Preliminary Assessment of Project Management Practices of Public Housing Authorities

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Abstract

Successful Project Management (PM) is becoming increasingly important for any organization to remain competitive in today's dynamic world. Organizations in all industries are striving to raise their PM maturity by adopting PM tools and continuously improving their PM practices and processes. The Public Housing Authorities (PHAs) have limited funding resources to satisfy the ever-increasing demand for affordable low-income housing. The use of best PM practices would increase their chances of completing a project successfully and reduce the widening gap between the number of affordable housing units available and the number of low-income renters.

The goal of this research is to examine the performance of selected PHAs in the area of PM. A model developed for this evaluation is used for identifying the strengths and weaknesses of PHAs in PM. A survey questionnaire was developed based on the critical success factors (CSFs) for PM identified through a literature review. The questionnaire was used to collect information related to PM practices and process of PHAs. A PM assessment system was developed based on the CSFs identified to score the survey responses. The scores were then analyzed to identify the common weaknesses of PHAs in PM and improvement measures were suggested.

For every CSF, a set of sub-factors were identified. A closed ended question was be formulated for every sub-factor and thus, the sub-factors served as direct performance measures. Various analytical and quantitative models were studied and the most apt model was used for the PM assessment system. Every PHA had an overall score on the PM assessment system along with an individual score for every CSF. These individual scores for all PHAs were averaged and compared with the maximum possible score (ideal score) to identify the common weaknesses of PHAs in PM.

Housing and Urban Development (HUD) can use this PM assessment system to compare the performances of PHAs in the area of PM. Best PM practices can be identified through comparisons which will then serve as guidelines for PHAs to improve their PM maturity. The use of best PM practices will ensure that the limited resources are used most efficiently. Also, HUD can provide technical assistance in specific PM areas (identified through this assessment) in which PHAs lack expertise. A Project Management Approach followed by PHAs will attract investors from the private market towards the Public Housing Industry, promoting the development of Public-Private ventures. These investors can be viewed as a potential source of funding by PHAs, reducing their reliability on HUD for capital requirements.

I. Introduction

Overview of Public Housing Industry in United States

The federal public housing program was created by the U.S. Housing Act of 1937, which provided capital funding to local housing authorities to build affordable houses for eligible low-income families, the elderly and persons with disabilities. Today, the Public Housing program has 1.3 million households living in public housing units and provides shelter to almost 3 million people (CLPHA 2004). About one-third of all the public housing units are one and two-storey structures and another 23 percent are buildings with three to six stories (Ramirez et al. 2002). A total of 3,300 local Public Housing Authorities (PHA's) manage these units. Eighty-seven percent of these PHA's are small to medium size, which manage fewer than 500 units per year. "The New York City Housing Authority alone owns and manages 185,000 units" (Ramirez et al. 2002). About five percent of the total number of PHA's manage more than 1,250 units per year and are termed as large PHA's (CLPHA 2004).

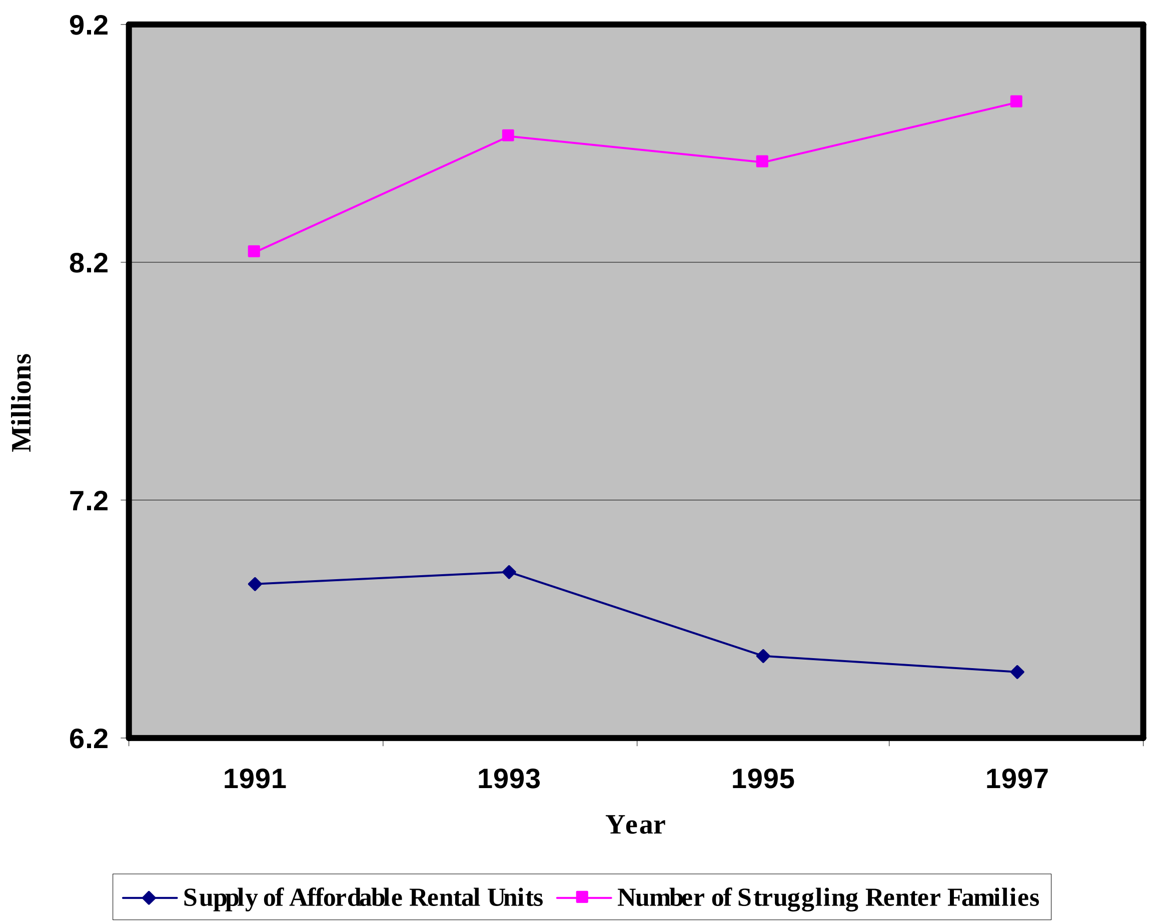

Fig. 1.1 **Disparity Between Number of Low Income Renters and Available Affordable Units in the U.S. (Source: Bureau of the Census, American Housing Survey, HUD 1999)**

"Families with children comprise 46% of all public housing and the elderly and disabled make an additional 41%" (CLPHA 2004). The demand for affordable housing has continued to increase. Even in the times of economic prosperity, there has been a severe shortage of affordable houses. In 1997, for every 100 households with income less than thirty percent of area median income, there were only 36 affordable units available for rent [HUD 1999]. In 1991, the difference between the low-income renters and the number of affordable units was about 1.3 million. This difference increased to about 2.5 million in the year 1997. The following graph, Figure 1.1, shows the trend of a widening gap between available affordable units and low-income renters

HUD – Assisted Public Housing

The U.S. Department of Housing and Urban Development (HUD) was established as a cabinet-level agency in 1965. "Under title VI of the civil rights act of 1964, HUD's Office of Fair Housing and Equal Opportunity is responsible for the agency's federally assisted programs, including housing and community development" (NRC 2003). The Stewart B. McKinney Act of 1987 engaged HUD in dealing with the issue of homelessness in all communities. Homelessness was a serious issue for the Native Americans and Alaskan Indians. HUD's goal of providing affordable houses for the low-income group was reinforced by the Cranston-Gonzalez National Affordable Housing Act of 1990. HUD administers federal aid to local Public Housing Authorities to build and manage houses for low – income residents at rents they can afford. The housing authorities are responsible for the proper functioning and management of these affordable housing units. HUD assists low-income families by providing affordable housing through various programs. Since this study is related to assessment of construction project management practices of PHAs, only programs related to new development projects and major rehabilitation projects have been described in the following paragraphs. A summary of these selected Public Housing Programs offered by HUD is as follows (HUD 2004):

Capital Fund

This program provides funding to PHAs for developing new housing units, and modernizing and managing existing units. The amount of funding given to a PHA is determined by a formula based on the number of units managed by the PHA. The Office of Public Housing Investments sets a limit on the amount of money a PHA can spend to modernize their existing public housing. This limit is called the Total Development Cost (TDC) limit and it provides the standard cost limits for developing public housing projects of various sizes, and types.

HOPE VI

This program was introduced by HUD in 1993 and has been them most effective program in the last decade in serving the distressed communities (CLPHA). This program allowed the PHAs to partner with private developers for the first time. The purpose of this program was to eradicate severely distressed public housing by revitalization in three areas: physical improvements, management improvements, and social and community services to address resident needs (HUD).

Operating Fund

The Operating Fund provides PHAs with subsidy to fund the operating and maintenance expenses of the developments they own. The funds are used towards general maintenance of developments, utilities, and tenant and protective services. It also helps in keeping the rents affordable for Lower-income families.

Public Housing Authorities

Public Housing Authority (PHA) is defined as "any State, county, municipality, or other governmental entity or public body which is authorized to engage in or assist in the development or operation of low-income housing" (HUD 2004). A PHA must be approved by HUD as an eligible PHA i.e. it should have both the legal authority and the local cooperation required for developing, owning and operating a public housing project.

A typical public housing project involves PHA as the owner, General Contractor, HUD area field office, low-income residents, sub-contractors, architect, engineer and some other state or local government bodies. Due to a large number of stakeholders for any given project, the probability of disagreement among project participants is very high. Moreover, a bunch of approvals are required to move forward at every step in all phases of the project. In such situations, best Project Management practices followed by the PHA (owner) would increase the chances of project being successful i.e. on time and within budget. Thus, efficient Project Management techniques are very important for PHAs. In the next section, Public Housing Assessment System is explained in detail. This system is mainly used to evaluate the performance of PHAs in the area of Facilities Management.

Public Housing Assessment System (PHAS) [HUD 2004]

This system was developed by HUD to evaluate the performance of a Public Housing Agency (PHA) on a yearly basis. It serves as a management tool for effectively and fairly measuring the performance of a PHA in essential housing operations, including rewards for high performers and consequences for poor performers. A score between 0 to100 is assigned to every PHA based on their assessment of four major operational areas viz. physical, financial, management and resident satisfaction. The score distribution is as follows:

Management Assessment Subsystem (PASS)
– 30 points
Financial Assessment Subsystem (FASS)
– 30 points
Physical Assessment Subsystem (MASS)
– 30 points
Resident Assessment Subsystem (RASS)
– 10 points

The objectives of PHAS are:

- To review and assess major components of a PHA through PHA and property level data.
- To drill down to specific actionable items such as repair items or business areas that needs improvement through better management practices and control.
- To support PHA in efforts to provide housing that is decent, safe, sanitary and in good repair.

A PHA is termed as "High Performer" if it has an overall score of more than 90 and a minimum of 60% in all four indicators. A "High Performer" is eligible for Capital Fund Bonus and if it is a small PHA (manages less than 250 units) it is eligible to be PHAS assessed every other year.

A PHA is termed as "Standard Performer" if it has a score of more than 60 but less than 90 and a minimum of 60% in PASS, MASS and FASS. A "Standard Performer" is eligible to be PHAS assessed every other year if it is a small PHA.

A PHA is termed as a "Troubled Performer" if it has an overall score of less than 60 and has less than 60% in more than one indicator. A "Troubled Performer" is remanded to Field Office HUB and if troubled for two years, it is referred to Departmental Reinforcement Center, which may lead a PHA to be suspended or debarred.

A PHA is termed as a "Substandard Performer" if it has an overall score of more than 60 but has less than 60% in any one of the indicators.

The following table explains the PHAS scoring system in detail:

PHAS Designation Status		
PHAS Status Designation	**Composite PHAS score**	**Individual Indicator Score**
High Performer	90% or higher	At least 60% in all indicators
Standard Performer	Less than 90% and more than or equal to 60%	Not less than 60% of total points available in: PASS, FASS, MASS
Substandard Performer = TROUBLED		
Substandard Performer = Troubled	60% or more	Less than 60% in only one indicator i.e. PASS, FASS or MASS
Substandard Management = Troubled	Less than 60%	Less than 60% in only the MASS indicator
Substandard Physical = Troubled	Less than 60%	Less than 60% in only the PASS indicator
Substandard Financial = Troubled	Less than 60%	Less than 60% in only the FASS indicator
Troubled Performer	Less than 60%	Less than 60% in more than one indicator i.e. PASS, FASS or MASS
Capital Fund Troubled	Less than 60%	Less than 60% in the Capital Fund Sub indicator of MASS indicator
Troubled /Capital Fund Troubled	Less than 60%	Troubled and less than 60% in the Capital Fund indicator of MASS indicator

Table 1.1: PHAS Scoring Pattern
Source: U.S. Department of Housing and Urban Development, 2004

A brief overview of each sub-system is as follows:

Management Assessment Sub System (MASS)

It measures certain key PHA management operations and responsibilities for the purpose of assessing the PHA's capabilities and performance in these areas. The sub-indicators for this indicator are as follows:

1. Vacant Unit Turnaround Time
Measures the annual average time between when a PHA is aware that units are vacated and when leases for those units are in effect. Scoring Components for this sub-indicator are:

- <u>Down Time</u>
  It is the period of time between, the day unit was found vacant or lease expired and the day keys are handed over to maintenance staff for cleaning/fix-up.
- <u>Make Ready Time</u>
  It is calculated as "Days from date maintenance staff receives keys until date they return unit back to management for rental."
- <u>Lease Up Time</u>
  It is calculated as "Days from date maintenance staff turns unit back to management for rental until effective date of new lease".

2. Capital Fund
Measures performance under a PHA's modernization program in five key areas:

- Unexpended funds over three federal fiscal years
- Timeliness of fund obligation
- Adequacy of contract administration
- Quality of Physical Work
- Adequacy of Budget Controls

3. Work Orders
Measures how a PHA manages work orders and the time it takes to abate and complete work orders in two areas:

- Emergency Work Orders
  They are defined as "A deficiency that poses an immediate threat to life, health and/or safety of a property or resident or that is related to fire safety and includes unhealthy or undrinkable water supply, gas leak, broken/blocked sanitary sewer line, failed heating system, hazardous electrical system, inoperable smoke detector and exposure to toxic materials".
- Non-emergency Work Orders
  They are defined as "A deficiency that does not poses an immediate threat to life, health and/or safety of a property or resident and includes repair needs and preventative maintenance and findings from annual inspections of units and systems".

4. Annual Inspection of Units and Systems
Measures percentage of units and systems that a PHA annually inspects using Uniform Physical Condition Standards and local codes to determine short-term maintenance and long-term capital fund needs. Scoring Components for this sub-indicator are:

- Annual inspection of dwelling units
- Annual inspection of systems including non-dwelling spaces and common areas.

5. Security
Measures how a PHA tracks, reports and prevents crime, screens applicants, enforces leases, and prevents drug use. Scoring Components for this sub-indicator are:

- Tracking and reporting crime related problems
- Screening applicants
- Lease enforcement
- Drug prevention and/or crime reduction program goals

6. Economic Self-Sufficiency Measures and Point Value
It measures whether a PHA has established economic self-sufficiency program and can document that it is meeting the goals as planned.

Financial Assessment Sub System (FASS)

This subsystem throws light on the areas of improvement that can increase the stability and quality of services provided by a PHA. It enables a PHA to make better investment and operating decisions and ensures that services will not be unnecessarily disrupted. The sub-indicators for this indicator are:

1. Current Ratio
It measures how well prepared is a PHA for covering its short-term obligations.

2. Months Expendable Fund Balance
It measures the capacity of a PHA to cover unexpected expenses.

3. Tenant Receivables Outstanding
It measures how well a PHA collects rent from its tenants.

4. Occupancy Loss
It evaluates the marketing strategies of a PHA to increase occupancy rates and maximizing their revenue.

5. Net Income
It measures the impact of the results of operations on the PHA's viability.

6. Expense Management
It measures: PHA's operating cost per unit in order to control expenses; PHA's ability to maintain its expense ratios at a reasonable level relative to that of its peers. The expense ratio is calculated as follows:

$$\text{Expense Management} = \frac{\text{Weighted Sum of Expense Categories}}{\text{Number of Dwelling Units}}$$

Physical Assessment Sub System (PASS)

The Physical Assessment subsystem measures the physical condition of HUD properties through an inspection process to determine whether a PHA's housing stock is meeting the standard of decent, safe, and sanitary and is in good repair. The Uniform Physical Standards are used to make inspections. These standards identify the five inspectable areas (dwelling units, building exterior, building systems, common areas and site) and exigent health and safety hazards; standardized definitions for inspectable items; and provide uniform, objective protocol for training inspectors to perform inspections of all property types and sizes, at any location. The inspection process helps identify the common deficiencies in the five inspectable areas.

Resident Assessment Subsystem (RASS)

The RASS survey is a PHA management tool that:

- Assesses resident level of satisfaction.
- Opens lines of communication between PHA Management and residents.
- Identifies PHA strengths and areas that may need improvement.
- Encourages resident participation.

The survey provides important resident feedback in five areas: Maintenance and Repair, Communication, Safety, Services and Housing Property Appearance. This indicator has three scoring components. They are:

- Implementation Plan Certification
- PHA certifies dates that it has marketed the survey to residents.
- Survey Results
- Resident question scores are calculated to obtain the PHA score.
- Follow-up plan certification

PHA certifies dates that it will correct deficiencies identified on the Resident Survey.

The next section gives a brief description of a project and Project Management. It also states why Project Management is important for PHAs in order to complete their new development and major rehabilitation projects successfully.

Project Management

A project can be considered to be any series of activities and tasks that (Kerzner 1998):

1) Have a specific objective to be completed within certain specifications
2) Have defined start and end dates
3) Have financial limitations
4) Consume resources.

