Evaluation of Self-Managed Vis a Vis Professionally Managed Construction Projects

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Thesis of

Master of Science

in

Construction Engineering and Management

Department of Construction Engineering & Management

National Institute of Transportation

School of Civil & Environmental Engineering

National University of Sciences & Technology

Islamabad, Pakistan

(2019)

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Evaluation of Self-Managed Vis a Vis Professionally Managed Construction Projects

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has been accepted towards the partial fulfillment

of the requirements for the degree of

Master of Science in Construction Engineering and Management

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This thesis is dedicated to my parents, respected teachers and batch fellows

Acknowledgement

In the name of Almighty Allah, the most Merciful the Beneficent. All praise is only for Allah who created us and always planned the best for us. I am grateful to the Almighty Allah for His countless blessings and mercy bestowed upon me through the difficulties of life and I seek His guidance and pray to Him for blessings and ease throughout this life and the life to come.

I feel privileged and honored to have this opportunity of being a part of this prestigious institute. I would pay my debt of deepest gratitude to my supervisor Dr. Khurram Iqbal Ahmad Khan (Head of Construction Engineering & Management Department), for addressing each problem with the clarity and professionalism. I am extremely thankful to my co-supervisor Dr. Mohamad Sohail Anwar Malik for his time, encouragement, guidance, motivation and support to accomplish my task on time. I am very grateful to my committee members, Dr. Mohammad Jamal Thaheem (NIT-SCEE) and Dr. Abdur Rehman Nasir (NIT, SCEE) for their sincere guidance in completing the research work.

I owe my special thanks to my batch mates of CEM-08 for their support and motivation throughout the research work. I also owe my special thanks to the respondents for their valuable contribution to this research task.

In the end, I pay gratitude to my family for their endless support, encouragement, prayers and patience.

ABSTRACT

Based on the limitations of traditional adoption of self-managed construction projects (SMCP); which is managing projects by unqualified/unprofessional individuals over professionally managed construction projects (PMCP); which is through hiring outside project management consultant or dedicated professional managers as employees in developing countries, this study uses analytical hierarchical process (AHP) for selection of best management practices for either of the two. Using extensive literature review with focus laid on construction sector for the impact of self-managed construction projects and their affecting factors are identified along with their four groups. An AHP-based decision support system has been developed using data collected through a detailed questionnaire survey to rate and prioritize their effect on cost, time and quality which further facilitated to develop the conceptual approach for adoption of PMCP. The findings reveal that for project success criteria time is affected the most with an overall weight of above 52% while category of performance with about 50% has the highest influencing effect on best management selection. However, factors that must be keenly observed for time are vested interest on timely competition (0.134) and for cost and quality are optimum resource utilization (0.084, 0.037) respectively. Since Super Decision software was used for analysis that shows the successful trend for adoption PMCP (73%) as a uniformed and validates better decision made for selection of best management practice. The construction industry will benefit from adoption of PMCP and a prolonged exposure may help improve and enhance its value system.

Keywords: **Self-Managed Construction Projects, Professionally Managed Construction Projects, Analytical Hierarchical Process, Decision Support System, Best Management Practices**

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LIST OF ABBREVIATIONS

Self-Managed Construction Projects	=	SMCP
Professionally Managed Construction Projects	=	PMCP
Architectural / Engineering	=	A/E
Construction Managers	=	CM
Professional Managers	=	PM
Decision Support System	=	DSS
Analytical Hierarchy Process	=	AHP
Self-Managed Teams	=	SMT
Reluctance in timely Decisions	=	RTD
Non-Competitive bidding phase (short bid time)	=	NCBP
Negligence in identifying Critical activities	=	NICA
Poor monitoring and Budget Feedbacks	=	PM&B
Expertise insufficiency	=	EI
Disagreements in A/E design	=	DA/ED
Lack of coordinating abilities with client/contractor	=	LCA
Severe conflicts among team members	=	SCTM
Lack of selecting key members at early stages of construction phase	=	LSKM
Accomplishment of project lacks user expectation & satisfaction	=	ALUES
Optimum Resource utilization	=	ORU
Vested interest on quality and timely completion of project	=	VTQTC
Inappropriate organizational structures & stability	=	IOSS
Pass by environmental impact assessments on site	=	PBEIA
Insufficient control over safety and health issues	=	ICSH
Size and value of Project being large	=	S&VL
Lack of Construction Control meetings	=	LCCT
Over sighting proper planning tools and techniques for risk management	=	OPTT
Lesser supervision over lower staff	=	LSOLS
Poor commitment level with other parties of project	=	PCL
Lack of transparency in financial issues	=	LTFI

