

## **RESEARCH METHODOLOGY**

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### **4.1 INTRODUCTION**

Design of a research study for a complex subject like critical success factors for public private partnerships in a metro system, is a challenging task and needs systematic approach to identify research variables, evolve conceptual framework and hypotheses and research methodology to meet research objectives.

Urban transport has been chosen as the domain for this study as it is an important factor to support urbanization and the development of smart cities. The huge investment requirements in rail based MRTS requires support from private sector. Public private partnerships (PPPs) are the preferred mode for private sector investment and policy makers and planners need to focus on how to make such partnerships in urban metros successful. The study focuses on identification of critical success factors and evaluation of their impact in achieving this objective.

This part primarily focuses on the design of the research study, research process and the kind of tools and procedures used. This includes the steps in the research process and the most 'objective' (unbiased) procedures employed.

The research process included deductive (based on logic) as well as inductive approaches therefore both Qualitative and Quantitative research methodology has been used.

### **4.2 RESEARCH DESIGN**

The research design and its components are described in the ensuing paragraphs.

## 4.3 RESEARCH VARIABLES

As a result of literature survey, performance indicators to define the success of a PPP metro were identified and also critical success factors that contribute to the success of a PPP metro. They are explained in ensuing paragraphs.

### 4.3.1 PERFORMANCE INDICATORS

Before identifying critical success factors that influence the success of a PPP metro project, we need to define what constitutes success. Based on various studies the 12 criteria for defining the success of the project have been identified across three stages of a PPP project: contract stage, implementation stage and post implementation stage. These are reproduced in Table 4.1. These performance indicators will be further validated during pilot study.

**Table - 4.1: Success Criteria in a PPP Project**

<b>Success Criteria</b>	<b>Performance Indicators</b>
Contract Success	<ul style="list-style-type: none"><li>• Quality and completeness of the contract</li><li>• Appropriate risk sharing and risk allocation</li><li>• Selection of concessionaire and contract agreement</li><li>• Financial closure within stipulated time</li></ul>
Implementation Success	<ul style="list-style-type: none"><li>• Timely project delivery</li><li>• Project completion within budget</li><li>• Scope of the project as per contract</li><li>• Quality of construction</li></ul>
Post Implementation Success	<ul style="list-style-type: none"><li>• Ridership recovery in short and long term</li><li>• Last mile connectivity</li><li>• Service quality in O&amp;M</li><li>• User satisfaction</li></ul>

### 4.3.2 CRITICAL SUCCESS FACTORS

As a result of an extensive literature review, 18 critical success factors (CSFs) were identified as tabulated in Table-2.4 in Chapter-2. These CSFs (referred to as micro factors) have been grouped under six macro factors viz.

socio-political economic environment, well structured PPP project, effective procurement, risk management, mutual trust, institutional and legal framework. Six macro factors are further sub-divided into two types of factors-internal (i.e. related to a PPP project) and external (i.e. environmental) -as shown in Table 4.2. These six macro factors were assumed to be part of the proposed conceptual framework.

**Table-4.2: Critical Success Factors in a PPP Project**

Type of Factors	Macro Factors	Critical Success Factors (micro Factors) Identified through Literature Survey
External Factors	Institutional legal framework	Institutional legal framework
	Socio-Political-Economic Environment	Political/social environment/ support
		Stable macro-economic environment
Internal Factors	Well Structured PPP Project	Financial market availability
		Capable & well organized public agency
		Multi benefit objectives
		Consultation with stake holders
		Contract compliance for results
		Techno-economic feasibility of project
	Effective Procurement	Thorough cost-benefit assessment
		Competitive and transparent procurement
	Risk Management	Strong consortium
		Govt. support & guarantee
		Appropriate risk Allocation and sharing
	Mutual Trust	Contract Agreement
Commitment, responsibility and defined role of partners		
Shared authority between public and private		
	Good governance	

A brief description of macro factors is given in the ensuing paragraphs.