Project Management, on the other hand, is the planning, organizing, staffing, coordinating, directing and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives (Syal 2004). "The parameters for any project are on-time completion, within the specific budget, and with requisite performance (technical requirements)" (Dey 2002). Project Management best practices do not ensure project success nor does their absence guarantee failure. But their presence increases the chances for success. New Development and major rehabilitation projects of PHAs have the typical characteristics of any project and are therefore subjected to time and cost overruns and quality non-achievement.

Need Statement

HUD provides federal grants to Public Housing Authorities throughout the nation through the Public Housing Development Program to develop housing for low-income families that cannot afford housing in the private market. HUD has not provided new funding for this program since 1994. However, PHAs could use Capital Fund and Hope VI funding flexibly towards the cost of developing new housing units. On an average (last five years), HUD disburses about 3.3 billion dollars annually to local PHAs through its Capital Fund and Hope VI Programs. Housing is developed in one of the following three primary ways:

a) The PHA hires a contractor to construct housing units in accord with a HUD-approved program, on a site owned by the PHA.

b) The PHA advertises for and selects a developer to develop a new project on a developer-owned site that is sold to the PHA after completion.
c) The PHA acquires existing units from the private market.

While grants provided by HUD towards new development projects have been declining over the years, more and more money is being spent on major Rehabilitation/ Revitalization projects. This is mainly due to the requirements of new grant programs offered by HUD. Unsuccessful completion of projects (time and cost overruns) by PHAs would result in a low score on the PHAS, which may lead a PHA to be suspended or debarred. Some of the main contributing factors for unsuccessful completion of a project are: Expansion of scope and subsequent increases of input resources; engineering and design changes, underestimation and incorrect estimation; and unforeseen inflation.

The Public Housing Assessment system, described in the previous section, does not evaluate the Project Management practices of PHAs in developing new housing units. A Project Management Approach, if followed by the PHAs, would assist them in clear identification of their requirements, establishing achievable objectives, balancing the competing demands for cost, time and quality, and adapting HUD specifications, plans and approach to meet the expectations of HUD. This will ultimately lead to a successful completion of the project i.e. on time, within budget and without any contractual disputes. It will also assist in reducing the widening gap between affordable housing units and the number of low-income renters. Thus, there is a need for an assessment system, which evaluates the current Project Management practices of PHAs and highlights the areas in which, they could potentially improve. This assessment system could also serve as a performance indicator for HUD while making decisions related to allocation of funds to every large PHA.

Research Scope and Limitations

This research is restricted to include only large and extra large Public Housing Authorities. A large PHA, as defined by HUD, is the one that manages more than 1,250 but less than 10,000 housing units every year while an extra large PHA manages more than 10,000 housing units every year. The biggest limitation of this research is that the relative weights assigned to the critical success factors and their sub-factors are based on the researcher's knowledge and expertise in the area of Construction Project Management. The results of the study are based entirely on the responses received from the survey participants. Moreover, the critical success factors and its sub-factors are identified through literature review only. All these factors make the Project Management Assessment model in this study, a preliminary framework for assessing the Project Management practices of Public Housing Authorities.

Goal and Objectives

The goal of this research is to examine the performance of Public Housing Authorities in the area of Project Management. A model developed for this evaluation will assist in identifying the strengths and weaknesses of PHAs in project management. The findings from the survey will help HUD in serving the PHAs better by providing technical and/or financial assistance in specific areas of project management identified through this study.

The following objectives were set to accomplish this goal:

Objective I: To collect information related to Project Management practices and processes of Public Housing Authorities.

Objective II: To develop a Project Management Assessment System based on the key performance indicators identified through literature review.

Objective III: To use the Project Management Assessment System to analyze the performance of PHAs participating in the survey and suggest improvement measures.

Methodology

The proposed research will be conducted as per the following research steps. Each research step is associated with one or more objectives listed in the previous section.

Objective I: To collect information related to Project Management practices and processes of Public Housing Authorities.

A thorough literature review will be done to identify key Project Management performance indicators affecting the cost, duration, and quality, throughout the entire life cycle of a construction project. For every indicator, a set of sub-indicators serving as direct performance measures will be formed. Based on the sub-indicators created, a list of closed ended questions will be developed to be included in the survey questionnaire. The survey questionnaire will then be mailed to the Executive Directors of large and extra large PHAs (as defined earlier).

Objective II: To develop a Project Management Assessment System based on the key performance indicators identified through literature review.

A number of quantitative and analytical models of comparison will be studied and the model that is most suitable for comparing Project Management practices and processes, based on the indicators identified, will be selected for this research. A Project Management Assessment System will then be developed to match the structure of the model selected. An appropriate scoring method for the survey responses will then be formulated. The scores for each sub-indicator will be averaged to determine one score for each performance indicator. The scores for every indicator will be averaged to obtain the overall score on the Project Management Assessment System.

Objective III: To use the Project Management Assessment System to analyze the performance of PHAs participating in the survey and suggest improvement measures.

The survey responses will be scored for every PHA participating in the survey and the overall score on the Project Management Assessment System will be calculated. The individual score for each indicator will reflect the level of performance of a PHA in that particular Project Management area while the total score will indicate the overall

Project Management maturity level of a PHA. Summary statistics will be calculated to identify the common weaknesses of PHAs in Project Management. General improvement measures will then be suggested for the identified weakness areas.

Expected Outcomes

The Project Management Assessment system developed in this research will serve as a tool for HUD to evaluate the Project Management practices and processes of Public Housing Authorities. "Best Project Management Techniques" can be identified and applied by PHAs to make the best possible use of limited funding available from HUD. Also, HUD can provide technical assistance in the common Project Management areas in which the PHAs lack expertise. A Project Management Approach followed by PHAs may attract investors from the private market towards the Public Housing Industry, promoting the development of Public-Private ventures. These investors can be viewed as a potential source of funding by PHAs, reducing their reliability on HUD for capital requirements.

Organization of the Report

This research report is presented in four chapters. Chapter One gave a quick snapshot of the public housing industry in the United States, which was followed by a brief discussion of the Public Housing Assessment System. The need for more affordable houses and the importance of Project Management were discussed. A need statement was formulated. The research goal and objectives and methodology were presented along with the research scope and limitations.

Chapter Two discusses existing literature on assessment of Project Management practices with a brief overview of the quantitative and/or analytical models used for assessment. The Analytic Hierarchy Process is also presented in this chapter.

Chapter Three outlines the methods and tools that were used to accomplish the set goal of the research. Detailed methodology and approach for each objective is discussed. Sample data collected through the survey is used for demonstrating how the Project Management Assessment System works. Results of data analysis and recommendations for improving the Project Management performance of PHAs are also presented in this chapter.

Chapter Four provides a summary of this research study along with the conclusions drawn, based on the results of data analysis. A section on the value of Project Management Assessment System to HUD is also incorporated in this chapter. Future areas of research are suggested.

II. Literature Review

This chapter presents a summary of the literature review related to this research. This is to help outline the research methodology. Key performance indicators affecting the cost, duration and quality need to be identified for this research. A number of research papers were referred to gain a better understanding of the factors affecting a construction project. The first section of this chapter summarizes literature related to identification of critical success factors for successful Project Management.

The next step in this research was to study the different Project Management Assessment models and select the most appropriate model for the critical success factors identified. The second section of this chapter gives an overview of the different analytical and quantitative models used for the assessment of Project Management practices. The Analytic Hierarchy Process, a multiple-criterion decision-making technique is also described in the last section.

Critical Success Factors

Critical Success Factors for Different Project Objectives (Chua et. al 1999)

It is generally accepted that budget, schedule and quality are the primary goals of any construction project (Chua et. Al 1999). Chua, Kog, and Loh conducted a study to identify Critical Success Factors (CSFs) according to the primary project goals of budget, schedule and quality. CSFs were identified based on expert opinions through the analytic hierarchy process. They developed a hierarchical model for Construction Project Success as shown in the following figure:

Fig. 2.1 **Hierarchical Model for Construction Project Success (Chua et. al. 1999)**

Sixty-seven success related factors were considered for this study and were grouped under four main project aspects, viz. project characteristics, contractual arrangements, project participants and interactive processes in the hierarchical model for project success (Fig. 2.2). A survey questionnaire was developed and distributed to experts with overall average of 20 years of experience in the construction industry, to facilitate systematic data collection in this study. The CSFs identified were then compared with findings of previous studies conducted by Chua et al. and Kog et al.

Factors Affecting the Success of a Construction Project (Chan et. al. 2004)

Different researchers have tried to identify the factors for a successful project for a long time. List of variables have been abounded in literature but no general agreement has been reached. Albert Chan, Scott and Ada Chan conducted a study to develop a conceptual framework on Critical Success Factors (CSFs). They conducted a thorough literature review on CSFs in seven major management journals, viz. Construction Management and Economics (U.K.), International Journal of Project

Management (U.K.), Journal of Construction Procurement (U.K.), Journal of Construction Engineering and Management (U.S.), Engineering, Construction and Architectural Management (U.K.), Journal of Management in Engineering (U.S.), and Project Management Journal (U.S.). They identified five major groups of independent variables, viz. project-related factors, project procedures, project management actions, human-related factors, and external environment, as crucial to project success. The framework on CSFs can be represented as shown in the Figure 2.3 on the next page.

Project Aspect	**Success-related factor**
Project characteristics	(1) Political risks; (2) economic risks; (3) impact on public; (4) technical approval authorities; (5) adequacy of funding; (6) site limitation and location; (7) constructability; (8) pioneering status; (9) project size
Contractual arrangements	(10) Realistic obligations/clear objectives; (11) risk identification and allocation; (12) adequacy of plans and specifications; (13) formal dispute resolution process; (14) motivation/incentives
Project participants	(15) PM competency; (16) PM authority; (17) PM commitment and involvement; (18) capability of client key personnel; (19) competency of client proposed team; (20) client team turnover rate; (21) client top management support; (22) client track record; (23) client level of service; (24) Capability of contractor key personnel; (25) competency of contractor proposed team; (26) contractor team turnover rate; (27) contractor top management support; (28) contractor track record; (29) contractor level of service; (30) capability of consultant key personnel; (31) competency of consultant proposed team; (32) consultant team turnover rate; (33) consultant top management support; (34) consultant track record; (35) consultant level of service; (36) capability of subcontractors key personnel; (37) competency of subcontractors proposed team; (38) subcontractors team turnover rate; (39) subcontractors top management support; (40) subcontractors track record; (41) subcontractors level of service; (42) capability of suppliers key personnel; (43) competency of suppliers proposed team; (44) suppliers team turnover rate; (45) suppliers top management support; (46) suppliers track record; (47) suppliers level of service
Interactive Processes	(48) Formal design communication; (49) informal design communication; (50) formal construction communication; (51) informal construction communication; (52) functional plans; (53) design complete at construction start; (54) constructability program; (55) level of modularization; (56) level of automation; (57) level of skill labors required; (58) report updates; (59) budget updates; (60) schedule updates; (61) design control meetings; (62) construction control meetings; (63) site inspections; (64) work organization chart; (65) common goal; (66) motivational factor; (67) relationships

Fig. 2.2 **Success-Related Factors (Chua et. al. 1999)**

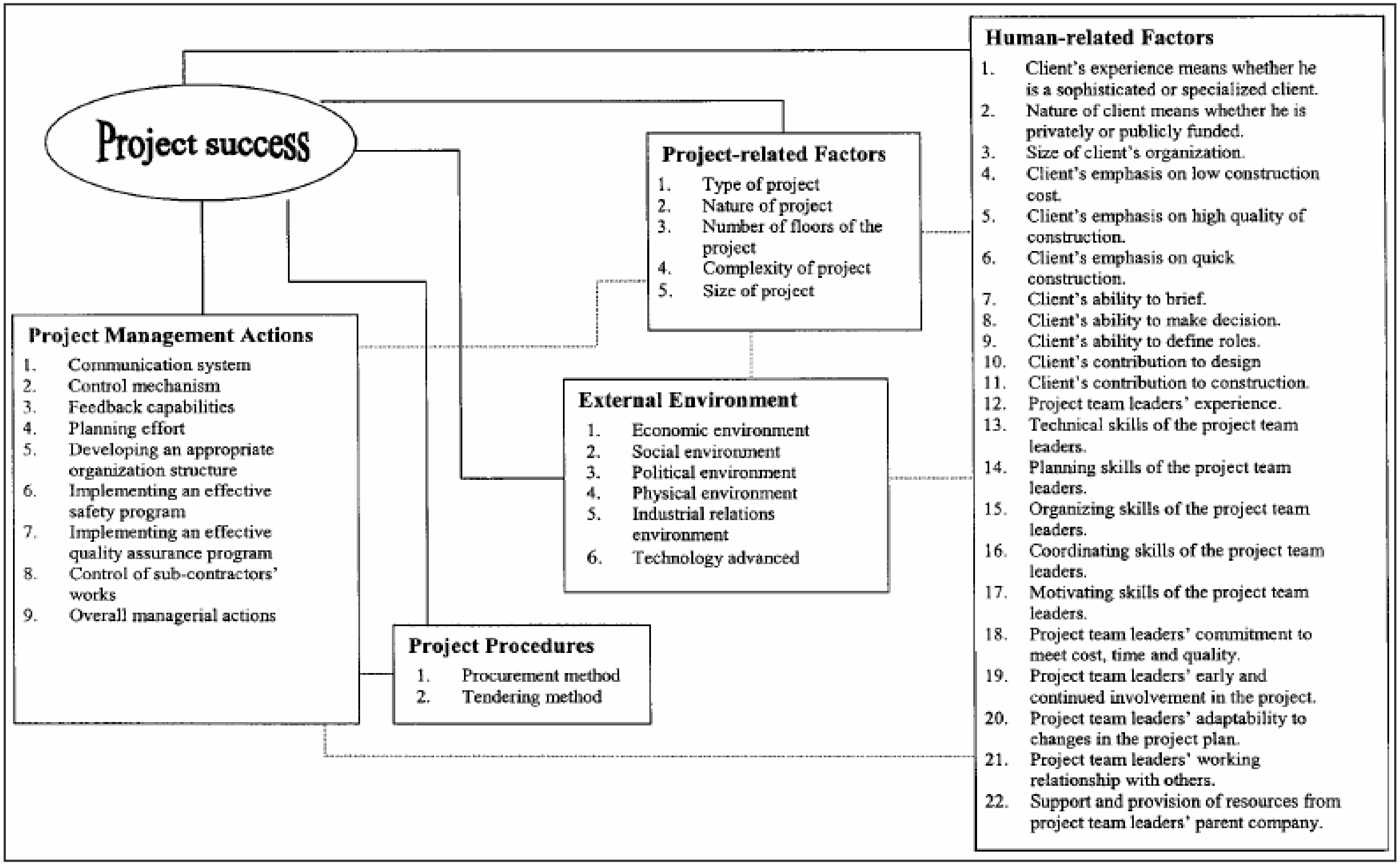

Fig. 2.3 **Conceptual framework for factors affecting project success (Chan et. al. 2004)**

Key Performance Indicators for Construction (Cox et. al. 2003)

Key Performance Indicators (KPIs) are compilations of data measures used to assess the performance of a construction operation (Cox et. Al 2003). The management typically compares the actual and estimated performance in terms of effectiveness, efficiency, and quality in terms of both workmanship and product. Cox, Issa and Ahrens conducted a study to collect management perceptions of key performance indicators utilized in the construction industry. An initial set of perceived key performance indicators was generated based on literature review and was then included in a survey sent to project managers and construction executives of selected companies. A statistical analysis was done to identify a common set of perceived Key Performance Indicators by construction sector, management level, and experience level. The results of survey data analysis supported the hypothesis that KPIs vary according to management's perspective. Six indicators, viz. Quality Control, On-Time Completion, Cost, Safety, $/Unit, and Units/MH were found to be most useful by every segment of the construction industry involved in the study.

Budget and Schedule Success for Small Capital-Facility Projects (Gao et. al 2002)

The Project Management environment of small capital projects is unique in a number of ways (Gao et. Al 2002). They rely heavily on resources for approvals, reviews, and execution relative to the overall values of the capital works. Gao, Smith and Minchin conducted a study to identify project success factors that are most crucial for small capital projects. Project success factors identified in the literature were reviewed and additionally, data was collected from active small project-program personnel for this study. Through analysis and comparison between data collected and project success factors identified in the literature, a comprehensive list of small-project success factors was developed. It was discovered that the factors on small projects are not unlike those on large projects. However, the frequency of process implementation varies, which affects the timing and execution of project work phases for small projects. The critical success factors identified for small projects were: Team-building activities, Core Management group for small projects, Maintenance contracts concurrent with small projects, Project processes (standard operating procedures), and Front-end planning. Out of these, Front-end planning was found to have the greatest influence on improving processes in terms of reducing budget and time variability for small capital projects.

Project Management Assessment Models

Project Management Process Maturity Model (Ibbs & Kwak 2002)

A research team leaded by Professor William Ibbs at the University of California at Berkley, developed a five-level "Project Management Process Maturity" $(PM)^2$ model that determines and positions an organization's relative project management level with other organizations. "Project Management maturity is a well-defined level of sophistication that assesses an organization's current project management practices and processes" (Ibbs & Kwak, 2002). Each maturity level consists of project management characteristics, factors and processes. "The model evolves from functionally driven organizational practices to project driven organization that incorporates continuous project learning" (Ibbs and Kwak, 2002). The five level maturity model can be represented as follows:

Fig. 2.4 **Project management process maturity model (PM)^2 (Ibbs & Kwak, 2002)**

The five levels of maturity can be described as follows (Ibbs & Kwak, 2002):

Level 1 – Ad-hoc Stage:
Organizations at level 1 are functionally isolated and lack the support of senior management. Project success depends on individual efforts rather than team efforts. They neither have consistent Project Management processes or practices nor do they have consistent Project Management data collection or analysis.