Chapter 1

INTRODUCTION

1.1 Background

It is generally perceived that the construction market has changed radically in the most recent decades. While we positively should not overestimate these progressions thus called changes in transformations of management skills, such as the expansion of flexible work and part time (Doogan, 2009). We contend that the difficulties looked by local firms are profoundly established in governance characteristics (i.e. the incentives, authority and legitimacy) which permeate them with trademark abilities, handicaps and path dependencies (Nirenberg, 2003). The construction industry has experienced a significant change throughout the most recent 50 years, which has put an impressive weight on the management side because of its complex nature henceforth indulging a competent project manager is essential to extend achievement. (Zahra and Filatotchev, 2004) reason the essential issue confronting limited firms identifies with authoritative learning and knowledge management, we set asset procurement and usage to be similarly vital. The consequence of taking measures to upgrade the accomplishment of the construction industry at various levels of economic improvement has been perceived in numerous nations. While construction industry wherever faces issues and difficulties, the complexities and difficulties are most critical in developing nations because of the general circumstance of financial issues, absence of assets, authoritative shortcomings, and a powerlessness to manage basic circumstances (Ofori, 2000). It is greatly critical to comprehend the way of life of the construction firm which infers that as leading from the front you ought

to be sensitive to the organization's reactions on the things you say around and do (Schein, 1993). Most experts would likely agree that construction firms get their special energy from the effect of family on trade, whereas earlier study has contended that self-values and benchmarks significantly influence construction dealings (Dyer Jr, 2003, Fletcher and Perry, 2002). It has furthermore been centered on how the effect of family is transferred through the targets of the construction engineering, ordinarily a confusing mix of financial, social and enthusiastic points of view has been developed (Sharma, 2004).

Our motivation—to propose an expanded comprehension of professionally managed and self-managed construction projects—is directed by a wide-ranging study question: In what way would we be able to see professionally managed viz a viz self-managed in typical construction industry in a way that even more unequivocally perceives the exceptional qualities of these organizations, starting in the impact of the industry. Estimating the execution of any construction project as far as progress or disappointment however looks just, is in actuality an extremely complex process (De Wit, 1988). Present day construction projects amplifies indeed direct in estimate which are for the foremost portion multidisciplinary in nature and they incorporate concept of designers, contractors, subcontractors, specialists, construction supervisors, and consultants (Iyer and Jha, 2005). With the extending measure of the project, number of individuals within the task likewise builds, areas or destinations of all individuals which require not to be same indeed in each project, which characterizes the success or failure of a project without indicating the criteria for arbitrating the performance and the accomplishment holds no significance (Söderlund, 2004). Accomplishment for one member might be a disappointment for the other claimant relying upon the point of opinion through which everyone is viewing for the result (Iyer and Jha, 2005).

Researchers historically have recognized different sources or explanations (called "attributes") for Project success. There the whole thing is project explicit or and are aimed at the most part from various countries encountering researchers on completed construction projects. Additionally, these scholars have distinguished the basic traits that supervision of success of the construction projects and they advise that these characteristics should to be handled cautiously and if probably be further exploited to achieve better achievement in construction projects. On the other hand, the assignment of organization composing has studiously neglected the commitment of the Project Chief, and his or her expertise to the accomplishment of their objectives (Crawford et al., 2006). In the progression of recent years, there has been a changing knowledge of what comprises construction project success (Müller and Jugdev, 2012). In the late 1980s, scholars focused on the application of different tools and methods in construction industry (Morris, 1988). Moreover as of late, they have focused on risk managing and supremacy provision for the project received from the concerned association (Blomquist and Müller, 2006). Historically, examination into project management group has stressed on effectiveness rather than behavioral or interactive features (Munns and Bjeirmi, 1996).