***Institutional Legal Framework.*** The PPP policy, institutional responsibilities, effective legal, regulatory mechanism and procedures constitute the substance of the PPP framework.

***Socio-Political Economic Environment.*** Social and political factors shape economic development of a country and economic prosperity influences socio-political eco-system. Governments in developing countries need to create an enabling environment to make PPPs attractive.

***Mutual Trust.*** While it is more of a cultural aspect of institutions and organizations, a thorough understanding of role and responsibility of partners, shared authority between public and private parties, commitment of both parties to the project and principles of good governance promote mutual trust.

***Well structured PPP project.*** PPP project has to be scoped and structured taking into account the applicable legal, regulatory and policy guidelines and requirements and provide for robust contract/concession agreement, service and output specification, mechanism for monitoring and control as well as for dispute resolution.

***Effective Procurement.*** In order to receive the best proposal and select good consortium with technical and financial capability that serves the objective of the PPP program and provides the value for money, the PPP procurement process needs to be transparent and neutral process that promote healthy competition.

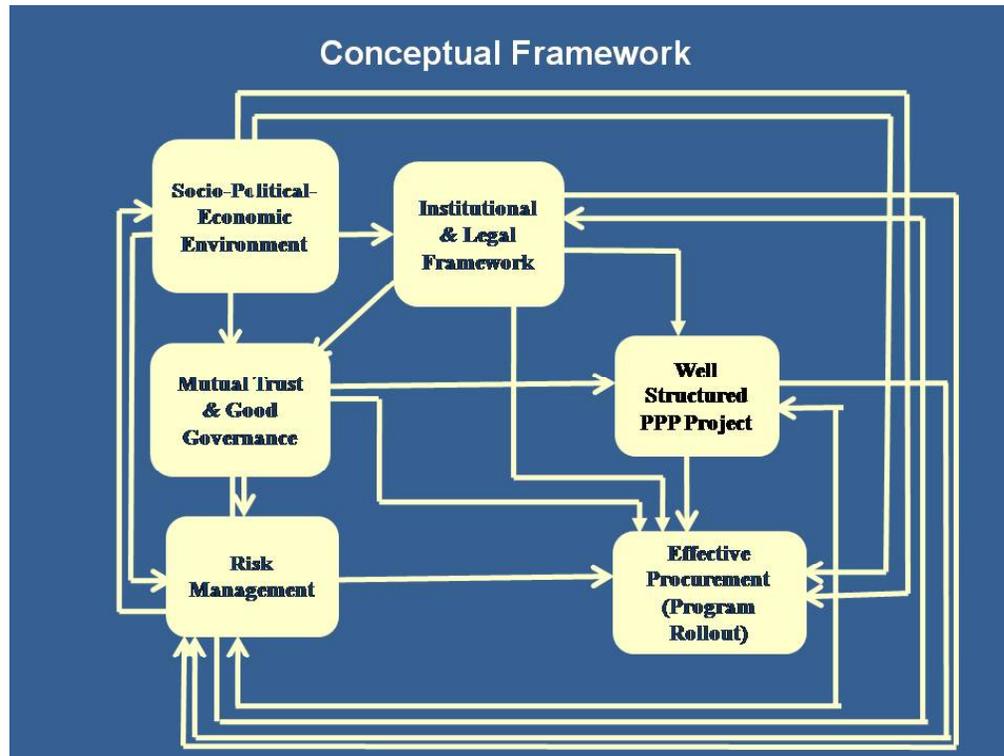
***Risk Management.*** Risk Management involves analysis of risk in the project, decisions as to which party is in the best position to bear the risk and strategies for risk mitigation so that the exposure of the project to potential risks is kept at an acceptable level.

#### **4.4 CONCEPTUAL FRAMEWORK**

The six-macro variables were assumed to be a part of the PPP framework. PPP Framework given in World Bank's PPP reference guide (PI see 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. A tentative framework was conceptualized based on available guidance. The conceptual framework is depicted in Figure-4.1 .