Level 2 – Planned Stage:
At the planned stage, organizations possess strengths in doing similar work and are weakly team oriented. Informal and incomplete processes are defined and informal Project Management data collection is practiced.

Level 3 – Managed at Project Level Stage:
Organization staff is informally trained in Project Management skills and practices. Formal project planning and control systems exist and formal Project Management data are managed.

Level 4 – Managed at Corporate Level Stage:
Organizations exhibit strong teamwork and have formal Project Management training for project team. Organizations can manage, integrate, and control multiple projects efficiently. Project Management process

data are quantitatively analyzed, measured and stored.

Level 5 – Continuous Learning Stage:

At this stage, organizations are project-driven, dynamic, energetic and fluid. Project Management processes are continuously improved and Project management data are optimized and sustained. Innovative ideas are vigorously pursued.

The $(PM)^2$ model breaks PM processes and practices in to nine different Project Management knowledge areas and integrates them with five PM processes by adopting Project Management Institute's PM body of knowledge (Ibbs & Kwak, 2002). This allows an organization to identify their strengths and weaknesses of PM practices and focus on weak PM practices to achieve high PM maturity. The model serves as an assessment tool and the results of analysis can be used to make suggestions in improving an organization's PM application expertise and its use of technology. The nine PM knowledge areas and the five PM processes used in the PM^2 model are represented as follows:

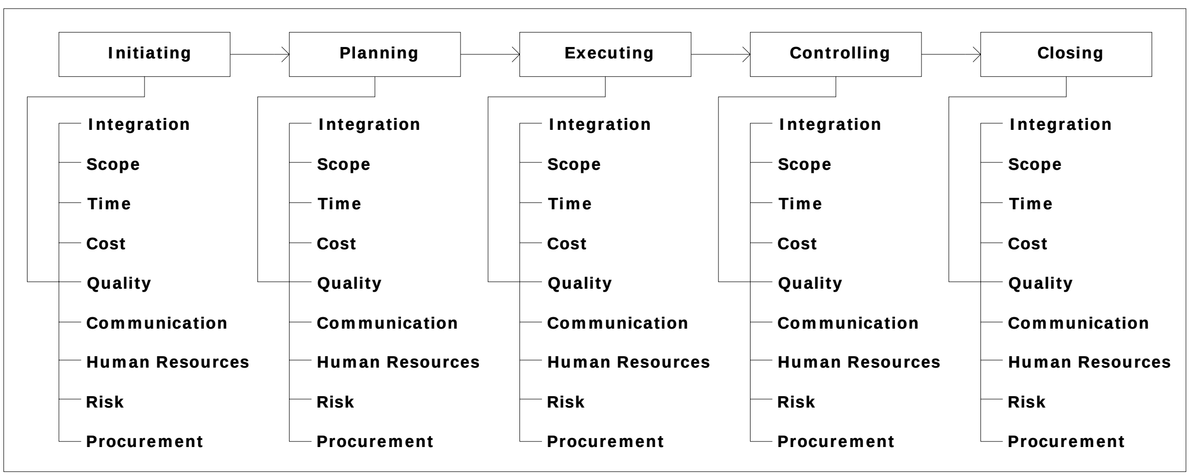

Fig. 2.5 **Integrating PM processes and PM knowledge areas (Ibbs & Kwak, 2002)**

Ibbs' research team used the PM^2 model to assess the Project Management maturity of 38 large international organizations from four different industries (Engineering and Construction, Information Management and Movement, Information Systems, Hi-Tech Manufacturing). Data was collected through interviews and a survey questionnaire consisting of 148 multiple-choice questions. They found an overall maturity average of 3.26 on the rating scale that ranged from 1 to 5. Surprisingly, Information Systems had the lowest PM maturity score while Engineering and Construction had the highest PM maturity score.

Kerzner's Project Management Maturity Model (Kerzner, 2001)

Harold Kerzner and the International Institute for Learning (ILL) view project management as a core competency that organizations must develop in order to survive in today's competitive world. Thus, he developed a Project Management maturity model that organizations can use to benchmark their Project Management practices with their competitors. This maturity model is an assessment tool for establishing Project Management excellence, which is considered to be a condition for success. Like PM^2 model described earlier, Kerzner's model also has five maturity levels. Level 1 represents organizations lacking Project Management processes while Level 5 represents organizations that are successful in the area of Project Management and are trying to improve their processes continuously in order to maintain their position in the competitive market. The five levels of maturity are as shown in the following figure:

Fig. 2.6 **Kerzner's project management maturity levels (Kerzner, 2001)**

The five levels of Project Management maturity can be described as follows:

Level 1 – Common Language:
The organization recognizes the importance of Project Management and a need for understanding the basic Project Management areas and practices.

Level 2 – Common Processes:
At this level, the organization recognizes that standard processes need to be defined and developed so that project success can be repeated. Survival in a competitive market is typically the motivating force behind an organization's effort to mature to this level.

Level 3 – Singular Methodology
This level marks the commitment of an organization to Project Management. The organization defines a single methodology for Project Management in order to take advantage of the associated synergizing effect.

Level 4 – Benchmarking
The organization benchmarks its Project Management practices and processes with its competitors and recognizes that process improvement is necessary to maintain competitive advantage.

Level 5 – Continuous Improvement
At this level, the organization evaluates and analyzes all the lessons learned from the previous levels and implements required changes to improve Project Management processes.

The questionnaire used for assessment is explained in detail in Kerzner's book on Project Management maturity models (Kerzner, 2001). The questionnaire has about 80 multiple-choice questions. This Project Management maturity assessment can be done electronically on IIL's website.

Financial Benefits of Project Management (Schiltz 2003)

Organizations have recognized the importance of Project Management and therefore have invested in the development of project management skills, acquisition of project management tools, set-up of project management offices, etc. (Schiltz 2003). But do they know "How much financial return they can expect from this investment in Project Management?" This question was addressed by Serge Schiltz, a master's student at City University in Washington. For his master's thesis, he developed a "Practical Method for Assessing the Financial Benefits of Project Management". A similar study was conducted by the Project Management Institute in partnership with University of California at Berkley (Schiltz, 2003). However, their maturity assessment was too complex for use by senior executives who are not yet fully convinced that it is worth investing into Project Management (Schiltz, 2003).

Schiltz developed a simple five level Project Management maturity model that is very similar to PM^2 model (described earlier). He used a simpler language to describe the different levels so that they can be better understood by senior managers who are not particularly familiar with the topic. His model is based on the key Project Management processes and organizational characteristics identified in Ibbs and Kwak's model. He developed a questionnaire consisting of 25 closed-ended questions, with each question formulated on key Project Management process area. His simple maturity model can be graphically represented as follows:

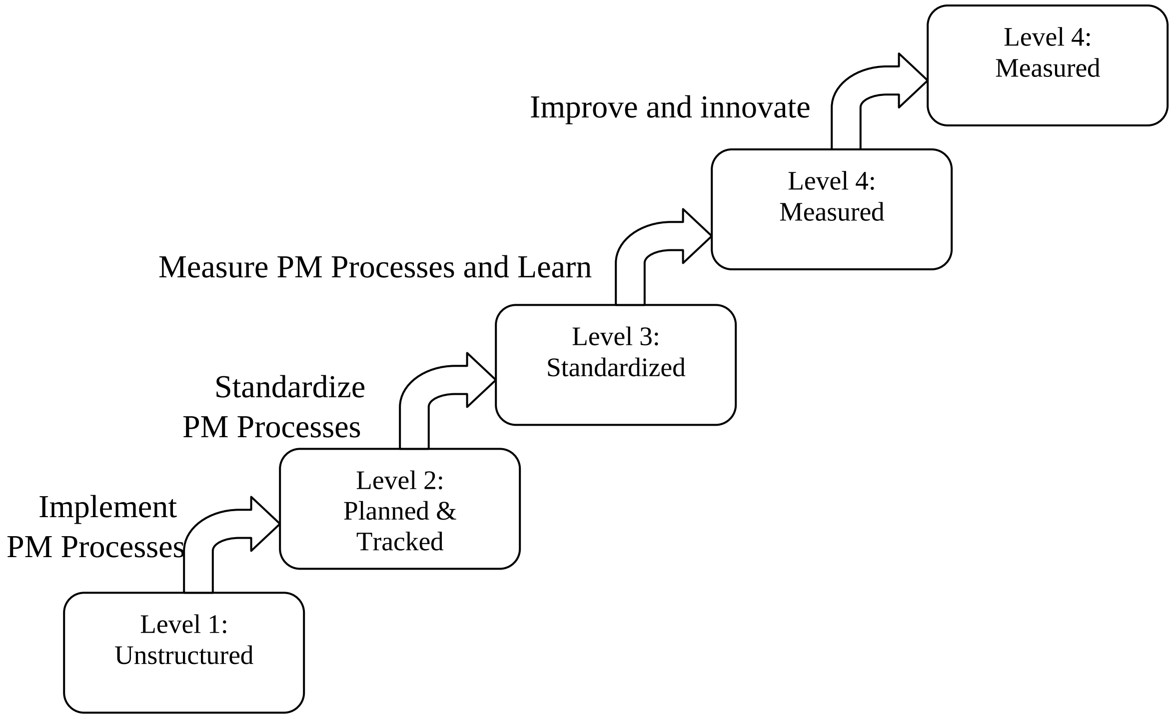

Fig. 2.7 **Simple project management maturity model (Schiltz 2003)**

The average project management maturity of all the survey participants was calculated along with the Absolute Cost Index (ACI) and Absolute Schedule Index (ASI). The formulas for calculating ACI and ASI are as follows:

$$ACI = \frac{\text{Actual Project Costs} - \text{Original Budget}}{\text{Original Budget}} + 1$$

$$ASI = \frac{\left|\text{Actual Project Duration} - \text{Original Project Duration}\right|}{\text{Original Project Duration}} + 1$$

The closer ACI and ASI are to 1, the better the project performance. Regression analysis was done to determine the correlation between the Absolute Cost Index and the Project Management maturity and between the Absolute Schedule Index and the Project Management maturity. The correlation coefficient R^2 was in the range of 0.5 for both indexes, which indicates that there is a reasonably strong dependency between the indexes and the PM maturity.

Benchmarking Project Management Practices (Dey 2002)

Prasanta Dey from the University of West Indies used the Analytic Hierarchy Process (AHP), a multiple attribute decision-making technique, to benchmark the Project Management practices of Caribbean public sector organizations with organizations in the Indian petroleum sector, organizations in the infrastructure sector of Thailand and the UK. This study describes problems and issues of Caribbean Project Management in the public sector and suggests improvement measures for effective Project Management. Dey carried out a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis with the involvement of project executives in Caribbean public sector organizations, to depict their current Project Management practices. The project executives of various organizations were interviewed to identify the critical success factors for Project Management. Appropriate feasibility study of the projects, adequate project plan, appropriate design and detailed engineering, availability of work front, effective material procurement, good contract management, appropriate monitoring and control, and effective termination, were identified as critical success factors. The critical success factors were then further divided in to sub-critical success factors with the active involvement of project executives. Thus, a hierarchy of the entire critical success factors and sub-factors was formed so that AHP can be applied. The hierarchical model with the critical success factors and sub-factors is shown in figure on the following page:

The Analytic Hierarchy Process (AHP) used for analysis will be explained in detail in the next section. AHP was selected for analysis because it helps in conducting quantitative benchmarking and incorporating both tangible and intangible factors (Dey 2002). It also provides a basis for making subsequent decisions for development projects (Dey 2002). Process integration, quality certification and intensive project management training at various levels, were the primary improvement measures suggested for effective project management practices in the Caribbean public sector. The problems identified in this study are typical for every public sector organization and so the Project Management model used in this study will also be used for this research.

Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process developed by Saaty (1980), is a multiple criteria decision-making technique that allows subjective as well as objective factors to be considered in the decision-making process. Formulating the decision problem in the form of a hierarchical structure is the first step of AHP. Elements of a certain level of hierarchy are pair-wise compared with respect to an element in a higher level of the same hierarchy to show the relative importance of each element of the lower level with respect to that element in the higher level. The steps involved in developing a scale using AHP are discussed in the following sections.

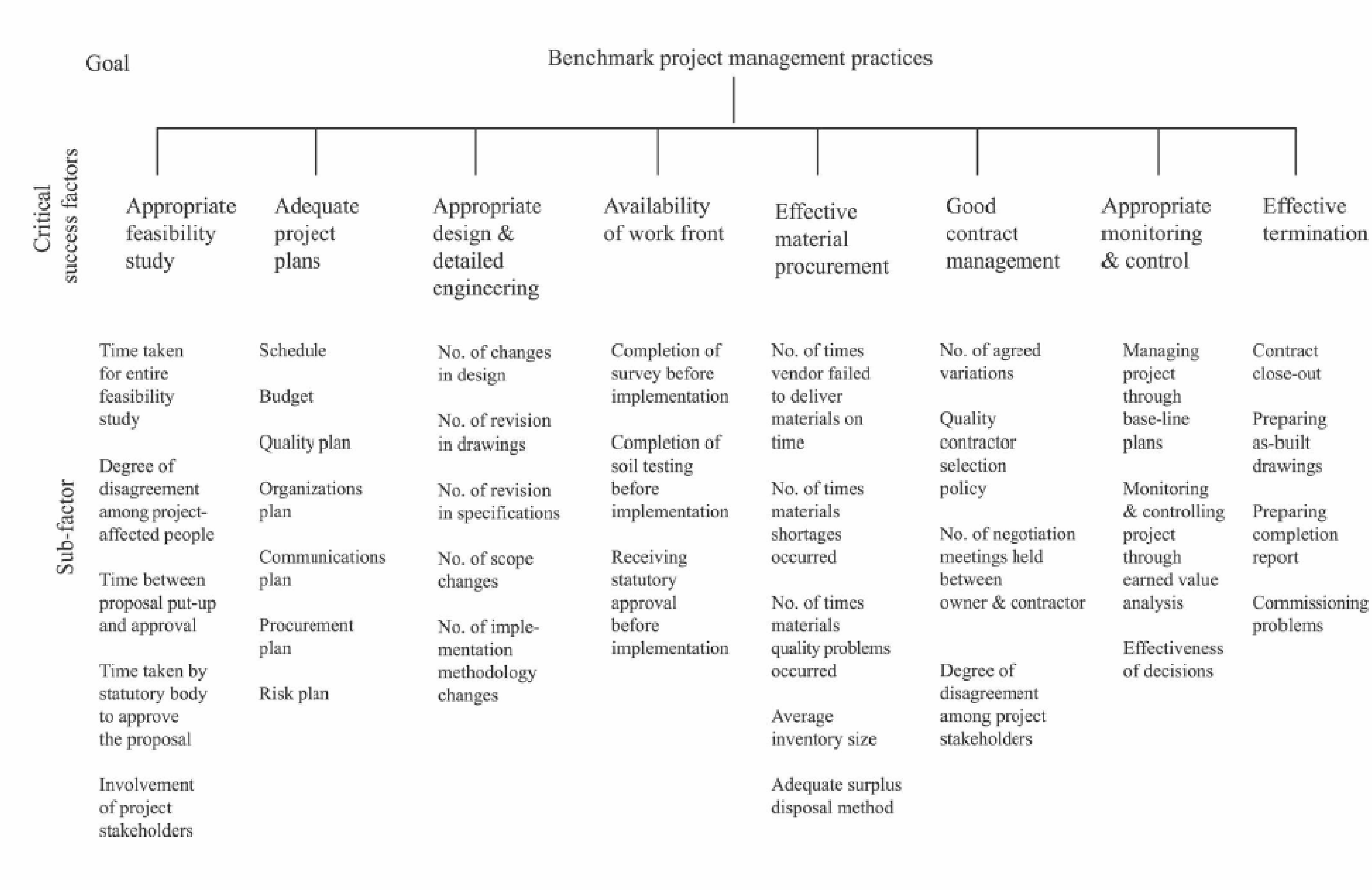

***Fig. 2.8* Hierarchy of critical success factors and sub-factors (Dey 2002)**

Matrix of Comparisons

A matrix of comparison is a matrix in which element is an outcome of the pair-wise comparison of a set of criteria. The following scale of relative importance is used for pair-wise comparison.

Intensity	Definition	Explanation
1	Equal importance	Two activities contribute equally to the object
3	Moderate importance	Slightly favors one over another
5	Essential or strong importance	Strongly favors one over another
7	Demonstrated importance	Dominance of the demonstrated importance in practice
9	Extreme importance	Evidence of favoring one over another of highest possible order of affirmation
2, 4, 6, 8	Intermediate values	When compromise is needed

Table 2.1: Scale of relative importance for pair-wise comparison (Dey 2002)

A matrix of comparison is formulated as follows:

Consider a criterion "x" and let "a", "b", and "c" be the sub-factors affecting criterion "x". The sub-factors "a", "b", and "c" are pair-wise compared in their strength of influence on the criterion "x" using the scale of comparison explained above. So the matrix of comparison would look as follows:

	a	b	c
a	(a,a)	(a,b)	(a,c)
b	(b,a)	(b,b)	(b,c)
c	(c,a)	(c,b)	(c,c)

Fig. 2.9 **Matrix of Comparisons (Barshan 2002)**

Numbers ranging from 1 to 9 are entered in the white cells of the matrix. (a,b) represents the relative importance of "a" with respect to "b" in affecting criterion "x". It can be easily seen that all the diagonal elements in the matrix will be 1 and the elements below the main diagonal will be reciprocals of the corresponding elements above the main diagonal. For example, cell (b,a) will be the reciprocal of (a,b) and so on. The final step is to compute the vector of priorities.

Vector of Priorities

The normalized principal eigen vector is the vector of priorities for any matrix of comparisons. The vector of priorities outlines the relative weights of the elements of matrix considering their strength on influencing the main criterion with respect to which they are being compared. It is computed by normalizing the columns in the matrix of comparison and then adding the elements in each resulting row and dividing this sum by the number of elements in the row. This is a process of averaging over the normalized columns.