1.2 Problem Statement:

New projects and investment goes for profitability and proficiency which results into a short term arrangement of issues (De Wit, 1988). The long term implication of such infrastructure projects require detailed examination, analysis and investigation with the reason for exchange off their expenses with enough benefits (Fletcher and Perry, 2002). Construction Industry is a rising industry around the world, with a considerable measure of creating need and potential accessible for the improvement (Morgeson et al., 2005).

Unfortunately, there is no such governing body or managing authority to direct where to develop. This leads to skill variety of properly managed construction projects vacuuming large need of a job. Certain areas need proper specified technical managers either in self-managed or professional managed projects to work with defined management skills which set up the right skillset for the job. It is therefore a dire need of the time to address the issue with identification of factors that lead to a significant management skill and to development of a conceptual approach for successful adoption of PMCP system that will educate and train. Most importantly, help in the development of the organization (firms) for the required tasks and to be competent around the globe.

1.3 Reasons / Justification for Selection of the Topic:

There is dearth of research that distinguishes self-management Vis a Vis professionally managed projects especially in construction field. Leadership has been criticized recently, the cause that they are not technically managed (self-managed) or has been applied incorrectly to autocratic and governmental situations. Failing of appreciation and understanding of professional management processes and integrating it with new leadership-making model, and then applying these concepts in construction industry. As a result, it’s contradictorily impacting the image of construction projects by lowering its quantified quality and compromising its quality, time and cost.

1.4 Objectives:

1) To identify and analyze factors affecting project objectives; i-e. Cost, Time & Quality, by adoption of SMCP.
2) To prioritize the influence of highlighted factors over Cost, Time and Quality using Multiple criteria decision making (MCDM) approach.
3) Development of a conceptual approach for adoption of PMCP.

1.5 Relevance to National Needs:

Project Management is based on divine principles and morals. Man-made laws may not be given preference over divine laws, only then stability can be achieved and shall give support to reduce problems associated with in construction industry. Development of effective, reliable and legal conceptual approach which would help the federal and provincial governments to pursue their constructional project within time, budget and standardized quality. Moreover, a forum may be established specially for contractors and clients to share and utilize their views and experiences carrying out projects through professional's; i-e. Consultants during distinct phases of construction (initiating, planning, execution and monitoring & controlling). Setup of forum or cell within industry comprising of expertise for handling project lifecycle, record, revise and update the policies.

1.6 Advantages:

Identification of organization's better management trend which will not only help to minimize resources (optimum utilization) but would make more effective decisions in construction projects. Recognize influential causes contributing to preference of SMCP over PMCP hence improving efficiency of projects by reducing cost and time overruns. Country's growth will be enhanced by inducting and making the construction industry more competent and complement to handle even complex projects.

1.7 Areas of Application:

This research will have broad area of application in both public and private construction industries. It will identify possible remedial factors and techniques that would be close to our local and subcontinental construction industries for all influential stakeholders. It will also provide a model with fresh orientation of professional management vis a vis Self-management. Through this research top management can adopt proactive measures to reduce mishaps during construction projects with optimum utilization of country's resources.

According to a report published in *Dawn, December 6th, 2017*, official resources revealed that in majority of CPEC projects, Chinese have created modern rules for endorsing financing the projects, which might appear to be in transitory challenges and projects specified (but for the mega project such as dam structure or heavy high-rise buildings which mostly is rejected), can be back on track within no time. Or this may well be the moment when CPEC is changing gears, entering a new period of its construction phase. The 'early harvest' construction control projects, and the undertaking is growing beyond the capacity of the government to viably oversee the complexity of projects.

1.8 Thesis Plan:

The thesis is separated into 5 parts as shown in Fig.1-1. The first part/chapter is about introduction followed by next chapter on detailed literature review, third discuss the adoption and development of methodology, fourth part have analyses on their results and discussion. Last but not the least we have concluded things around while suggesting possible recommendation for the future research.

Cahpter 1	**Introduction**
Chapter 2	**Literature Review**
Chapter 3	**Methodology and Design**
Chapter 4	**Results and analysis**
Chapter 5	**Conclusion and Recomendations**

Figure 1-1: Thesis Design

1.8.1 Chapter 1: Introduction

This part includes study background, problem statement, reasons / justification for selection of the topic, research objectives, relevance to national needs, advantages, areas of application and thesis outline.