It was realized that the framework seems to cover only the first stage of PPP project i.e. contract success. However the concept that "Improvement of the enablers is collective; development of one enabler inevitably involves that of another" (PPIAF, 2009) was considered good enough to assume that each enabling macro is influencing the other macro. In any case, the relationships between the six macro variables were to be validated and refined

through findings of the study. In fact the macros itself were to be revisited based on the final list of CSFs emerging as an outcome of the study.



**Figure 4.1 : Conceptual Framework**

#### **4.5 RESEARCH PROPOSITIONS FOR THE STUDY**

A pragmatic schematic scheme, as explained below, may offer a guideline for preparing research questions and for getting answers to the enquiry of the study:

- Define the problem
- Gather information on earlier work done on the subject and resources
- Form propositions/hypotheses
- Design research instrument and collect data
- Analyze data
- Interpret data and draw conclusions that serve as a starting point for new hypotheses
- Test & validate hypotheses
- Finalize results

The iterative cycle inherent in this step-by-step methodology goes from the point of making propositions/hypotheses to draw conclusions and

back to propositions/hypotheses again. This scheme outlines a typical proposition/hypotheses testing method. In the research proposition for the pilot study, the objective is to understand the impact of 18 CSFs on the success of a PPP metro project. Another proposition of this research is to understand which variables would act as drivers and which would act as enablers. The key research propositions are as follows:

- All the twelve performance indicators identified through literature survey are significant indicators that define the success of a metro project in Indian context.
- All the eighteen critical success factors identified through literature survey are significant factors that contribute to the success of a metro project in Indian context.
- Critical success factors are enabling factors for the success of a PPP metro project i.e. some of the critical success factors are predictors of one or more of the performance indicator. The macro success factors influence each other i.e. some macro factors are predictors of one or more of the other macro factors.
- There is no significant difference among private and public sector stakeholders on the on the significance of critical success factors and their influence on the success of a PPP metro system in India?

#### **4.6 RESEARCH QUESTION**

Based on the identified research gap, the fundamental research question in the proposed study is **“What are the Critical Success Factors (CSFs) impacting the success of a public private partnership for rail based urban mass transit systems in India (PPP in metro system)”?**

The following are research sub questions:

- I. What performance indicators define ‘success’ in PPP in metro system?
- II. What are the critical success factors in PPP in metro systems in India?

- III. What is the relationship and significance of the critical success factors in impacting the success of a PPP in metro system?
- IV. Is there a significant difference in perception of public and private sector stakeholders on the significance of critical success factors in impacting the success of a PPP metro system in India?

#### **4.7 RESEARCH OBJECTIVES**

The primary aim of the research will be to establish qualitatively and quantitatively the critical success factors, impacting the success (CSF) of public private partnerships for rail based urban mass transit systems in India (PPP in metro system) and the degree of the impact of CSFs based on which a conceptual framework could be developed.