Summary

Literature related to critical success factors for Project Management, quantitative and analytical models used for assessment of Project Management practices and the Analytic Hierarchy process were presented in this chapter. In the next chapter, the Project Management Assessment model used for this research will be explained in detail and the application of AHP will be illustrated.

III. Methodology, Data Collection, and Analysis

The literature review presented in the previous chapter assisted in identifying the critical success factors for Project Management. From the different assessment models explained earlier, AHP based model used for benchmarking the Project Management practices of Caribbean public sector organizations was selected for this research. The Project Management issues identified for Caribbean public sector organizations in the area of Project Management are typical for any public sector organization. Therefore, the same critical success factors will be used for this study. Each success factor will be discussed in detail in one of the following sections. This section will be followed by a section with a brief explanation on how the survey questionnaire was developed. The next section discusses the Project Management Assessment System that is developed based on AHP. The procedure followed to calculate the relative weights for critical success factors and their sub-factors will be illustrated in this section. The steps used to calculate the overall score on the Project Management Assessment System will also be explained in detail. The following section explains how the data was analyzed with the help of comparison graphs and general summary statistics like mean, median, standard deviation, maximum and minimum. The last section in this chapter presents the results of data analysis.

The overall goal, to examine the performance of Public Housing Authorities in the area of Project Management, has been classified in to three objectives. The steps followed to achieve each objective are as shown in the figure on the following page.

Critical Success Factors

Some of the common issues faced by public sector organizations leading to unsuccessful projects are: poor contract administration and policies; unforeseen technical difficulties, schedule changes; poor project definition; changes in government policies and regulations, non-involvement of project staff in the planning stage, etc (Dey 2002). Prasanta Dey had identified similar issues and problems in project management in his research study for Caribbean public sector organizations. These concerns were identified in relation to each phase of the project. Appropriate feasibility study, Adequate Project Plans, Appropriate Design & detailed Engineering, Availability of Work front, Effective Material Procurement, Good Contract Management, Appropriate Monitoring & Control and Effective Close-out, were identified as critical success factors in his study. Since these success factors also address the issues in Project Management in PHAs, the same success factors will be used for this study. Each success factor is explained in detail in the following paragraphs.

1) Adequate Feasibility Study

Feasibility analysis is the very first and most important phase of a project. It assists in identifying the best alternative feasible project for the organization and also allows one to involve all stakeholders to take part in analysis through their requirement analysis and provides a solid foundation of projects and project management. This also provides a basis for fast approval from competent authorities, funding agencies like HUD and statutory authorities. Average amount of time devoted for feasibility study, degree of disagreement among project participants, average time gap between proposal put-up and HUD's approval, project scope definition and management involvement in feasibility phase are the sub-factors affecting this success factor.

2) Adequate Project Plan

In the planning phase of a project, a detailed estimate and schedule are prepared. A Quality assurance plan is also prepared to ensure safe, decent and healthy living conditions. An Organizational plan is developed to establish a platform of organization within the company, so that the latter may accomplish its mission, its strategy and its objectives (Taguspark). This plan defines the functions and communication and control lines associated with the plan of action and operation of the company. A Communication plan for disseminating information on project goals, progress, and outcomes among project participants is also developed.

3) Appropriate Design & Detailed Engineering

This ensures minimum change in technicalities of the project and effective management of technical change throughout the project phases. Any changes in drawings or design during the construction phase might increase the project cost and would also increase the project duration. Thus, detailed engineering and design are critical for the success of any project. Number of changes per project in design, drawings, specifications and scope, are the sub-factors affecting this success factor.

4) Availability of work front

Just before the actual construction begins, some groundwork needs to be completed. It includes tasks like soil testing, acquiring statutory approvals from respective authorities, land survey, etc. Availability of work front is an important factor for a successful project because if some of these tasks are not completed, it may lead to severe capital loss or extend the duration of a project by a significant amount.

5) Effective material procurement

Materials constitute the major portion of any construction project. If this is not managed properly, the project is bound to incur time and cost overruns. Procurement planning,

Goal: Examine the performance of PHAs in the area of Project Management

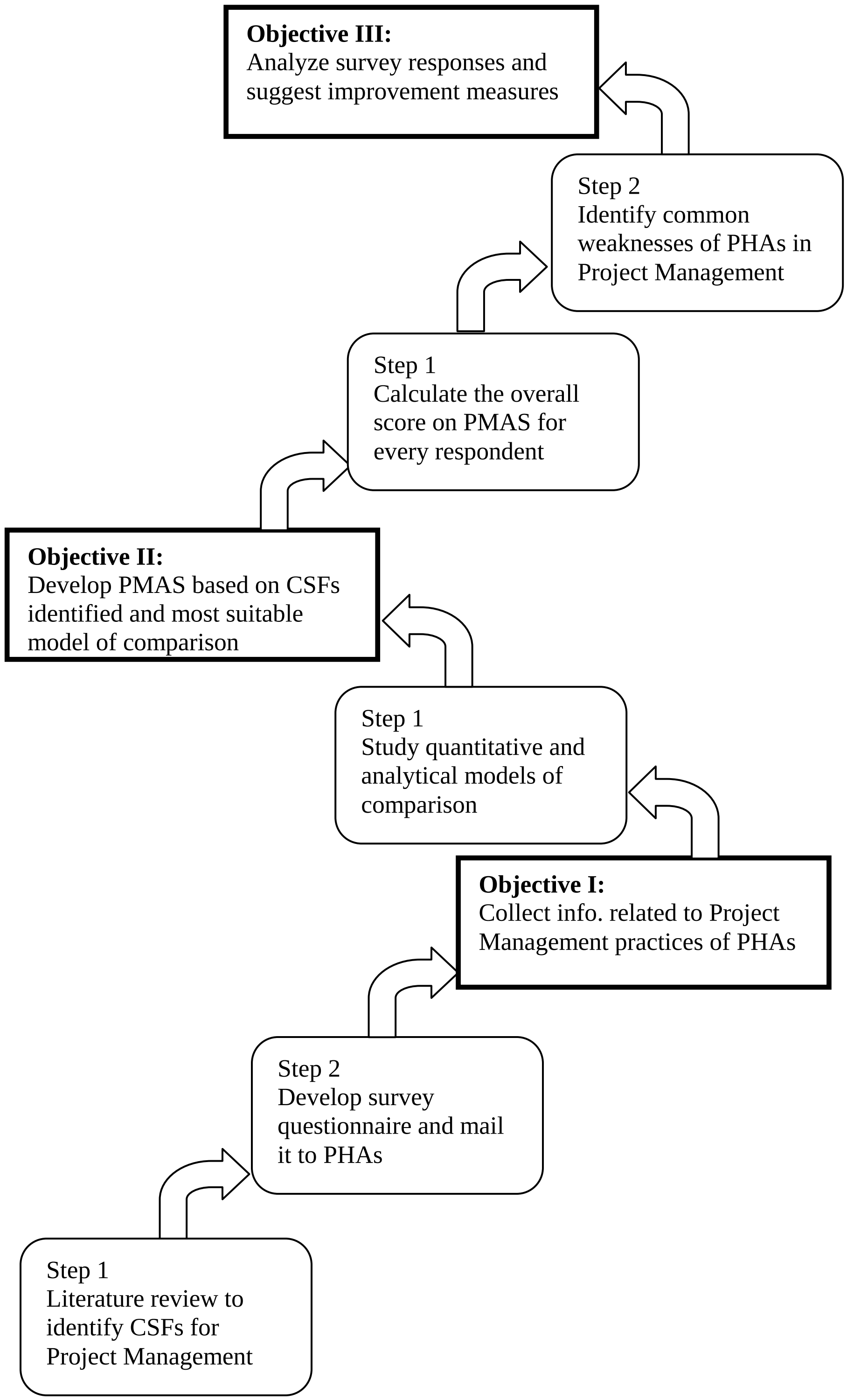

Fig. 3.1 **Representation of objectives in the workflow chart**

supplier selection, inventory control and an effective surplus disposal method are the sub-factors that form an effective procurement approach for construction projects. Good procurement practices can assist in reducing costs by taking advantage of quantity discounts, minimizing cash flow problems and seeking out quality suppliers.

6) Good Contract Management

All the project participants i.e. the PHA (owner), General Contractor, sub-contractors, architect and engineer, are usually committed to project achievement through some legal contract. Good contract management ensures smooth functioning of the project in various phases and it also builds team spirit among the project participants. Most of the PHAs hire a General Contractor through competitive bidding process to do the entire construction work. Thus, the contractor selection policy is very crucial for project's success. Effective contract management would also reduce the number of change orders in a project and thus, evading the time-consuming approval process. Also, good team spirit among project participants and negotiation meetings with GC will assist in reducing the degree of disagreement among project stakeholders.

7) Appropriate Monitoring and Control

This measures the project performance in line with the planning standard. Managing a project through a base-line plan and earned value analysis provides the basis for effective decision across various phases of the project. Earned value analysis is a standard technique to measure a project's progress, forecast its completion date and final cost, and provide schedule and budget variances along the way. It assists in bringing the project back on track in case of deviations from the planned budget and schedule. Effective decision making is very crucial in this phase as it directly affects the project's actual cost and schedule.

8) Effective Close-out

A good beginning does not necessarily guarantee a good finish. Momentum is vital to a construction project and it is imperative to maintain it all the way to final completion. It is a very common phenomenon where the project close-out activities will be delayed forever in projects nearing completion. The effectiveness of a project depends on how effectively the project is handed over for operations. Contract close-out, preparation of completion report, as-built drawings, operating manual along with handling commissioning activities effectively derives the project's fate to some extent in the long run.

The critical success factors described above are represented in a hierarchical model along with their sub-factors in figure 3.2. It is same as Dey's Project Management model with a few modifications. The sub-factor "scope definition" was added under Appropriate Feasibility study because project scope definition is a very important element in the feasibility phase and was missing in Dey's model (see next page).

Data Collection

The first step in data collection was to identify the participants for this study. Since the benefits of Project Management best practices are more apparent on large projects (greater cost and duration) than on small projects, large PHAs who manage more than 1,250 housing units per year, were selected for this study. The next step was to figure out who would be the most appropriate person in a PHA who would have the right resources and knowledge to answer the survey questions. To answer most of the questions in the survey, a person who has an overall picture of all the on-going projects as well as the past projects would be the ideal candidate to participate in the survey. The Construction Manager or Modernization and Facilities Manager of PHA would be the right target for this study. But since there is a possibility that some PHAs may not have a construction manager, the researcher decided to e-mail the surveys to Executive Director of PHA, keeping in mind the time constraint and the feasibility of the research study. The names and email addresses of all executive directors were taken from the PHA profiles provided on HUD's website. The questionnaire was then emailed to executive directors of all eligible PHAs as an attachment along with the consent letter. The survey questionnaire had thirty-five closed ended questions on Project Management preceded by nine general questions (see Appendix A). The general questions were included in the questionnaire to collect information like the annual budget of PHAs, staff strength of PHA, their attitude towards Project Management, their Project Management team composition, etc. The real purpose of having these general questions was to get the participant in the mode of answering Project Management related questions. Each closed ended question on Project Management was based on the sub-factors affecting each critical success factor. The participant was asked to select the best possible answer by highlighting or underlining one of the options. The questionnaire was prepared in Microsoft Word so that the participant could easily type their answers for open ended questions. The survey participants were requested to answer all the questions and return the questionnaire to author's email address within seven to ten days.

Project Management Assessment System (PMAS)

The researcher decided to use Analytic Hierarchical Process as an analysis tool for this study because it allows to assign relative weights in a logical manner through pair-wise relative comparison. If the relative weights are assigned randomly, then the distribution of points in PMAS would also be random. On the other hand, AHP is a standardized technique and so even if the relative weight for one of the factors is changed; its influence on the other factors can be easily accounted for. Also, it allows objective as well as subjective factors to be considered in the decision-making process.

The use of AHP entails the development of a tree-like structure. Since it makes use of pair-wise comparison, the interdependencies between related factors can be accounted for while comparing the factors. On the other hand, it allows you to independently compare pairs of inter-related factors. The first step in developing the Project Management Assessment System is to form a hierarchical structure with the top level reflecting the overall goal of this study i.e. to assess the Project Management practices of PHAs. The critical success factors for Project Management represented the next level in the hierarchy. The lower most level in the hierarchical structure was the sub-factors affecting each critical success factor.

Since AHP will be used for assessing Project Management practices, it was necessary to form this hierarchical structure. The hierarchical model is shown in figure 3.2.

Goal

ASSESSMENT OF PROJECT MANAGEMENT PRACTICES

Critical Success Factors / SUB FACTORS

Appropriate Feasibility Study
- Time taken for entire feasibility study
- Degree of disagreement among project participants
- Time gap between ppproposal put-up & HUD's approval
- Project Scope Definition
- Management Involvement

Adequate Project Plans
- Schedule
- Budget
- Quality Assurance
- Organizational Plan
- Communications Plan
- Procurement Planning
- Risk Plan

Appropriate Design & detailed Engineering
- No. of changes in design
- No. of revisions in drawings
- No. of revisions in Specifications
- No. of Scope Changes

Availability of Work front
- Completion of survey before construction
- Completion of soil testing before construction
- Receiving Statutory Approvals before construction

Effective Material Procurement
- No. of times supplier failed to deliver materials on time
- No. of times material shortage occurred
- No. of times material quality problems occurred
- Average Inventory Size
- Adequate Surplus Disposal method

Good Contract Management
- No. of agreed variations
- Contractor Selection policy
- No. of negotiation meetings with Contractor
- Degree of disagreement among project stakeholders

Appropriate monitoring & control
- Managing project through base-line plans
- Monitoring & controlling project through earned value analysis
- Effectiveness of Decisions

Effective Close-out
- Contract close-out
- Preparing as built drawings
- Preparing completion report
- Commissioning Problems

Fig. 3.2 **Hierarchical structure of critical success factors and sub-factors (Modified from Dey 2002)**

Relative Weights of Critical Success Factors and sub-factors

The next step in AHP is to make a pair-wise comparison of all the elements belonging to the same level of hierarchy. The elements are pair-wise compared with respect to an element in a higher level of the same hierarchy to show the relative importance of each element of the lower level with respect to that element in the higher level. Thus, each critical success factor will be compared with the remaining success factors to determine their relative importance for Project Management, the topmost level in the hierarchy. Likewise, the sub-factors will be compared pair-wise to determine their impact on the critical success factor relative to other sub-factors. The steps followed in calculating the relative weights can be explained with the help of the following example:

Let's assume that we are comparing the sub-factors: Managing projects through base-line plans; Monitoring & controlling project through earned value analysis; and Effectiveness of decisions. Each sub-factor is pair-wise compared with the remaining two sub-factors in its strength of influence on the critical success factor in the next level of hierarchy i.e. Appropriate Monitoring & Control. The following scale of relative importance is used for pair-wise comparison.

Intensity	Definition	Explanation
1	Equal importance	Two activities contribute equally to the object
3	Moderate importance	Slightly favors one over another
5	Essential or strong importance	Strongly favors one over another
7	Demonstrated importance	Dominance of the demonstrated importance in practice
9	Extreme importance	Evidence of favoring one over another of highest possible order of affirmation
2, 4, 6, 8	Intermediate values	When compromise is needed

Table 3.1: Scale of relative importance for pair-wise comparison (Dey 2002)

The matrix of comparison is formulated after all pair-wise comparisons are made. The values entered in the matrix of comparison are based on the researcher's knowledge and experience in Project Management. The matrix is as shown in the following figure:

Appropriate Monitoring & Control			
Sub-factors	Managing Project through base-line plans	Monitoring & Controlling project through earned value analysis	Effectiveness of decisions
Managing Project through base-line plans	1	1	3
Monitoring & Controlling project through earned value analysis		1	3
Effectiveness of decisions			1

Fig. 3.3 **Matrix of comparison for sub-factors affecting Appropriate Monitoring & Control**

The values in the shaded cells are reciprocals of the corresponding elements above the main diagonal. The next step is to calculate the sum of all elements in a column and divide each element in that column by this sum. This process is known as normalizing the column. So for the first column, each element will be divided by (1+1+0.333) = 2.333. Thus, the new values in first column are (1/2.333) = 0.429, (1/2.333) = 0.429 and (0.333/2.333) = 0.143. The same steps are repeated for the remaining columns. The normalized matrix looks as follows:

Appropriate Monitoring & Control			
Sub-factors	Managing Project through base-line plans	Monitoring & Controlling project through earned value analysis	Effectiveness of decisions
Managing Project through base-line plans	0.429	0.429	0.429
Monitoring & Controlling project through earned value analysis	0.429	0.429	0.429
Effectiveness of decisions	0.143	0.143	0.143

Fig. 3.4 **Normalized matrix for sub-factors affecting Appropriate Monitoring & Control**

The final step is to add all the elements in a row of the normalized matrix and divide it by the number of elements in that row. The new value obtained is the relative weight for the sub-factor represented by that row. So for the first row, the new value is (0.429 + 0.429 + 0.429)/3 = 0.43. Similar calculations are done for the remaining rows to obtain the relative weights. The relative weights for the three sub-factors are shown in the following table:

Appropriate Monitoring & Control			
Sub-factors	Managing Project through base-line plans	Monitoring & Controlling project through earned value analysis	Effectiveness of decisions
Relative Weights	0.43	0.43	0.14

Table 3.2: Relative weights for sub-factors affecting appropriate monitoring & control

The steps described above were also used to calculate the relative weights for critical success factors and the sub-factors for each success factor. All the calculations done for obtaining the relative weights are shown in Appendix B. The calculated relative weights for the remaining sub-factors and critical success factors are shown in table 3.3 through table 3.10. The relative weights for critical success factors were multiplied by one hundred so that the maximum possible overall score on Project Management Assessment System is one hundred and is obtained by adding the maximum scores for all critical success factors.