1.8.2 Chapter 2: Literature Review

This portion of the research covers definitions of self-managed and professionally managed construction projects, identification of affecting factors by adoption of SMCP and their influence on project success criteria i-e cost, time and quality in construction industry.

1.8.3 Chapter 3: Methodology & Design

This section covers introduction to research design, procedures, tools and techniques used. It explains the methodology adopted for the research and steps projected for the adoption of AHP technique used. Initiating from the literature gathering to formulating a trend of adoption of SMCP in construction industry, it includes the study tools used, means of data collection hired, and the data scrutiny tools applied. Interviews and questionnaire are the foremost basis of data gathering.

1.8.4 Chapter 4: Results and Analysis

Further, on the analyzing the things around this section explains the results deduced from both questionnaire surveys. Primary half of the questionnaire consists of the organizational data. It gives indication about the kind, role and local/international experience of the organization or firm. Subsequent half comprises of the questions based on effects by adoption SMCP. Formerly survey is done, and results are attained. This part sums up with the achievement of research aims and objectives.

1.8.5 Chapter 5: Conclusions & Recommendations

Conclusion along with recommendations have been summarized in this portion. It concludes the research by stating and reviewing the deductions, findings, limitations and recommendations. The insight helps us understand the root of the study and parting ways for future endeavors related to this area of research.

Chapter 2

LITERATURE REVIEW

2.1 Introduction:

Dissecting leadership in groups, depicts leader as the leader towards the group in general (Blomquist and Müller, 2006, Stewart and Spencer, 2006). Based on an evaluation of dynamic literature we examine the principal view of self-managed viz a viz professionally managed construction projects, which we contend is excessively oversimplified and harsh, making it impossible to the sociocultural dynamics of typical construction developing firms.

2.2 Self-Managed Construction Projects (SMCP):

A self-organized, semi-autonomous little gathering whose people determine, plan, and cope with their regular exercises events and responsibilities beneath decreased or no administration, additionally called self-coordinated organization or self-guided characteristic group (Dekker, 2010). The inventive thought of self-administration has made a significant object starting late in the administration writing. A self-administration unit is that gathering or person who is having full flexibility in performing, checking and supervising its own work procedure and lead (Hackman, 1990). People watch the direct of others in given conditions and note the consequences of those practices, along these lines, they use this data to shape their own particular lead in comparative settings with wants of indistinguishable outcomes (Hsieh, 2009). They are socialized into a valuation for the qualities, limits, expected practices and social data fundamental for their new obligations, particularly in authoritative life (Louis, 1983). Theories portraying reasonable management for self-managing with regularly attention on plain

authority patterns: dictated and tutoring leadership (Stewart and Spencer, 2006, Day et al., 2004, Marks et al., 2001). Dictated leadership, similarly called task concerned with leadership or “initiating structure”, as one orthodox thought or individual situated initiative, a champion among the greatest administration views. While holding a formal position acting self-managed inside an organization unmistakably passes on some significance concerning initiative, this various leveled point of view does not clarify why a few bosses are not seen as pioneers (Blomquist and Müller, 2006) or on the other hand why a few people are pioneers in spite of not holding "leaderlike" positions (Corkin and Burke, 2006, Orth et al., 1990). Though, coaching leaders are just viable where supporters are more capable, experienced, pleasant and where execution or results require change, it likewise helps in propelling aptitudes and gives a great deal of direction (Kauffeld, 2006). There remains negligible precise research that takes assessing the association, expecting any, among these dualistic sorts of organization lead and specific self-overseeing part viability. A couple of creators, while investigating initiative in gatherings, depict administration as the direct of a pioneer towards the gathering when all is said in done (Bird and Brush, 2002, Marks et al., 2001, Stewart and Spencer, 2006).

2.2.1 SMCP need self-driven people:

Making a self-managed project requires assessing if the colleagues themselves can act self-managed and self-propelled. In principle, everybody adores how it sounds: not a considerable measure of chain of importance, not micromanaged and permitted to complete stuff, and self-governing (Morgeson et al., 2005). As shown in Fig.2-1, self-managed or self-guided means each colleague is in charge of recognizing what to chip away at and why (Dekker, 2010). In construction industry, ideally the product manager or project manager is the best helping guider

to you. All things considered, the PM won't sit behind you. You owe your timetable and your day (Hwang and Ng, 2013).