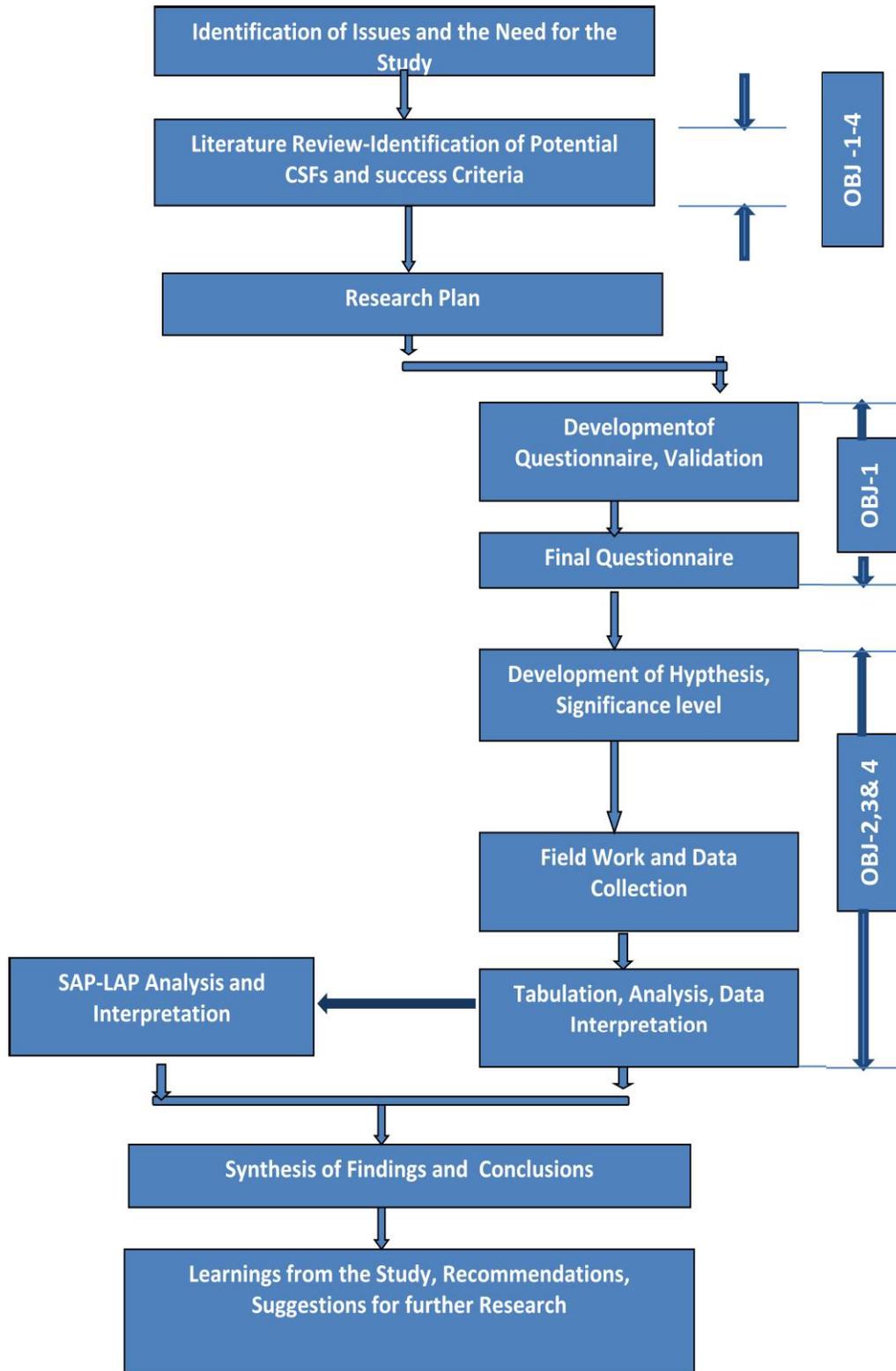
Thus, the objectives of the research are framed as:

- Objective-1 :** To identify key performance indicators which define the success of a public private partnership for rail based urban mass transit systems (PPP metro system) in India.
- Objective-2 :** To identify the critical success factors impacting PPP metro systems and their relative importance.
- Objective-3 :** To develop conceptual framework for success in a PPP metro system in Indian context.
- 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

#### **4.8 RESEARCH METHODOLOGY**

Since both deductive (based on logic) as well as inductive approaches are used for the study therefore both Qualitative and Quantitative research methodology has been used.

A road map depicting the flowchart for research methodology has been shown in Figure-4.2.



**Figure 4. 2 Research Road Map in the form of of Flow Chart for Research Methodology**

## 4.9 SOURCE OF INFORMATION—SAMPLE DESIGN

Sample design for data collection is discussed in the ensuing paragraphs

### 4.9.1. SAMPLE DESIGN FOR PRIMARY DATA

This step includes the activities performed to collect the primary data from the sampled units from the field for subsequent analysis.

### 4.9.2. POPULATION:

The Population in this study is finite and is defined as the group of all stakeholders from private and public sectors that have exposure to PPP projects in railways/MRTS sector as executive decision makers.