Availability of Work Front			
Sub-factors	Completion of Survey before Construction	Completion of soil testing before construction	Receiving Statutory Approvals before Construction
Relative Weights	0.43	0.43	0.14

Table 3.3: Relative weights for sub-factors affecting availability of work front

Appropriate Design & Detailed Engineering				
Sub-factors	No. of changes in design	No. of revisions in drawings	No. of revisions in specifications	No. of Scope Changes
Relative Weights	0.12	0.11	0.15	0.62

Table 3.4: Relative weights for sub-factors affecting appropriate design & detailed engineering

Effective Material Procurement					
Sub-factors	No. of times supplier failed to deliver materials on time	No. of times material shortage occurred	No. of times material quality problems occurred	Average Inventory Size	Adequate Surplus Disposal Method
Relative Weights	0.19	0.28	0.14	0.28	0.11

Table 3.5: Relative weights for sub-factors affecting effective material procurement

Good Contract Management				
Sub-factors	No. of agreed variations	General Contractor Selection Policy	No. of negotiation meetings with General contractor	Degree of disagreement among project stakeholders
Relative Weights	0.14	0.45	0.14	0.26

Table 3.6: Relative weights for sub-factors affecting good contract management

Effective Close-out				
Sub-factors	Contract close-out	Preparing as built drawings	Preparing completion report	Commissioning Problems
Relative Weights	0.29	0.29	0.29	0.14

Table 3.7: Relative weights for sub-factors affecting effective close-out

Appropriate Feasibility Study					
Sub-factors	Time taken for entire feasibility study	Degree of Disagreement among project participants	Time gap between proposal put-up & HUD's approval	Project Scope Definition	Management Involvement
Relative Weights	0.21	0.09	0.21	0.33	0.17

Table 3.8: Relative weights for sub-factors affecting Appropriate Feasibility Study

Adequate Project Plans							
Sub-factors	Schedule	Budget	Quality Assurance	Organizational Plan	Communications Plan	Procurement Planning	Risk Plan
Relative Weights	0.21	0.22	0.14	0.13	0.08	0.12	0.09

Table 3.9: Relative weights for sub-factors affecting Adequate Project Plans

Assessment of Project Management Practices								
Sub-factors	Appropriate Feasibility Study	Adequate Project Plans	Appropriate Design & Detailed Engineering	Availability of Work Front	Effective Material Procurement	Good Contract Management	Appropriate Monitoring & Control	Effective Close-out
Relative Weights	0.22	0.18	0.07	0.07	0.12	0.10	0.20	0.04

Table 3.10: Relative weights for critical success factors

Overall Score on Project Management Assessment System

After calculating the relative weights for all the sub-factors and critical success factors, the next step is to score responses for each closed ended question in the questionnaire. Every closed-ended question in the survey is based on a sub-factor and so it has a relative weight assigned to it. The relative weight for each question was scaled so that the total points of the sub-factors added up to the weight of the corresponding critical success factor. This is done by multiplying the relative weight of the question by one hundred by the maximum score of the corresponding success factor. The minimum score awarded to an option was 0.25 while the maximum was nine. The scoring pattern represents author's discretion and is solely based on his knowledge in the field of Project Management. The points awarded for each option for every question in the survey is shown in Appendix A.

The Project Management Assessment System with the maximum points for each critical success factor and sub-factor is shown in figure 3.5. To calculate the overall score on Project Management Assessment System, the following steps should be followed:

1) Add up the scores for all the sub-factors of a given critical success factor. This sum represents the performance of a PHA in the given area of Project Management.
2) Repeat step one for the remaining critical success factors.
3) The PHA score for all critical success factors is then added up to obtain the overall score.

The above steps have been demonstrated with the help of an example provided in Appendix C.

Data Analysis

The overall score for all the participating PHAs was calculated by following the steps explained in the previous section. A graph comparing the overall score of PHAs with the overall ideal score and the average overall score is shown in figure 3.6. The summary statistics (mean, median, standard deviation, maximum and minimum) for the overall score on PMAS are displayed in table 3.11.

The score for each critical success factor was calculated by adding the scores for all the sub-factors affecting the success factor. The ideal score for each critical success factor was calculated by multiplying its relative weight with one hundred. Graphs comparing the scores of participating PHAs with the ideal and average scores for each critical success factor are shown in figures 3.7 to 3.14. The summary statistics for PHA scores for each critical success factor are displayed in tables 3.12 to 3.19. The common Project Management practices of PHAs identified through the survey are shown in Appendix D.

Goal

ASSESSMENT OF PROJECT MANAGEMENT PRACTICES

Critical Success Factors

SUB FACTORS

Appropriate Feasibility Study (25)
- Time taken for entire feasibility study (5)
- Degree of disagreement among project participants (2)
- Time gap between proposal put-up & HUD's approval (5)
- Project Scope Definition (8)
- Management Involvement (5)

Adequate Project Plans (20)
- Schedule (4)
- Budget (4)
- Quality Assurance (3)
- Organizational Plan (3)
- Communications Plan (2)
- Procurement Planning (2)

Risk Plan (2)

Appropriate Design & detailed Engineering (5)
- No. of changes in design (0.5)
- No. of revisions in drawings (0.5)
- No. of revisions in Specifications (1)
- No. of Scope Changes (3)

Availability of Work front (5)
- Completion of survey before construction (2)
- Completion of soil testing before construction (2)
- Receiving Statutory Approvals before construction (1)

Effective Material Procurement (10)
- No. of times (2) supplier failed to deliver materials on time
- No. of times material shortage occurred (3)
- No. of times (1) material quality problems occurred
- Average Inventory Size (3)
- Adequate Surplus Disposal method (1)

Good Contract Management (10)
- No. of agreed variations (1)
- Contractor Selection Policy (5)
- No. of negotiation meetings with Contractor (1)
- Degree of disagreement among project stakeholders (3)

Appropriate monitoring & control (20)
- Managing project through base-line plans (8)
- Monitoring & controlling project through earned value analysis (9)
- Effectiveness of Decisions (3)

Effective Close-out (5)
- Contract close-out (1.5)
- Preparing as built drawings (1.5)
- Preparing completion report (1.5)
- Commissioning Problems (0.5)

Fig. 3.5 **Points breakdown for project management assessment system**

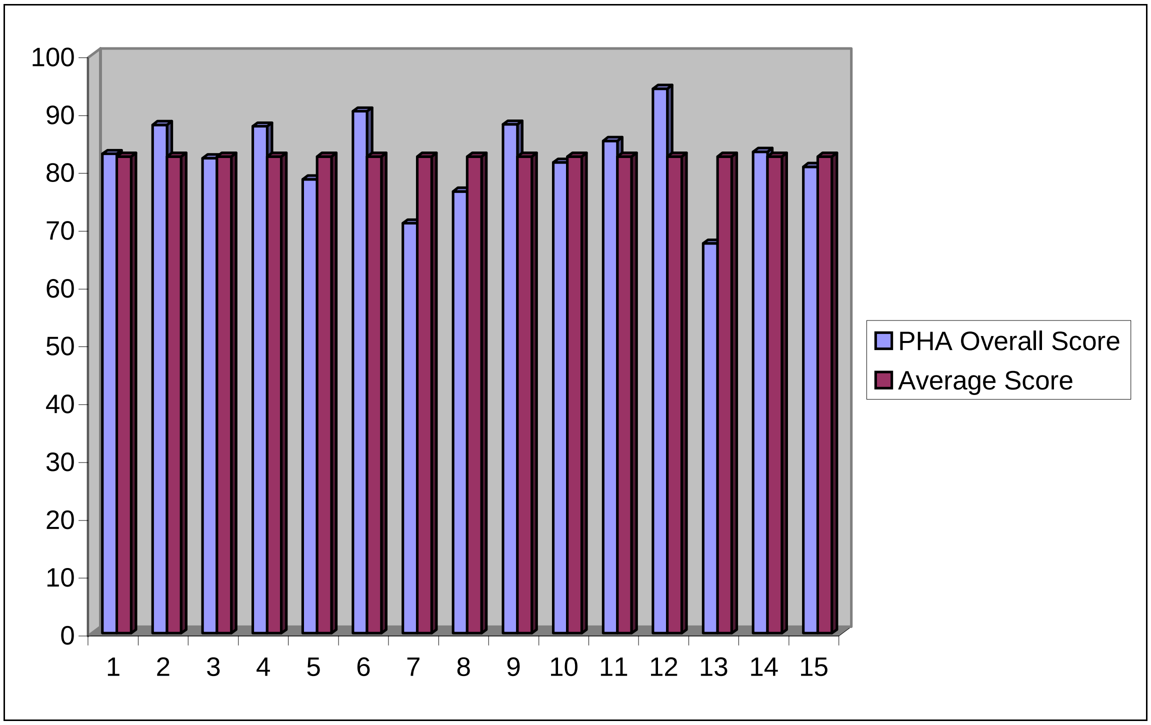

Fig. 3.6 **Comparison of overall score of PHAs**

Overall Score on PMAS	
Mean	82.44
Median	82.9
Standard Deviation	7.12
Minimum	67.4
Maximum	94.15

Table 3.11 Summary statistics for overall score on PMAS

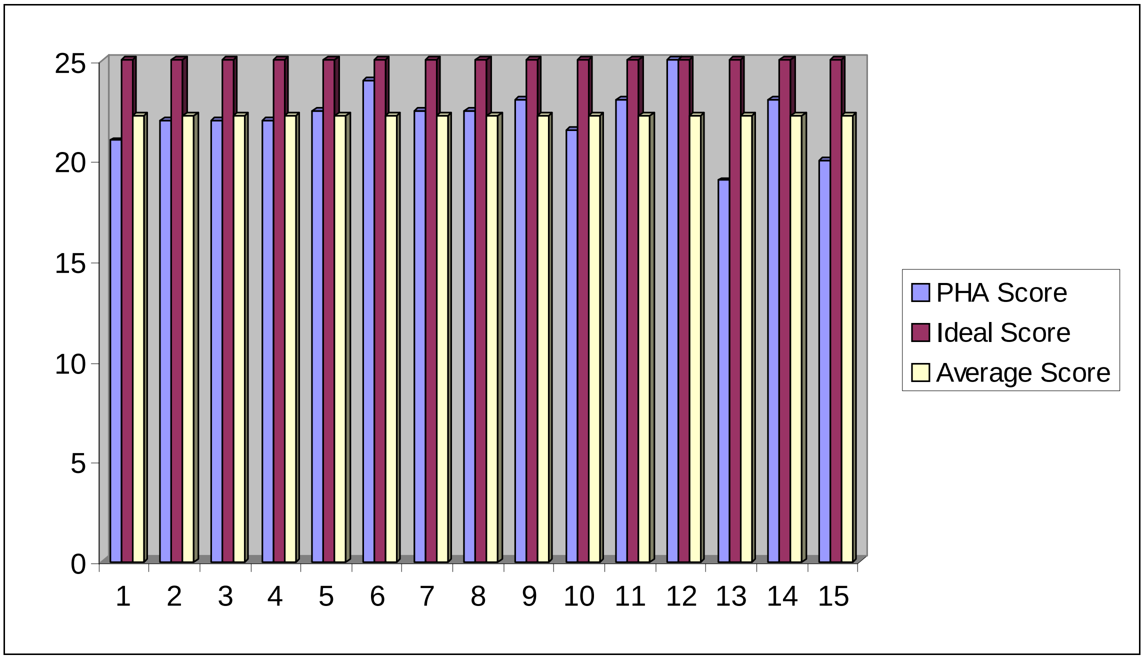

Fig. 3.7 **Comparison of PHA scores for Appropriate Feasibility Study**

Weighted Scores for Appropriate Feasibility Study	
Mean	22.2
Median	22.5
Standard Deviation	1.47
Minimum	19
Maximum	25

Table 3.12: Summary statistics for PHA scores for appropriate feasibility study

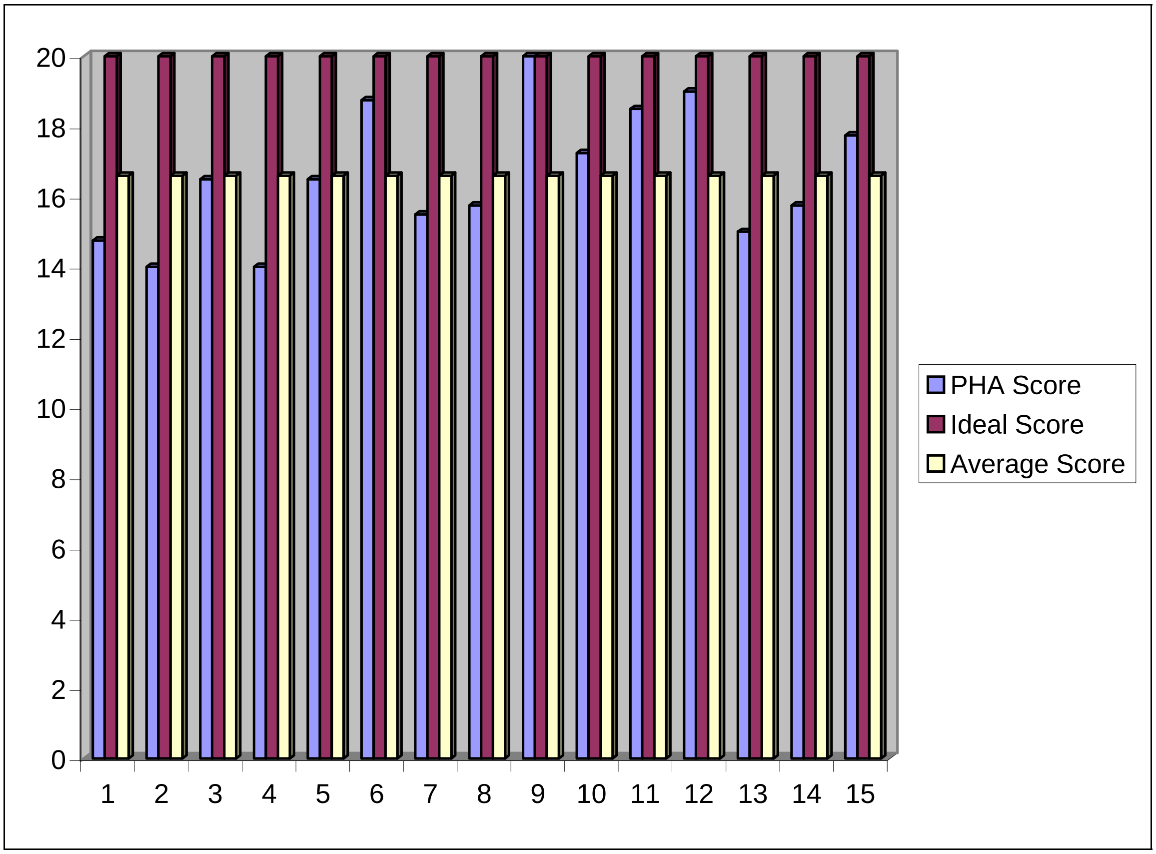

Fig. 3.8 **Comparison of PHA scores for adequate project plans**

Weighted Scores for Adequate Project Plans	
Mean	16.6
Median	16.5
Standard Deviation	1.88
Minimum	14
Maximum	20

Table 3.13: Summary statistics for PHA scores for adequate project plans

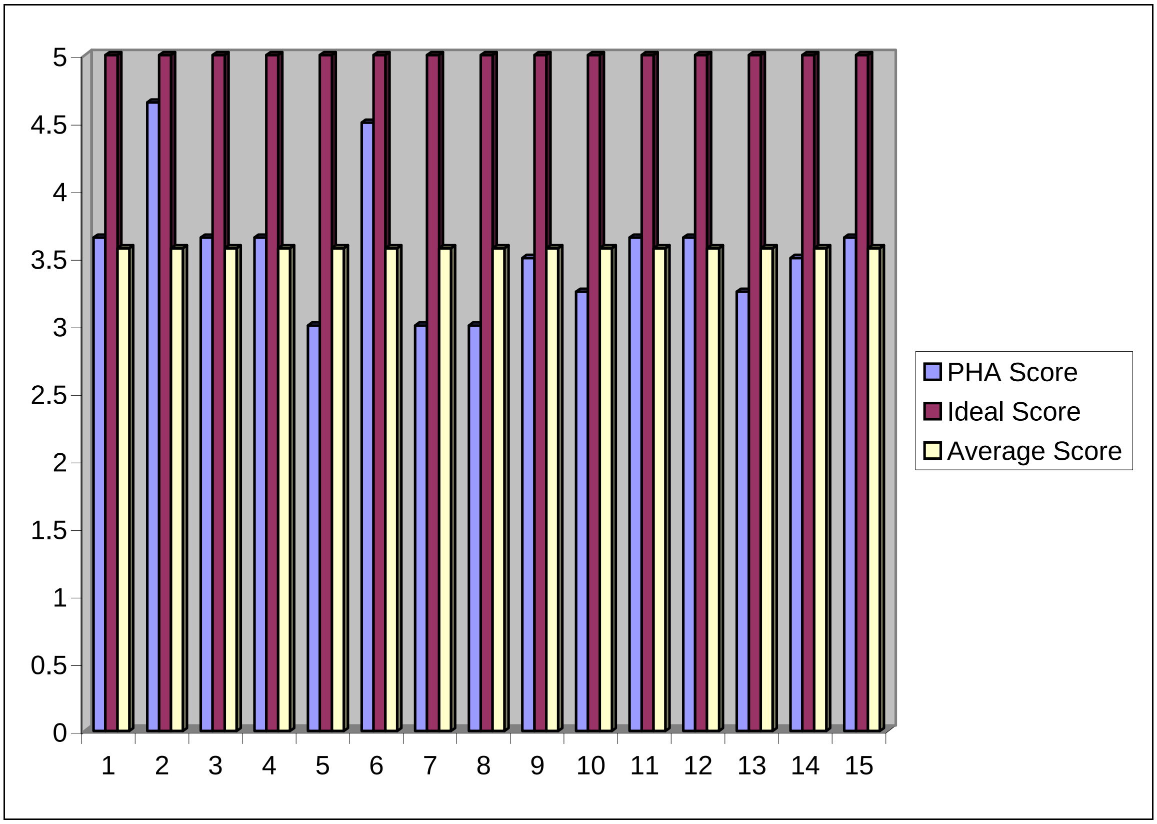

Fig. 3.9 **Comparison of PHA scores for appropriate design & detailed engineering**