It very well may overpower for some colleagues when they are first introduced with a self-guided group (Gedajlovic et al., 2004). Having administration hands off is scaring. In what capacity will my supervisor know I'm doing admirably? Do my colleagues comprehend what I am really going after? How would I demonstrate my incentive to the organization? These are for the most part substantial concerns (Morgeson et al., 2005). Self-managed projects work with and for each other. Every part's prosperity is everybody's prosperity. Be that as it may, it doesn't mean you won't need to re move certain colleagues from the group (Kauffeld, 2006).

Figure 2-1: Self-managing Competency Model (Alldredge and Nilan, 2000)

2.2.2 Faith Determines Transparency, Morality, and Modesty:

Specifically considering for a self-managed projects to succeed, the group of people must disclose construction related secrets to each other (Marks et al., 2001). Faith is the beginning stage to take into consideration honesty, legitimacy, and modesty to exist. without these, it's far hard to get to the fundamental base of the problems and help groups develop. Trustworthiness and ease do not liken to being in thoughtful. They evaluate to having tough discussions to permit the organization to be better. Now and then, those open doorways for improvement which are particular to the challenges and the discussions show up generally (Ilies et al., 2005). Numerous proceedings, the difficulty may additionally have nothing to do with the current challenge. For remarkably many people, this suggests announcing things you're difficult in saying to it and being more trustworthy, having extra practicality, and being keen to take and pitch it out (Hsieh, 2009).

For instance, if a colleague is having an identity issue with an individual colleague, a self-managed group have the capacity to deal with the circumstance (Kazaz et al., 2008). It is vital that the group confides in each other sufficiently with the goal that a team can go to a designer and express his or her disappointments helpfully, so a common solution can be discovered (Mir and Pinnington, 2014).

Humility is of critical significance also. Having the capacity to concede disappointment, owning up to mix-ups, or saying "I don't have a clue, would anyone be able to offer direction?" sounds simple, yet it's not (Marks et al., 2001). At the point when the group confides in each other and isn't exhausted, everybody should need to offer help for progress and having the capacity to concede these things and rapidly searching for help is vital. Contact other colleagues

straightforwardly, check with others to check whether you might miss something, or counsel individuals outside the group if necessary (Zheng et al., 2010).

2.2.3 Self-Managed led Projects Still Necessitate Direction

Not having a major direction is not like knowing for not having a leader and yet being a supervisor doesn't suggest you are a directive and they may be detected at any level of the organization (Hwang and Ng, 2013). Having self-managed members in project doesn't substitute the requirement for the group to have legitimate initiative inside and outside the group. Fig. 2-2 , shows how a group needs a care group to offer direction, tutoring, and thoughts (Ilies et al., 2005). For the most part, a self-managed member will naturally discover a pioneer inside it. This is awesome yet having different pioneers accessible outside the group is additionally critical (Liao, 2017).

Forming	Storming	Norming	Performing
High Promise	Less Promise	Some Promise	High Promise
Low Capability	Some Capability	High Capability	High Capability
Member come but develop competence with work	Member is unhappy with the teams as they grow trust.	Changes in commitment while expertise remains constant.	Devotion and skill remain high.
↓			
Appropriate Leadership style			
Decide	Consult	Facilitate	Delegate

Figure 2-2: Stage of self-managed team development

Though self-controlled projects are self-sufficient as a long way as how they oversee and do their feature, despite everything the whole thing they require is course from leaders inside the ordered chain of knowledge (Hall and Nordqvist, 2008). Exterior leaders give the joining between the extra considerable connection and the self-guided institution, allowing the organization to succeed. Likewise, pushing on its benefit external leaders may additionally struggle to find the precise parity in their management style: their own managers may also expect that they could be more involved, while the institution might also oppose obvious explanations (Stoker, 2008).

