and tests the difference of private and public sector respondents on the ratings of critical success factors for PPP metro.

For Critical Success Factors B_i (where $i=1, 2, 3, \dots, 18$)

Null Hypothesis (H₀): There is no significant difference between ratings given by private and public sector respondents in India on the significance of

factor Bi on the success of a PPP metro.

Table 6.11: Results of Test of Hypothesis for Difference (Objective-4)

S. No	Critical Success Factors	Anova Test		Mood's Median
		F	p	P values
1	Political/social environment/ support	0.01	0.933	0.902
2	Stable macro-economic environment	1.49	0.225	0.078
3	Institutional & Legal Framework	0.03	0.863	0.767
4	Financial market availability	0.00	0.987	0.884
5	Capable & well organised public agency	0.83	0.364	0.297
6	Good governance	4	0.028	0.066
7	Consultation with stake holders	3.38	0.068	0.267
8	Multi benefit objectives for all stake holders from the project	0.37	0.545	0.510
9	Thorough Cost-Benefit Analysis of the project	0.83	0.365	0.235
10	Techno-economic feasibility of project	2.21	0.140	0.033
11	Competitive and transparent procurement process	0.17	0.683	0.326
12	Strong consortium	4.13	0.044	0.071
13	Government support and Government Guarantee	4.50	0.036	0.003
14	Risk analysis and proper risk allocation	0.31	0.581	0.384
15	Contract Agreement	0.65	0.423	0.217
16	Contract compliance for results & monitoring by public agency	0.62	0.433	0.401
17	Commitment, responsibility and defined role of partners	0.008	0.974	0.895

18	Shared authority between public and private agency	1.11	0.294	0.311
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Alternate Hypothesis Ha: There is significant difference between ratings given by private and public sector respondents in India on the significance of factor Bi on the success of a PPP metro.

There are about 18 hypotheses that are to be tested. One way ANOVA-test analysis was done for eighteen micro variables to determine if there was a significant difference between the two sectors. Details of Anova test for all the micro variables are presented along with Mood's Median Test results in Table 6.11.

Inferences

F critical is 2.74 at $\alpha=0.1$ (using numerator df equal to one and denominator df equal to 120). Wherever F value (observed) is greater than F (critical) i.e. 2.74 or p value less than 0.1 then there is significant difference in the opinion of respondents from two sectors. From the table it is seen that this happens in case of four cases. The F (observed) values are lower as compared to F (critical) in all other cases. The test run with 90 percent confidence level has shown that null hypothesis is not rejected for these four cases. Thus, null hypothesis, that "All means are equal or that there is no significant difference between the two sectors on the ratings of critical success factors for PPP metro" is accepted for twelve cases.

In four cases, the null hypotheses are not accepted at 90 percent confidence level. These micro variables are good governance (B6), consultation with stake holders (B7), strong consortium (B12), government support and government guarantee for the project (B13). A look at mean obtained for these two sectors (Table-6.4) suggest that more respondents from private sector attach importance to good governance, consultation with stakeholders, and government support and guarantee compared to respondents from public sector and reverse is the case for factor 'strong consortium' where higher significance is attached by public sector than private sector respondents.

The inferences drawn from Anova test are confirmed by Mood's median test except for 'consultation with stake holders' (B7) which is rated

equally by both the sectors. Findings of this test and study of comparative means (Table-6.4) however, reveal that private sector attaches higher significance to ‘techno-economic feasibility of the study’ (B2) and ‘stable macro-economic environment’ than the public sector. We have drawn inferences taking Mood’s median test as the final one.

All such micro variables are important and significant but attitudes towards them seem to be different across two sectors. In majority of micro variables, the analysis indicates that executives from the two sectors are of similar views on the significance of contribution of the factors in the success of a PPP metro.

The analysis of micro variables at 90 percent confidence indicates that there is no difference amongst the views of executives on the significance of CSFs impacting a PPP metro (except 5 micro variables).

On the basis of above analysis and inferences we conclude that there is no significant difference in the perception of private and public sector in India on the significance of critical success factors which impact the success of a PPP metro in Indian context except in case of five factors namely; stable macro-economic environment, techno-economic feasibility of the project, good governance, government support and guarantee and strong consortium. While private sector attaches relatively higher significance to first four than government sector, government sector does so for fifth factor.

6.8. CONCLUDING REMARKS

The analysis of opinion survey data has revealed that all the eighteen critical success factors identified through literature survey are indeed significant for success of a PPP metro in Indian context. Step by step analysis of opinion survey data through appropriate statistical tools presented in this chapter has led to achievement of all the objectives set in the beginning of the study. Based on opinion survey a framework has been suggested for success of a PPP metro in Indian context. Development of framework has also used the findings of SAP-LAP study of Hyderabad metro where CSFs were tested in real life settings in a field study. The next chapter deals with SAP-LAP study of Hyderabad metro in detail. Opinion survey has also brought out that there is unanimity among private sector and public sector stakeholders on significance of most of the CSFs which impact the success of a PPP metro in Indian

context except that each sector attaches more significance to the role played by the other. The frame work has been further discussed in the chapter on ‘Synthesis of findings and conclusions’.