Weighted Scores for Appropriate Design & Detailed Engineering	
Mean	3.57
Median	3.65
Standard Deviation	0.48
Minimum	3.00
Maximum	4.65

Table 3.14: Summary statistics for PHA scores for appropriate design & detailed engineering

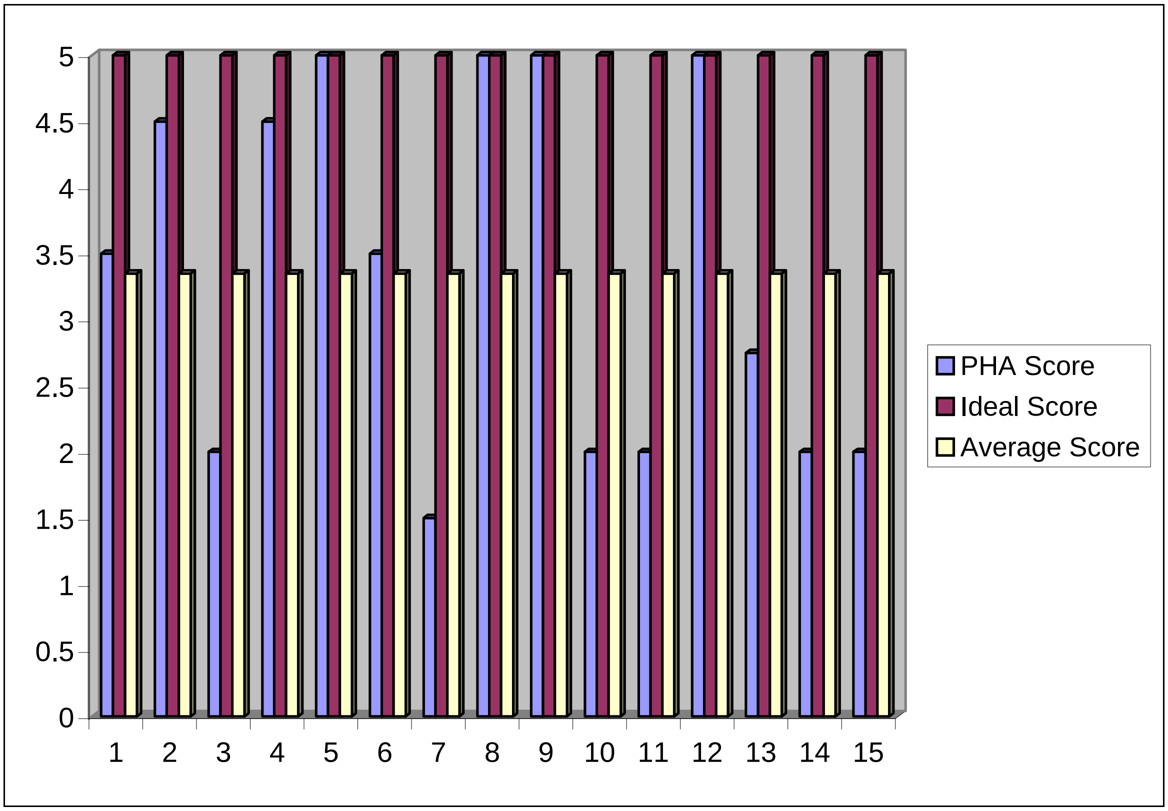

Fig. 3.10 **Comparison of PHA scores for availability of work front**

Weighted Scores for Availability of Work Front	
Mean	3.35
Median	3.5
Standard Deviation	1.38
Minimum	1.5
Maximum	5.00

Table 3.15: Summary statistics for PHA scores for availability of work front

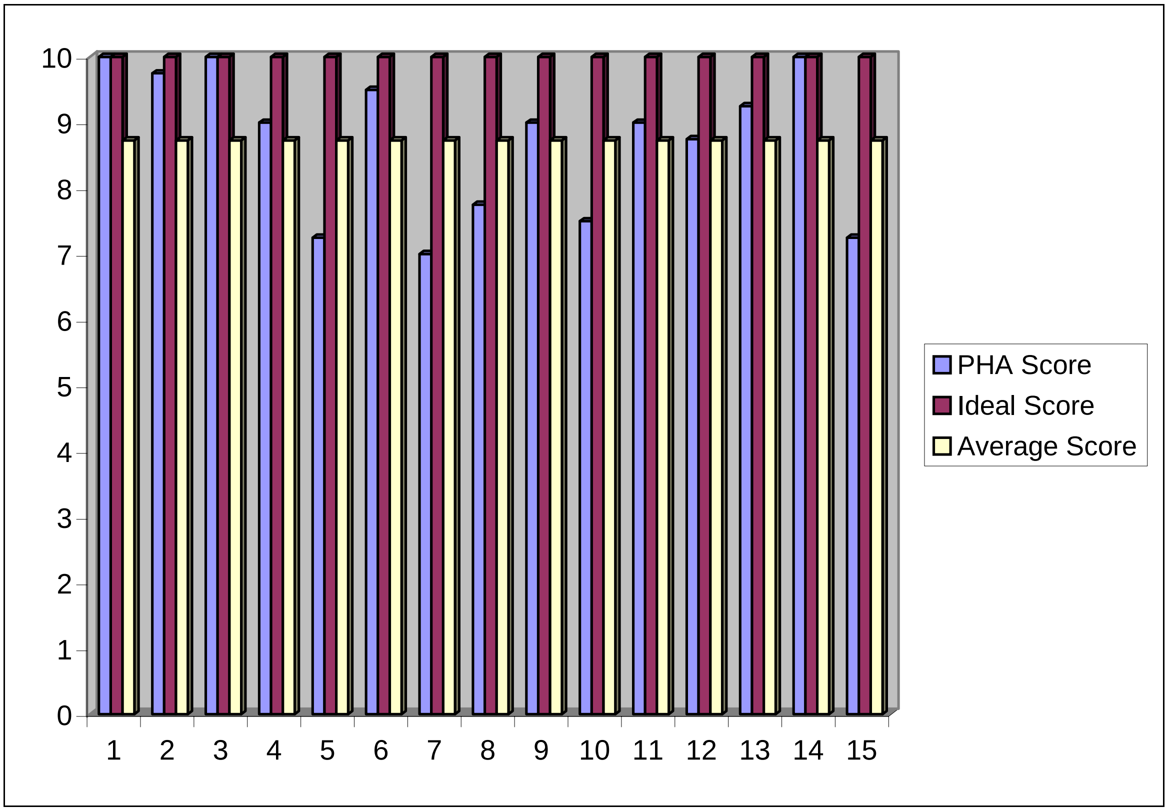

Fig. 3.11 **Comparison of PHA scores for effective material procurement**

Weighted Scores for Effective Material Procurement	
Mean	8.73
Median	9.00
Standard Deviation	1.10
Minimum	7
Maximum	10

Table 3.16 Summary statistics for PHA scores for effective material procurement

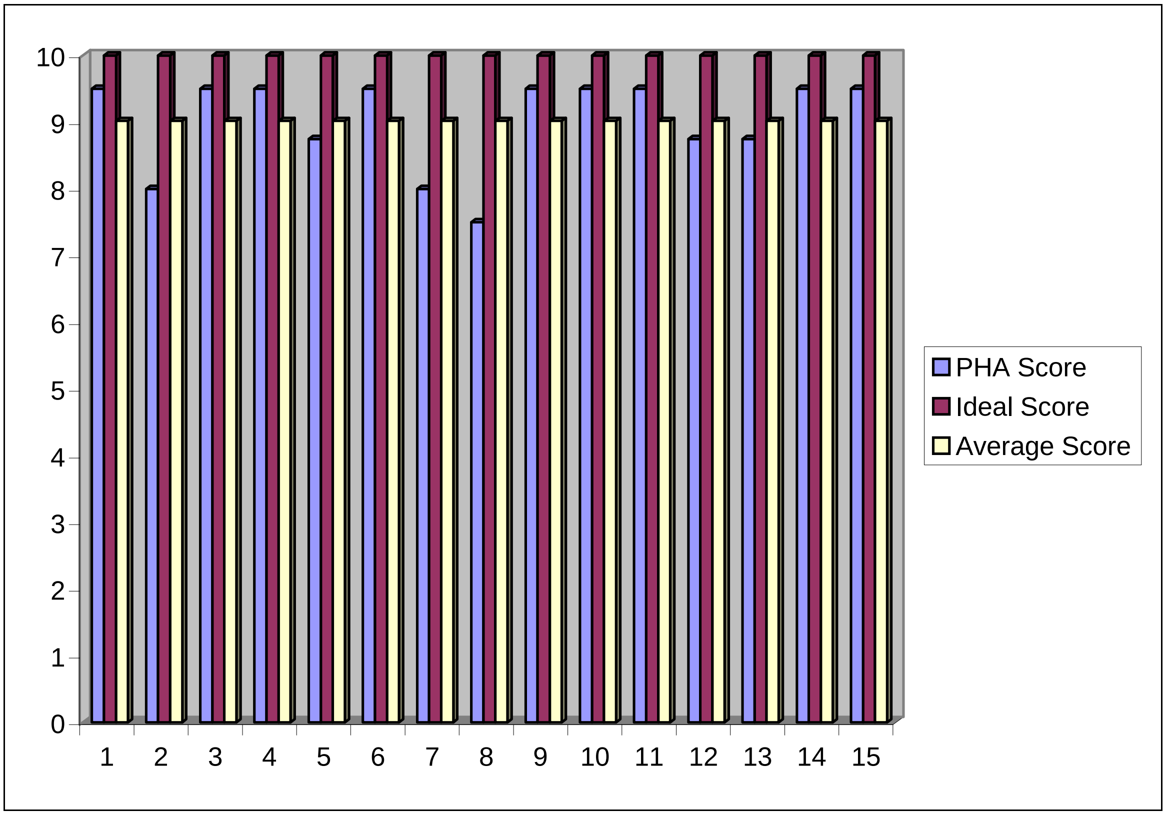

Fig. 3.12 **Comparison of PHA scores for good contract management**

Weighted Scores for Good Contract Management	
Mean	9.02
Median	9.50
Standard Deviation	0.69
Minimum	7.50
Maximum	9.50

Table 3.17 Summary statistics for PHA scores for good contract management

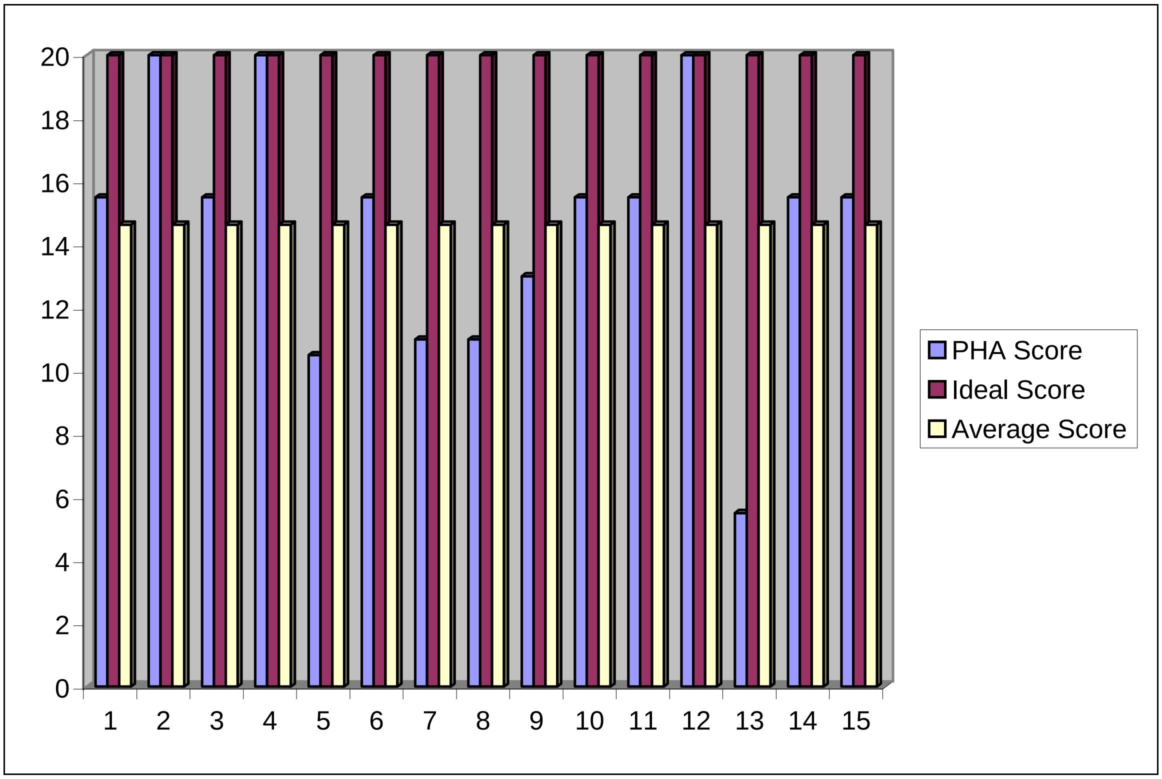

Fig. 3.13 **Comparison of PHA scores for appropriate monitoring & control**

Weighted Scores for Appropriate Monitoring & Control	
Mean	14.63
Median	15.50
Standard Deviation	3.98
Minimum	5.50
Maximum	20.00

Table 3.18 Summary statistics for PHA scores for appropriate monitoring & control

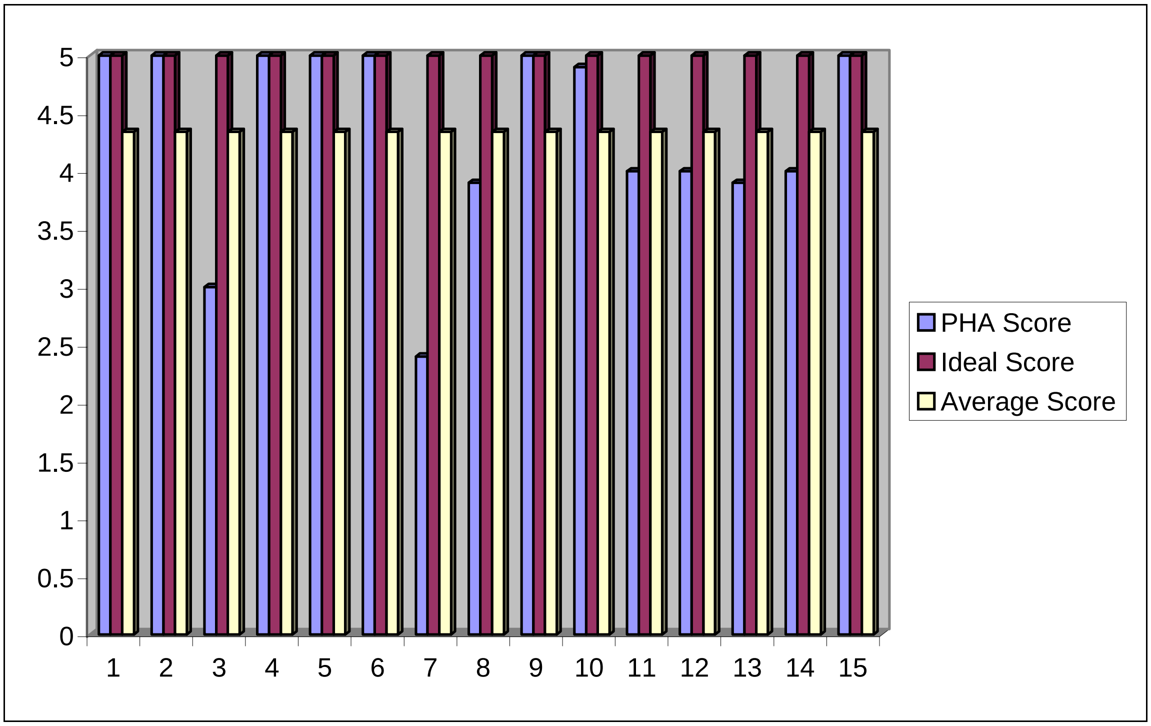

Fig. 3.14 **Comparison of PHA scores for effective close-out**

Weighted Scores for Effective Close-out	
Mean	4.34
Median	4.90
Standard Deviation	0.83
Minimum	2.40
Maximum	5.00

Table 3.19 Summary statistics for PHA scores for effective close-out

Results of Data Analysis & Recommendations

The scale shown in table 3.20 is used for evaluating the overall score of PHAs. This scale is very similar to the scale used by HUD in the Public Housing Assessment System. The average overall score on Project Management Assessment System was 82.44 while the maximum possible score (ideal score) is 100. This clearly indicates that there is scope for improvement for PHAs in the area of Project Management. The PHAs can compare their overall scores with other high-performing PHAs to identify the Project Management areas in which they can improve, and adopt some of the practices followed by these high-performing PHAs with appropriate modifications depending on their needs and availability of resources.

PHA Status Designation	Overall PMAS score	Individual Success factor score
High Performer	90 or higher	At least 60% of ideal score for every success factor
Standard Performer	75 - 89	At least 60% of ideal score for every success factor
Troubled Performer	Less than 75	At least 50% of ideal score for every success factor

Table 3.20: Scale of Evaluation for PMAS

Based on the above scale of evaluation, the PHAs were categorized in to High Performers, Standard Performers and Troubled Performers. The distribution of participating PHAs in to these three categories is presented in table 3.21.