### 4.9.3. SAMPLING METHODOLOGY:

A data collection plan will include the following sampling methodology and sample Size (Table 4.3):

**Table-4.3 : Description of Research Methods and Sampling Techniques Used**

<b>Study Phase</b>	<b>Objective of the Study</b>	<b>Research Method Used</b>	<b>Sampling Technique Used</b>
<i>Pilot Study</i>	<ul style="list-style-type: none"> <li>• To Check reliability and validity of questionnaire</li> <li>• To identify criteria for success variables (Objective-1)</li> <li>• To evaluate impact of CSFs on performance indicators</li> </ul>	Semi-Structured questionnaire/Interviews	Judgmental Sampling
<i>Opinion Survey</i>	To establish different micro variables (CSFs) of PPP metro and their relationship	Questionnaire based survey method	Stratified sampling . Within strata Judgmental/ Snow-ball sampling

<i>SAP-LAP Study</i>	To understand the influence of CSFs in real life settings in a PPP metro and interpretation of the same	SAP-LAP study through observation and interview methods	Purposive sampling
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#### 4.9.4. SAMPLING FRAME:

The population for the survey is divided into two broad stakeholders; public sector and private sector.

#### 4.9.5. SAMPLING ELEMENT AND SAMPLING UNIT

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. For example, 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. Samples (respondents) were selected based on judgmental sampling where opinion from colleagues, experts, seniors was taken regarding their profile matching the profile of target respondents of our study.

#### 4.9.6. SAMPLE SIZE SELECTION :

Sample Size has been calculated using the following formula (Cochran, 1963) considering large population size:

$$n_0 = \frac{Z^2 * p * (1 - p)}{c^2}$$

Where:

Z = Z value (1.96 for 95% confidence level)  
p = percentage picking a choice, expected as decimal  
(0.5 used for sample size needed)  
c = confidence interval, expressed as decimal (0.05)

Using the above formula the general sample size  $n_0 = 384$

However, if the population is small, then the sample size can be reduced. This is because a given sample size provides proportionately more information for a small proportion than for a large population what is called 'finite population correction' (Israel, Glenn D-1992). The sample size  $n$  can be adjusted using equation:

$$n_1 = \frac{n_0}{1 + \frac{n_0}{\text{Population Size}}}$$

Where  $n_0$  = Sample Size for Large Population

$n_1$  = Adjusted sample size for target population

The adjusted sample size calculated from above formula is 132

#### **4.10 TOOLS FOR DATA COLLECTION (RESEARCH INSTRUMENT)**

Research instrument design is discussed in the ensuing sub-section

##### **4.10.1. RESEARCH INSTRUMENT DESIGN**

A structured Questionnaire validated for face and content validity and reliability was adopted as a research instrument to conduct the study. Structured- undisguised questionnaire was used in the survey as this tool is easy to administer, it is standardized and easy to tabulate and analyze. The questionnaire was developed in English. In order to minimize the non-response issue, a covering letter was enclosed introducing the objectives of the research and the importance of the survey and was addressed to the names and position of the key informants, who were in charge of companies (e.g. Director, Executive Director, Head of department) for advising concerned executive to respond to the questionnaire. Companies having their offices in Delhi/NCR were contacted in person. A brief on the questionnaire was also enclosed.

The questionnaire consisted of two sections.

- a) In the first section respondents were asked to rate indicators of performance for success of a PPP in MRTS project using a five point

Likert scale (1=least important and 5=Highly important). *This section was given only to selected experts (Pilot Study).*

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

Both sections a) and b) had a provision for respondents to add factors/parameters other than included in the questionnaire. All together the questionnaire consisted of 40 questions for pilot study and 27 for opinion survey. Questionnaire and covering letter are given in Appendix (Exhibit-1)

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.