PHA Status Designation	Percentage of PHAs
High Performer	13%
Standard Performer	47%
Troubled Performer	40%

Table 3.21: Performance of PHAs on PMAS

In the following paragraphs, the results of data analysis for each critical success factor are discussed and recommendations for improving the Project Management performance in the respective areas are provided. The strengths and weaknesses of PHAs specific to each critical success factor are also identified based on the survey responses.

Appropriate Feasibility Study

Based on the AHP technique used for calculating the relative weights for all the critical success factors, this success factor had the highest relative weight of 0.22 and hence, the most important critical success factor for effective Project Management. The average score of all participating PHAs for this critical success factor was 22.20 while the maximum possible weighted score is 25. This implies that the PHAs did reasonably well in this category. Low degree of disagreement among project participants, well-defined project scope and active participation of Management staff at all levels were the strengths identified in this category. It was found that the PHAs didn't devote enough time for feasibility study, which may or may not have a significant impact on the project's performance. Appropriate requirement analysis with the involvement of all project stakeholders should be done. Equal emphasis should be given on all aspects of analysis viz. market and demand analysis, technical analysis, financial analysis, economic analysis, and impact assessment. Risk analysis of investment for the project should also be done.

Adequate Project Plans

This critical success factor had a relative weight of 0.18. The average score of PHAs for this success factor was 16.6 while the maximum possible score (ideal score) is 20. The performance of PHAs in this category was average. Lack of a comprehensive formal estimate and a detailed schedule with critical path identified, were the key weaknesses identified in this category. The entire project schedule should be divided in to a number of sub-projects and critical activities for each sub-project should be identified to ensure on-time completion of the project. A comprehensive formal estimate should be prepared with the help of a cost-estimating software (if possible) and project cost historical database.

Appropriate Design & Detailed Engineering

This critical success factor carried a low relative weight of 0.07. Since the designs and drawings of public housing units are standardized and simple, the author assumed that this factor would not make a significant impact on project's success in comparison with other success factors. The average scores of PHAs for this success factor was 3.57 while the maximum possible score (ideal score) is 5. The performance of PHAs in this category was below average. The number of revisions in specifications was low (as expected) because the public housing units are developed in accordance with the specifications provided in the development handbook by HUD. Surprisingly, the number of scope changes during the construction phase, was not as low as one would expect them to be. It was found that most PHAs outsourced the design and drawing work to private architects and engineers. The PHAs should strengthen their consultant selection process and closely monitor their work to reduce the number of changes during construction, in design, drawings, specifications and scope of the project.

Availability of Work Front

The relative weight for this critical success factor was again 0.07. As the sub-factors affecting this sub-factor (like completion of land survey before construction, completion of soil testing before construction, etc.) may not be applicable for all projects, the author assumed assigned lower scores on the scale of relative importance used for comparison with other success factors. The average score of PHAs for this success factor was 3.35 while the maximum possible score is 5. It was found that the PHAs were proactive in receiving statutory approvals before the actual construction work is started, thus avoiding significant delays.

Effective Material Procurement

This critical success factor had a relative weight of 0.12. The average score of PHAs for this success factor was 8.73 while the maximum possible score (ideal score) is 10. The PHAs did quite well in this category. Rare occurrence of material shortage and material quality problems and good surplus disposal method were some of the strengths identified in this category. The PHAs can reduce the total cost of a project considerably by implementing smart sourcing strategies like partnering with neighboring PHAs to purchase materials in bulk at discounted prices. Purchasing material from the same supplier for most of the projects would assist in developing a healthy relationship with the supplier, which in turn would ensure delivery of good quality material without any significant delays.

Good Contract Management

This critical success factor carried a relative weight of 0.10. The low value is mainly due to the fact that most of the contract management procedures are standardized by HUD and so the author assigned low scores on the scale of relative importance used for comparison. The average score of PHAs for this success factor was 9.02 while the maximum weighted score (ideal score) is 10. Low number of change orders, good contractor selection policy, and low degree of disagreement among project stakeholders during construction, were the strengths identified in this category. It was found that all most all PHAs outsource the entire construction work for all projects to a General Contractor and so it is very important for PHAs to build a long-term relationship with contractor

Appropriate Monitoring & Control

The relative weight for this critical success factor was calculated as 0.20. This success factor has a high relative weight because the author believes that once the construction is started, a project's success is highly dependent on the level of monitoring & control implemented by PHA. The average score of PHAs for this success factor was 14.63 while the maximum weighted score (ideal score) is 20. This clearly indicates that the PHAs did not do well in this category. It was found that quite a few PHAs did not make use of earned value analysis to measure the progress of a project, calculate budget and schedule variances develop strategies to complete the project on time and within budget. The use of Information Systems and Project Management software would assist in tracking project information effectively and providing the right information to the right person at the right time. Thus, budget and schedule variances will be minimized.

Effective Close-out

This critical success factor carried a relative weight of 0.04. It is the least significant success factor (relative to other success factors) because almost ninety percent of the project activities are complete at this stage and so it would have little impact on project's budget and schedule. The average score of PHAs for this success factor was 4.34while the maximum weighted score is 5. High percentage of projects with successful contract close-out, preparation of completion reports for most of the projects and low commissioning problems were the strong points identified in this category. Well-documented project data of projects with successful contract close-out can be used for effective decision-making for all future projects.

Summary

A brief description of all critical success factors, discussion of data collection tools and techniques, description of the components of Project Management Assessment System and data analysis, were presented in this chapter. The application of AHP to calculate the relative weights for sub-factors and critical success factors was explained with the help of an example. The results of data analysis were discussed and the strengths & weaknesses of PHAs in

Project Management were identified. Recommendations for improving PHAs performance in different areas of Project Management were also made in the last section. In the next chapter, a summary of this research study will be provided along with the conclusions. Future areas of research will also be stated in the next chapter.

IV. Summary and Conclusions

Overall Summary

Successful Project Management (PM) is becoming increasingly important for any organization to remain competitive in today's dynamic world. Organizations in all industries are striving to raise their PM maturity by adopting PM tools and continuously improving their PM practices and processes. This study was conducted to find out if PHAs were on par with other private organizations in different industries, in the area of Project Management.

The goal of this research was to examine the performance of PHAs in the area of Project Management. This goal was achieved with the help of three objectives. The first objective was to collect information related to PM practices and process of PHAs. A thorough literature review was conducted to identify critical success factors for Project Management and also, the sub-factors affecting these success factors. A questionnaire based on these critical success factors and their sub-factors was developed and mailed to executive directors of PHAs.

The second objective was to develop a Project Management Assessment System based on the key performance indicators identified in objective I. A number of quantitative and analytical models were studied, and the AHP model was selected for assessment because of the flexibility it provides by incorporating the objective as well as subjective factors. The Project Management Assessment System was based on a hierarchical structure, with the critical success factors at the upper level of hierarchy and the sub-factors at the lower level of hierarchy.

The third and final objective was to use the Project Management Assessment System (PMAS) to analyze the performance of PHAs participating in the survey and suggest improvement measures. The overall score on the PMAS was calculated for each participating PHA. The performance of PHAs in different aspects of Project Management was analyzed to identify their strengths and weaknesses in those areas. Recommendations for improving the performance of PHAs were also made.

Value of Project Management Assessment System for HUD

On an average, HUD disburses about 3.3 billion dollars annually through their HOPE VI and Capital Fund programs, to facilitate the construction of new housing units and to fund the major rehabilitation or remodernization projects of PHAs. To ensure that this huge amount of money is used effectively by PHAs, HUD should measure the performance of PHAs on these projects. HUD can use the Project Management Assessment System to evaluate the performance of PHAs in the area of Project Management. This kind of an evaluation by HUD will encourage the PHAs to follow best Project Management practices to improve their overall score on PMAS. Consequently, the percentage of successful projects i.e. on time completion and within budget would increase considerably.

Some of the ways in which PMAS can prove useful for HUD, are stated as follows:

1) PMAS can be used to compare the Project Management performance of two or more PHAs.
2) Common weaknesses of PHAs in different areas of Project Management can be identified. HUD can provide technical support in these areas (if possible) and assist PHAs in improving their overall score on PMAS.
3) HUD can use the overall scores of competing PHAs on PMAS, while making a decision regarding allocation of funds from competitive grants.
4) PM practices followed by PHAs with a high overall score on PMAS can be suggested to PHAs with low scores on PMAS.

Lessons Learned and Guidance for Future Research

As stated earlier, the biggest limitation of this research is that the relative weights assigned to the critical success factors and its sub-factors are based on researcher's knowledge and expertise in Construction Project Management. Pair-wise comparison of critical success factors and sub-factors is a critical element of this research because the maximum score for the success factors and its sub-factors are dependent on their relative weights. Also, the results of this study are based entirely on the responses received from the survey participants. Therefore, it is very important to establish guidelines for answering every question in the survey. This will help the respondent to select the best possible answer and would represent the current Project Management practices and processes of PHAs very closely. Moreover, the critical success factors and its sub-factors are identified through literature review only.

The Project Management Assessment System developed in this study will serve as a preliminary framework for building a model specifically customized to assess the Project Management practices of PHAs. The critical success factors and its sub-factors for this model could be identified by interviewing Construction Manager or Head of Construction / Modernization Department of PHAs. Past project reports could also be used to identify the critical success factors and sub-factors for this model. A list of success factors and sub-factors for small PHAs could be identified separately. This model will closely depict the problems faced by PHAs in Project Management. A focus group, comprising of a good mix of executive directors and construction managers of PHAs, could be formed to assign relative weights to the critical success factors and its sub-factors. A list of assumptions made while assigning relative weights could also be provided. This focus group could also develop specific guidelines for answering every question in the survey.

Areas of Future Research

The Public Housing industry is far behind other industries in all aspects. This can be accounted to a large number of approvals at every stage, slow movement of funds, lack of use of advanced technology, a large number of participants in public housing projects, etc. There is tremendous scope for research in the field of public housing. Some of the areas of research can be suggested as follows:

- Relative weights of critical success factors and sub-factors identified in this study.

- Financial benefits of Project Management for Public Housing Authorities – Return on Investment for Project Management
- Impact of use of technologies on the project performance of public housing projects.
- Decision support model for selection of public housing projects – Factors to be considered, influence of these factors on project selection.
- Partnership in Procurement for public housing projects – Its impact on budget and schedule of projects.

Conclusions

The results of data analysis clearly indicate that there is scope for improvement for Public Housing Authorities in the area of Project Management (PM) – specifically in Design & Detailed Engineering and Monitoring & Controlling phases of a construction project. The use of best PM practices will ensure that the limited resources are used most efficiently. Also, HUD can provide technical assistance in specific PM areas (identified through this assessment) in which PHAs lack expertise. A Project Management Approach followed by PHAs will attract investors from the private market towards the Public Housing Industry, promoting the development of Public-Private ventures. These investors can be viewed as a potential source of funding by PHAs, reducing their reliability on HUD for capital requirements.

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Appendix A
Questionnaire Sent to PHAs

ASSESSING PROJECT MANAGEMENT PRACTICES OF PUBLIC HOUSING AUTHORITIES

QUESTIONNAIRE

I) <u>GENERAL:</u>

1. The average annual budget of your organization (over the last three years) is $ ____________

2. What is the staff strength of your organization? ________________

3. Do you think project management is important for your organization?

   If yes, please explain why is it important?

   ____

   ____

   ____

4. Do you have a separate project management team in your organization? YES/NO ______________

5. How many Full-time employees do you have in your project management team? ______________

6. How many part-time employees do you have in your project management team? ______________

7. Is there a well-defined project planning process in your organization? If yes, please describe it briefly.

   ____

   ____

8. Who are the major participants involved in the planning process? Please specify their positions.

   ____

9. Do you use any project management software? If yes, which one do you use? Please specify.

II) PROJECT MANAGEMENT:

(Instructions: Select the best possible answer. Please answer all the questions to the best of your knowledge. The number in brackets indicates the points awarded for the option.)

1. What is the average amount of time devoted for entire feasibility study for any project?

a. 1 year or more (5)
b. 6 months to 1 year (4)
c. Less than 6 months (3)

2. What is the degree of disagreement among the project participants i.e. HUD, Architect/Engineer and PHA staff members, in the feasibility phase of the project?

a. High (1)
b. Medium (1.5)
c. Low (2)

3. What is the average time gap between proposal put-up and HUD's approval?

a. 3 months or more (3)
b. 1-3 months (4)
c. 1 month or less (5)

4. How well is the project scope defined?

(Note: Project Scope involves establishing broad project characteristics such as location, performance criteria, size, configuration, layout, equipment, services, and other owner requirements needed to establish the general aspects of the project)

a. Comprehensively and continuously defined (8)
b. Incomplete definition (4)

5. How would you describe the Management Involvement of your organization in the project feasibility phase?

a. Management at all levels is "in the loop" and focused on project success. (5)
b. Only high-level Management personnel are involved. (4)
c. Other (describe):

6. **What procedure is followed to develop the project schedule?**
   a. A project Work Breakdown Structure is developed but no critical path calculation is done. Each sub-project identifies critical tasks independently and sets work priorities. (2)
   b. Critical path based on committed milestone dates. No CPM calculation is performed, or CPM is used on individual sub-projects. (2.5)
   c. Key critical tasks are identified through non-quantifiable means, and used to drive the critical path calculation. (3)
   d. Critical path is calculated through integrated schedule, but only key milestone dates are communicated back to contractors and sub-contractors. (3.5)
   e. All critical tasks are identified and indicated in each individual sub-project schedule. Critical path is determined through integrated schedule. (4)
   f. Other (describe):

7. **What procedure is followed to develop the Total Project Cost Estimate?**
   a. An informal estimate is prepared based on the actual costs of similar projects in the past. (2.5)
   b. A conceptual estimate is prepared from the Means book or a similar standard reference. (3)
   c. A comprehensive line-item estimate is prepared based on the drawings and project specifications by referring to Means Book. (3.5)
   d. A comprehensive formal estimate is prepared with the help of a cost estimating software and project cost historical database. (4)
   e. Other (describe):

8. **How would you describe the Quality Assurance level in your organization?**
   a. Less than 50% of Quality Specifications for work items in the contract are met. (1.5)
   b. 50-70% of Quality Specifications for work items in the contract are met. (2)
   c. 70-90% of Quality Specifications for work items in the contract are met. (2.5)
   d. More than 90% of Quality Specifications for work items in the contract are met. (3)

9. **Describe the process for developing organizational plan for your projects.**

(Note: An Organizational Plan is developed to establish a platform of organization within the company, so that the latter may accomplish its mission, its strategy and its objectives. This plan should define the functions and the communication and control lines associated with the plan of action and operation of the company.)

   a. No organizational plan is developed. (1.5)
   b. A verbal Organizational plan is discussed. (2)
   c. An informal generic Organizational plan is developed. (2.5)
   d. A formal Organizational plan is specifically developed for each project. (3)

10. How will you rate your Communications plan for projects?

(Note: A Communication plan provides for disseminating information on project goals, progress, and outcomes that can generate enthusiasm and buy-in from stakeholders.)

a. Unsatisfactory (0.5)
b. Below Average (1)
c. Average (1.5)
d. Above Average (1.75)
e. Excellent (2)

11. Describe the procurement planning process in your organization.

(Note: Procurement refers to the ordering, expediting, and delivering of key project equipment and materials, especially those that may involve long delivery periods.)

a. No formal procurement planning is done. (0.5)
b. A procurement plan is developed based on the milestone dates in the project schedule. (1)
c. A procurement plan is developed based on the critical activities in the project schedule. (1.5)
d. A formal procurement plan is developed based on the resource requirements for every activity in the schedule. (2)

12. Describe the risk planning process for every project.

a. No risk assessment whatsoever is done. (1)
b. The potential risks are identified through an informal risk assessment. (1.5)
c. The potential risks are identified through a formal risk assessment and contingency plans are developed to safeguard against these risks. (2)

13. What is the average number of changes in design per project?

a. No change (0.5)
b. Fewer than 5 changes (0.4)
c. More than 5 changes (0.25)

14. What is the average number of revisions in drawings per project?

a. Fewer than 10 changes (0.5)
b. More than 10 changes (0.25)

15. What is the average number of revisions in specifications per project?

a. No change (1)
b. Fewer than 3 (0.75)
c. More than 3 (0.5)

16. What is the average number of scope changes per project?

Never (3)
Sometimes (2)
Frequent changes (1)

17. For how many projects, a complete land survey is done before construction is started?

a. Less than 50% (0.5)
b. 50-60% (1)
c. 60-80% (1.5)
d. 80-100% (2)

18. Do you do soil testing? If yes, for how many projects, a complete soil testing is done before construction is started?

a. Less than 50% (0.5)
b. 50-60% (1)
c. 60-80% (1.5)
d. 80-100% (2)

19. To what extent is the process of receiving all statutory approvals completed before construction is started?

a. Less than 50% (0.25)
b. 50-70% (0.5)
c. 70-90% (0.75)
d. 90-100% (1)

20. Considering last three projects, what is the average number of times suppliers failed to deliver materials on time?

a. Never or less than 10% (2)
b. 10-20% (1.5)
c. 21-50% (1)
d. More than 50% (0.5)

21. What is the average number of times materials shortages occurred?

a. 0-5% (3)
b. 6-25% (2.5)
c. 26-50% (2)
d. Over 50% (1.5)

22. What is the average number of times materials quality problems occurred?

a. 0-5% (1)
b. 6-25% (0.75)
c. 26-50% (0.5)
d. Over 50% (0.25)

23. What is the average material inventory size?

a. High (1)
b. Medium (2)
c. Low (3)

24. Do you have an adequate surplus disposal method?

a. Absent (0.5)
b. Fuzzy (0.75)
c. Good (1)

25. What is the average number of agreed variations/ change orders in a general contract per project?

a. 0-10 (1)
b. 10-20 (0.75)
c. 20 or more (0.5)

26. How would you rate your Contractor selection policy in terms of timely completion, within budget and quality of work?

a. Good (5)
b. Average (4)
c. Unsatisfactory (3)

27. What is the average number of negotiation meetings held between PHA and General Contractor during the construction phase?

a. 5 or fewer (0.5)
b. 5-10 (0.75)
c. 10 or more (1)

28. What is the degree of disagreement among project stakeholders, leading to delays, during the pre-construction and construction phase of the project?

a. High (1)
b. Medium (2)
c. Low (3)

29. How will you describe your organization's performance with regard to managing projects through base-line plans?

a. Unsatisfactory (2)
b. Below Average (3)
c. Average (4)
d. Above Average (6)
e. Excellent (8)

30. How would you describe your organization's performance with regard to monitoring and controlling projects through earned value analysis?

(Note: Earned Value Analysis is an industry standard way to measure a project's progress, forecast its completion date and final cost, and provide schedule and budget variances along the way.)

a. Unsatisfactory (2)
b. Below Average (4)
c. Average (5)
d. Above Average (7)
e. Excellent (9)

31. How would you describe the effectiveness of the decisions made in the project monitoring and control phase to fulfill the goal of completing the projects successfully?

(For e.g. Delivery of material for a critical activity got delayed. What steps/decisions did you take to bring the project back on track? Were these decisions effective in completing the project on time and within budget?)

a. Unsatisfactory (1)
b. Below Average (1.5)
c. Average (2)
d. Above Average (2.5)
e. Excellent (3)

32. What percentage of projects had a successful contract close-out ?

a. 0-25% (0.5)
b. 25-50% (0.75)
c. 50-75% (1)
d. 75-100% (1.5)

33. On what percentage of projects did you prepare as-built drawings?

a. 0-25% (0.5)
b. 25-50% (o.75)
c. 50-75% (1)
d. 75-100% (1.5)

34. On what percentage of projects did you prepare completion reports?

a. 0-25% (0.5)
b. 25-50% (0.75)
c. 50-75% (1)
d. 75-100% (1.5)

35. To what extent, do you face commissioning problems?

(Note: Commissioning problems are the problems faced by the occupants just after they move in to the newly constructed/rehabilitated facility.)

a. High (0.25)
b. Medium (0.4)
c. Low (0.5)

The survey ends here. Thank you once again for your time and co-operation. Please highlight your responses and send it as an attachment along with the consent letter to my email address gandhiji@msu.edu or jimi.gandhi@msu.edu.

APPENDIX B
Relative Weight Computations

Matrix of Comparison for Critical Success Factors

	Appropriate Feasibility Study	Adequate Project Plans	Appropriate Design & Detailed Engineering	Availability of Work Front	Effective Material Procurement	Good Contract Management	Appropriate Monitoring & Control	Effective Close-out
Appropriate Feasibility Study	1	2	3	3	2	2	1	5
Adequate Project Plans	0.50	1	3	2	2	3	1	3
Appropriate Design & Detailed Engineering	0.333	0.333	1	1	0.5	1	0.333	3
Availability of Work Front	0.333	0.5	1	1	0.333	0.5	0.333	3
Effective Material Procurement	0.5	0.5	2	3	1	1	0.5	3
Good Contract Management	0.5	0.333	1	2	1	1	0.5	4
Appropriate Monitoring & Control	1	1	3	3	2	2	1	5
Effective Close-out	0.2	0.333	0.333	0.333	0.333	0.25	0.2	1
SUM	4.366	6	14.333	15.333	9.166	10.75	4.866	27

Relative Weights for Critical Success Factors

	Appropriate Feasibility Study	Adequate Project Plans	Appropriate Design & Detailed Engineering	Availability of Work Front	Effective Material Procurement	Good Contract Management	Appropriate Monitoring & Control	Effective Close-out	Relative weights
Appropriate Feasibility Study	0.229	0.333	0.209	0.196	0.218	0.186	0.206	0.185	**0.22**
Adequate Project Plans	0.115	0.167	0.209	0.130	0.218	0.279	0.206	0.111	**0.18**
Appropriate Design & Detailed Engineering	0.076	0.056	0.070	0.065	0.055	0.093	0.068	0.111	**0.07**
Availability of Work Front	0.076	0.083	0.070	0.065	0.036	0.047	0.068	0.111	**0.07**
Effective Material Procurement	0.115	0.083	0.140	0.196	0.109	0.093	0.103	0.111	**0.12**
Good Contract Management	0.115	0.056	0.070	0.130	0.109	0.093	0.103	0.148	**0.10**
Appropriate Monitoring & Control	0.229	0.167	0.209	0.196	0.218	0.186	0.206	0.185	**0.20**
Effective Close-out	0.046	0.056	0.023	0.022	0.036	0.023	0.041	0.037	**0.04**

Matrix of Comparison Appropriate Feasibility Study

	Time taken for entire feasibility study	Degree of Disagreement among project participants	Time gap between proposal put-up & HUD's approval	Project Scope Definition	Management Involvement
Time taken for entire feasibility study	1	2	3	0.333	0.5
Degree of Disagreement among project participants	0.5	1	0.5	0.333	0.5
Time gap between proposal put-up & HUD's approval	0.333	2	1	1	2
Project Scope Definition	3	3	1	1	3
Management Involvement	2	2	0.5	0.333	1
SUM	6.833	10	6	3	7

Relative Weights for Appropriate Feasibility Study

	Time taken for entire feasibility study	Degree of Disagreement among project participants	Time gap between proposal put-up & HUD's approval	Project Scope Definition	Management Involvement	Relative Weights
Time taken for entire feasibility study	0.146	0.200	0.500	0.111	0.071	**0.21**
Degree of Disagreement among project participants	0.073	0.100	0.083	0.111	0.071	**0.09**
Time gap between proposal put-up & HUD's approval	0.049	0.200	0.167	0.333	0.286	**0.21**
Project Scope Definition	0.439	0.300	0.167	0.333	0.429	**0.33**
Management Involvement	0.293	0.200	0.083	0.111	0.143	**0.17**

Matrix of Comparison for Adequate Project Plans

	Schedule	Budget	Quality Assurance	Organizational Plan	Communications Plan	Procurement Planning	Risk Plan
Schedule	1	1	2	2	2	2	2
Budget	1	1	2	2	2	3	2
Quality Assurance	0.5	0.5	1	2	2	0.5	2
Organizational Plan	0.5	0.5	0.5	1	2	2	2
Communications Plan	0.5	0.5	0.5	0.5	1	1	0.5
Procurement Planning	0.5	0.333	2	0.5	1	1	2
Risk Plan	0.5	0.5	0.5	0.5	2	0.5	1
SUM	4.5	4.333	8.5	8.5	12	10	11.5

Relative Weight for Adequate Project Plans

	Schedule	Budget	Quality Assurance	Organizational Plan	Communications Plan	Procurement Planning	Risk Plan	Relative Weights
Schedule	0.222	0.231	0.235	0.235	0.167	0.200	0.174	**0.21**
Budget	0.222	0.231	0.235	0.235	0.167	0.300	0.174	**0.22**
Quality Assurance	0.111	0.115	0.118	0.235	0.167	0.050	0.174	**0.14**
Organizational Plan	0.111	0.115	0.059	0.118	0.167	0.200	0.174	**0.13**
Communications Plan	0.111	0.115	0.059	0.059	0.083	0.100	0.043	**0.08**
Procurement Planning	0.111	0.077	0.235	0.059	0.083	0.100	0.174	**0.12**
Risk Plan	0.111	0.115	0.059	0.059	0.167	0.050	0.087	**0.09**

Matrix of Comparison for Appropriate Design and Detailed Engineering

	No.of changes in design	No.of revisions in drawings	No. of revisions in specifications	No. of Scope Changes
No.of changes in design	1	1	1	0.2
No.of revisions in drawings	1	1	0.5	0.2
No. of revisions in specifications	1	2	1	0.2
No. of Scope Changes	5	5	5	1
SUM	8	9	7.5	1.6

Relative Weights for Appropriate Design and Detailed Engineering

	No.of changes in design	No.of revisions in drawings	No. of revisions in specifications	No. of Scope Changes	Relative Weights
No.of changes in design	0.125	0.111	0.133	0.125	**0.12**
No.of revisions in drawings	0.125	0.111	0.067	0.125	**0.11**
No. of revisions in specifications	0.125	0.222	0.133	0.125	**0.15**
No. of Scope Changes	0.625	0.556	0.667	0.625	**0.62**

Matrix Comparison for Availability of Work Front

	Completion of Survey before Construction	Completion of soil testing before construction	Receiving Statutory Approvals before Construction
Completion of Survey before Construction	1	1	3
Completion of soil testing before construction	1	1	3
Receiving Statutory Approvals before Construction	0.333	0.333	1
SUM	2.333	2.333	7

Relative Weights for Availability of Work Front

	Completion of Survey before Construction	Completion of soil testing before construction	Receiving Statutory Approvals before Construction	Relative Weights
Completion of Survey before Construction	0.429	0.429	0.429	**0.43**
Completion of soil testing before construction	0.429	0.429	0.429	**0.43**
Receiving Statutory Approvals before Construction	0.143	0.143	0.143	**0.14**

Matrix Comparison for Effective Material Procurement

	No. of times supplier failed to deliver materials on time	No. of times material shortage occurred	No. of times material quality problems occurred	Average Inventory Size	Adequate Surplus Disposal Method
No. of times supplier failed to deliver materials on time	1	0.5	2	0.5	2
No. of times material shortage occurred	2	1	2	1	2
No. of times material quality problems occurred	0.5	0.5	1	0.5	2
Average Inventory Size	2	1	2	1	2
Adequate Surplus Disposal Method	0.5	0.5	0.5	0.5	1
SUM	6	3.5	7.5	3.5	9

Relative Weights for Effective Material Procurement

	No. of times supplier failed to deliver materials on time	No. of times material shortage occurred	No. of times material quality problems occurred	Average Inventory Size	Adequate Surplus Disposal Method	Relative Weights
No. of times supplier failed to deliver materials on time	0.167	0.143	0.267	0.143	0.222	**0.19**
No. of times material shortage occurred	0.333	0.286	0.267	0.286	0.222	**0.28**
No. of times material quality problems occurred	0.083	0.143	0.133	0.143	0.222	**0.14**
Average Inventory Size	0.333	0.286	0.267	0.286	0.222	**0.28**
Adequate Surplus Disposal Method	0.083	0.143	0.067	0.143	0.111	**0.11**

Matrix for Comparison for Good Contract Management

	No. of agreed variations	General Contractor Selection Policy	No. of negotiation meetings with General contractor	Degree of disagreement among project stakeholders
No. of agreed variations	1	0.333	1	0.5
General Contractor Selection Policy	3	1	3	2
No. of negotiation meetings with General contractor	1	0.333	1	0.5
Degree of disagreement among project stakeholders	2	0.5	2	1
SUM	7	2.166	7	4

Relative Weights for Good Contract Management

	No. of agreed variations	General Contractor Selection Policy	No. of negotiation meetings with General contractor	Degree of disagreement among project stakeholders	Relative Weights
No. of agreed variations	0.143	0.154	0.143	0.125	**0.14**
General Contractor Selection Policy	0.429	0.462	0.429	0.500	**0.45**
No. of negotiation meetings with General contractor	0.143	0.154	0.143	0.125	**0.14**
Degree of disagreement among project stakeholders	0.286	0.231	0.286	0.250	**0.26**

Matrix of Comparison for Appropriate Monitoring & Control

	Managing Project through base-line plans	Monitoring & Controlling project through earned value analysis	Effectiveness of decisions
Managing Project through base-line plans	1	1	3
Monitoring & Controlling project through earned value analysis	1	1	3
Effectiveness of decisions	0.333	0.333	1

Relative Weights for Appropriate Monitoring & Control

	Managing Project through base-line plans	Monitoring & Controlling project through earned value analysis	Effectiveness of decisions
Managing Project through base-line plans	0.429	0.429	0.429
Monitoring & Controlling project through earned value analysis	0.429	0.429	0.429
Effectiveness of decisions	0.143	0.143	0.143

Matrix of Comparison for Effective Close-out

	Contract close-out	Preparing as built drawings	Preparing completion report	Commissioning Problems
Contract close-out	1	1	1	2
Preparing as built drawings	1	1	1	2
Preparing completion report	1	1	1	2
Commissioning Problems	0.5	0.5	0.5	1
SUM	3.5	3.5	3.5	7

Relative Weight for Effective Close-out

	Contract close-out	Preparing as built drawings	Preparing completion report	Commissioning Problems	Relative Weights
Contract close-out	0.286	0.286	0.286	0.286	**0.29**
Preparing as built drawings	0.286	0.286	0.286	0.286	**0.29**
Preparing completion report	0.286	0.286	0.286	0.286	**0.29**
Commissioning Problems	0.143	0.143	0.143	0.143	**0.14**

Appendix C
Overall Score Computations

PHA1			
Qest. No.	Rel. Wt.	Max. Score	Score
1	0.21	5	3
2	0.09	2	2
3	0.21	5	3
4	0.33	8	8
5	0.17	5	5
Appropriate Feasibility Study (25)			**21**
6	0.21	4	2
7	0.22	4	3
8	0.14	3	3
9	0.13	3	2.5
10	0.08	2	1.75
11	0.12	2	1
12	0.09	2	1.5
Adequate Project Plans (20)			**14.75**
13	0.12	0.5	0.4
14	0.11	0.5	0.5
15	0.15	1	0.75
16	0.62	3	2
Appropriate Design & Detailed Engg. (5)			**3.65**
17	0.43	2	2
18	0.43	2	0.5
19	0.14	1	1
Availability of Work Front (5)			**3.5**
20	0.19	2	2
21	0.28	3	3
22	0.14	1	1
23	0.28	3	3
24	0.11	1	1
Effective Material Procurement (10)			**10**
25	0.14	1	1
26	0.45	5	5
27	0.14	1	0.5
28	0.26	3	3
Good Contract Management (10)			**9.5**
29	0.43	8	6
30	0.43	9	7
31	0.14	3	2.5
Appropriate Monitoring & Control (20)			**15.5**
32	0.29	1.5	1.5
33	0.29	1.5	1.5
34	0.29	1.5	1.5
35	0.14	0.5	0.5
Effective Close-out (5)			**5**
Overall Score		**100**	**82.9**

Appendix D
Frequency of Responses to Survey Questions

Time taken for entire feasibility study	
Option	Percentage of PHAs
1 year or more	27
6 months to 1 year	13
less than 6 months	60

Degree of disagreement among project participants	
Option	Percentage of PHAs
High	0
Medium	27
Low	73

Time gap between proposal put up & HUD's approval	
Option	Percentage of PHAs
3 months or more	33
1-3 months	47
1 month or less	20

Project Scope	
Option	Percentage of PHAs
Comprehensively and continuously defined	100
Incomplete definition	0

Management Involvement	
Option	Percentage of PHAs
Management at all levels is "in the loop" and focused on project success	87
Only high-level Management personnel are involved	6.5
Other	6.5

Project Schedule	
Option	Percentage of PHAs
A project work breakdown structure is developed but no critical path calculation is done.	20
Critical path based on committed milestone dates	27
Key critical tasks are identified through non-quantifiable means, and used to drive the critical path calculation	13
Critical path is calculated through integrated schedule, but only key milestone dates are communicated back to contractors and sub-contractors	0
All critical tasks are identified and indicated in each individual sub-project schedule. Critical path is determined through integrated schedule	40

Project Cost Estimate	
Option	Percentage of PHAs
An informal estimate is prepared based on the actual costs of similar projects in the past.	27
A conceptual estimate is prepared from the Means book or a similar standard reference.	33
A comprehensive line-item estimate is prepared based on the drawings and project specifications by referring to Means Book	27
A comprehensive formal estimate is prepared with the help of a cost estimating software and project cost historical database.	13
Other	0

Quality Assurance Level	
Option	Percentage of PHAs
Less than 50% of Quality Specifications for work items in the contract are met	0
50-70% of Quality Specifications for work items in the contract are met	7
70-90% of Quality Specifications for work items in the contract are met	27
More than 90% of Quality Specifications are met	66

Organizational Plan	
Option	Percentage of PHAs
No organizational plan is developed	0
A verbal Organizational plan is discussed	13
An informal generic Organizational plan is developed	33
A formal Organizational plan is specifically developed for each project	54

Communications Plan	
Option	Percentage of PHAs
Unsatisfactory	0
Below average	7
Average	20
Above Average	40
Excellent	33

Procurement Planning	
Option	Percentage of PHAs
No formal procurement planning is done	13
A procurement plan is developed based on the milestone dates in the project schedule	20
A procurement plan is developed based on the critical activities in the project schedule	20
A formal procurement plan is developed based in the resource requirements for every activity in the schedule	47

Risk Planning	
Option	Percentage of PHAs
No risk assessment whatsoever is done	7
The potential risks are identified through an informal risk assessment	53
The potential risks are identified through a formal risk assessment and contingency plans are developed to safeguard against these risks	40

Appendix E
List of Survey Respondents

Sr. No.	State	Public Housing Authority
1	New York	Troy Housing Authority
2	Rhode Island	Providence Housing Authority
3	Nevada	Las Vegas
4	Missouri	Kansas City
5	Georgia	Columbus
6	New Jersey	Jersey City Housing Authority
7	Pennsylvania	Fayette County Housing Authority
8	California	Los Angeles City
9	Michigan	Detroit Housing Commission
10	Kentucky	Louisville Metro Housing Authority
11	Florida	Jacksonville
12	Louisiana	New Orleans HA
13	Illinois	Chicago Housing Authority
14	Wisconsin	Milwaukee Housing Authority
15	Pennsylvania	Johnstown Housing Authority