#### **4.11 PILOT TESTING:**

It is proposed to pre-test the questionnaire with 25-30 stakeholders of PPP metro system in the country. Primary data will be collected through a structured questionnaire to selected sample of respondents who were considered experts in the field of public private partnerships in railways/metros. Initially six experts considered as judges will be interviewed and consulted on the approach used for data collection and research instrument. A Structured Survey (Direct Approach) will be conducted by using formal lists of questions asked to all respondents in the pilot study group. Questionnaire will preferably be given in person to the extent feasible, otherwise over mail.

The questionnaire will be re-worded based on feedback received. These stakeholders will also be asked to define criteria for success of a PPP project in each of the three phases; contract stage, implementation and post implementation stage.

Face Validity and Content Validity approaches will be used to establish validity of factors. Under these approaches, various factors so identified will be used to design questionnaire. A small sample of 25-30 respondents will be interviewed to start with to understand whether the factors derived from literature survey are valid. Therefore, validity of the factors will be ascertained from secondary as well as primary data. Before starting the analysis the reliability of the scale will be checked with the help of appropriate tool.

#### **4.12 METHODOLOGY FOR SAP-LAP STUDY**

A field study will be conducted using SAP-LAP framework to analyze the macro CSFs in real-life settings of one Indian PPP metro. The study will be based on documents survey, observations and the feedback obtained through semi structured interviews of key players on how actions taken by them on various critical success factors contributed to the progress/success of PPP metro project and what lessons can be learnt.

#### **4.13 DEVELOPMENT OF HYPOTHESES AND SIGNIFICANCE LEVEL**

Based on the data gathered and its analysis two sets of hypotheses can be formulated and tested to achieve research objectives. The first set consists of hypotheses of difference and the other set comprises of hypotheses of association.

##### **4.13.1. HYPOTHESIS OF DIFFERENCE**

Test for hypothesis of difference will be conducted to establish the differences and similarities in public and private sector stakeholders on the significance of critical success factors in influencing the success of PPP metro systems in India. For example,

- ***Null Hypothesis***(Ho): There is no significant difference between select sectors of Indian PPP stakeholders in MRTS project on various macro and micro variables (CSFs)

- **Alternate Hypothesis**(*H<sub>a</sub>*): There is significant difference between select sectors of Indian PPP stakeholders in MRTS project on various macro and micro variables

#### 4.13.2. HYPOTHESIS OF ASSOCIATION

Based on the literature survey directional relationships among macro factors have been defined to conceptualize a tentative framework. These relationships will be further refined during the study through expert opinion and appropriate hypotheses of association will be formulated where it is implied that certain macro variables lead to enablement of some other macro variables, as explained in different hypotheses of association.

- **Null Hypothesis**(*H<sub>0</sub>*): One macro research variable is not a predictor of the other macro research variable
- **Alternate Hypothesis** (*H<sub>a</sub>*): One macro research variable is a predictor of the other macro research variable

The hypothesis will be tested at 95% confidence (Alpha .05) level or as considered appropriate.

#### 4.14 JUSTIFICATION OF THE METHODOLOGY CHOSEN

As is seen from the methodology detailed in this chapter, an attempt has been made to leverage opportunities available to make research findings theoretically sound and yet practical by blending pilot study, opinion survey and SAP-LAP study. Pilot study has been carried out with twin objectives of clarifying research variables identified in the literature review on PPP metro and understanding the contextual relationship of variables.

An extensive opinion survey was carried out on a larger sample base to capture the perception of private and public sector stakeholders of PPP metros through a detailed questionnaire. Analysis of the data so gathered helped in establishing the critical success factors and their grouping into macro clusters. The field study of case let of one Indian PPP metro project facilitated better insight of research variables in real life settings. A SAP-LAP framework has provided the useful information to capture the dynamics and to synthesize

practical insights and action ideas that can be used as key learning points for future knowledge in the area. It is used as a supplementary study to support the opinion survey, filling gap of the study, if any.

Conceptual framework is refined based on findings of the opinion survey and SAP-LAP study to help understand relationship among key research variables. This has been further validated empirically to evolve a framework applicable to Indian PPP metros.

Table 4.4 describes research methods (research tools) used in the study for each objective with reference to authors, providing rationale for the methods used.

**Table-4.4: Objective Wise Description of Research Methods (Tools) Used**

Objective	Steps	Research Methods (Tools)	Author(s) References
Objectives-1 to 4	<u>Pilot Study</u> To check homogeneity of data and to test reliability and validity of research instrument for Performance indicators & CSFs	<i>Chronbach Alpha</i>	Nunnally & Bernstein, 1994
	Verification of impact of CSFs on Performance indicators		
	• To test for collinearity of variables with predictors	<i>Multicolinearity Test- Pearson correlation Test</i>	Kothari, 2004
	• To ascertain that data satisfy the assumption of homoscedasticity	<i>Hetroscedasticity Test-Leven's Test for equality of variances</i>	(Nist/Sematech, 2012)
	• To carry out regression analysis for ascertaining which CSFs impact which Performance indicators	<i>Step Wise Regression</i>	Nargundkar, 2008
<u>Objective-1</u> To identify key indicators which define the success of a PPP metro system in India.	To identify significant Performance indicators for PPP metro	<i>Chi-Square Test</i>	Kothari,2004 Malhotra, 2004

<u>Objective-2</u> To identify the critical success factors impacting PPP metro systems and their relative importance	<ul style="list-style-type: none"> <li>To identify significant Critical Success Factors for PPP metro</li> </ul>	<i>Descriptive Statistics</i> <i>Chi-Square Test</i>	Malhotra, 2004
	<ul style="list-style-type: none"> <li>To reduce CSFs into key macros</li> </ul>	<i>Factor Analysis</i> <i>Cluster analysis</i>	Malhotra, 2004
	<ul style="list-style-type: none"> <li>To test CSFs in real life settings of Hyderabad metro</li> </ul>	<i>SAP-LAP Analysis</i> <i>Interpretive Matrix Tool</i>	Sushi, 2000, 2005
<u>Objective-3</u> To develop conceptual framework for success in a PPP metro system in Indian context.	<ul style="list-style-type: none"> <li>Develop a conceptual framework, refine through experts</li> </ul>	<i>ISM</i>	Saxena et al., 2006 Malhotra, 2004
	<ul style="list-style-type: none"> <li>To ascertain that data satisfy the assumption of homoscedasticity</li> </ul>	<i>Heteroscedasticity Test-Leven's Test for equality of variances</i>	(Nist/Sematech, 2012)
	<ul style="list-style-type: none"> <li>To test Hypotheses of Association among clusters</li> </ul>	<i>Regression</i>	Saxena et al., 2006 Malhotra, 2004
<u>Objective-4</u> 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	<ul style="list-style-type: none"> <li>To ascertain that data satisfy the assumption of homoscedasticity</li> </ul>	<i>Heteroscedasticity Test-Leven's Test for equality of variances</i>	(Nist/Sematech, 2012)
	<ul style="list-style-type: none"> <li>To test the hypothesis of difference in the ratings of critical success factors for PPP metro by private and public sector respondents</li> </ul>	<i>One way ANOVA</i>	Nargundkar, 2008
	<ul style="list-style-type: none"> <li>In view of presence of heteroscedasticity, use non-parametric test as an alternative to Anova</li> </ul>	<i>Mood and Median Test</i>	Nargundkar, 2008

#### 4.15 CONCLUDING REMARKS

The research aims at studying select performance indicators and critical success factors (research variables) identified during literature review and preliminary confirmation through pilot study. Data generated through an opinion survey of public and private sector stakeholders in an Indian PPP metro will be used to validate the significance of selected research variables. The aim is to establish variables that can influence PPP metro in Indian

context. Further insight on the variables has been attempted through SAP-LAP study of an Indian PPP metro. Based on the conceptual framework evolved through the analysis of the data and SAP-LAP study, research hypotheses have been formulated for statistical testing leading to a validated framework for a PPP metro in Indian context. Both studies allowed carrying out a synthesis of findings, key findings, interpretations and recommendations. The implementation of the research methodology is discussed in subsequent chapters.