2.2.4 Ambitious Employee Decisions remain the Norm in SMCP

For self-controlled group to be powerful, the corporation or affiliation need to help employee driven choices (Druskat and Wheeler, 2004). Higher management assumes a component in lots of organization and ought to represent the undertaking and challenge objectives. At the other hand, hazard that the corporation's top administration institution must affirm all alternatives, manage ordinary organization activities and shade low degree factors of interest of the teamwork, acting certainly (Day et al., 2004). This isn't just a hazard with upper management, if a group has a solid individual, and whatever remains of the group doesn't have the certainty to differ with them, self-administration will be all the more difficult (Marks et al., 2001). That doesn't mean you can't take standards from how self-managed groups are fruitful and have a go at adding these components to your groups. For instance, building trust, the capacity to be completely forthright and straightforward, and taking into consideration lowliness will be profitable for any group and colleague (Aronoff and Ward, 2000).

2.2.5 Dangers of Self-Managed Project at Construction site

Self-managing groups, as a method for arranging work, is today a noteworthy pattern in associations. In the present innovation driven and individualistic working society organizations are hoping to push obligation onto the representative as a method for empowering inventiveness and get rid of purported prohibitive pecking orders (Marks et al., 2001). Arranging work in groups without supervision from administrators, giving the worker greater obligation to design their everyday exercises is accepted to be the method for the future (Druskat and Wheeler, 2004, Day et al., 2004).

The issue with self-managing projects isn't the real trick, yet that the idea of "obligation" can be hazy and a representative may trust that they ought to and additionally can completely "control" their work-life circumstance (Hackman, 1990). Study portrays that oneself overseeing parts of work as "liberating" and enabling them to "impact" how they tackled issues for customers. For instance, they shared that they eagerly went up against "obligation" for ability advancement and learning at work. This eagerness to bear obligation regarding fitness improvement and other work-life circumstances may be on the grounds that "duty" today is viewed as an indication of progression in a person's profession (Munns and Bjeirmi, 1996). As such, turning into a pioneer and additionally a goals supervisor is today the indication of accomplishment in the salaried business world. Despite the fact that the workers depicted "duty" as a great thing, they are misty about what it truly is (Zahra and Filatotchev, 2004). The employees depicted "duty" as having the capacity to "control" their work-life circumstance than sensible from an untouchable's point of view (Stewart, 2006). The perils with an obscured outskirt among "obligation" and "control" is that a representative can't simply control work-life circumstances like capability advancement on the grounds that there are hierarchical and societal components empowering or frustrating

these procedures (Dangerfield et al., 2010). Despite the fact that a strong self-managed group may also make a feeling of trust as true between colleagues, excessively company works can activate "mindless compliance": Company individuals will likely adapt with organization requirements than enhance troubles that may disrupt other co-workers (DeRue and Ashford, 2010). This could prompt decreased energy or oppressed expansion. Teams may also combat to make the alternate from manager drove management to self-administration, either because of absenteeism of relational talents or dreadful execution of the self-managed group concept inside the corporation (Dekker, 2010).

2.3 Professionally Managed construction Projects (PMCP):

A professionally managed construction project group comprises of professionally effective construction managers and technical people (Chittoor and Das, 2007). These expert development administration group complete the arranging, planning and development of undertakings in an incorporated way (Hall and Nordqvist, 2008). Clashes because of any differing between the colleagues is limited by keeping certain legally binding assertions inside the group. This assistance in bringing more noteworthy reaction and yield from the management group (Day et al., 2004). Professional management conduct is related to believed, then is portrayed as a regular, hands-on approach of helping authorities to see prospects to promote their own specific accomplishment and capacities (Orth et al., 1990). Research expressly concentrating on the thought of expert administration in privately-owned companies is still rare, it implies a methodology of providing guidance, reassurance and support to the gathering of people (Redshaw, 2000). (Dyer Jr, 2003) gives deep understanding of accounts of three means of professionalizing the family firm, yet astonishingly less research has been circulated as less

effort has been done. There is a substantial group of writing worried about administration progression (Sharma and Irving, 2005, Sharma, 2004, Miller and Salkind, 2002) that drops on the matter of professional administration however does not observe the importance of the idea. Mounting and constructing on early writings (Dyer Jr, 2003, Fletcher and Perry, 2002, Astrachan et al., 2002), we contend for a broadened comprehension of expert privately-run company administration that unequivocally considers community and social scopes, such as, qualities, standards then implications of the managers family. From the literature its identified that on family occupational cultures firm societies, we realize that have the capacities and tendency to be solid in privately owned companies (Hall and Nordqvist, 2008, Zahra and Filatotchev, 2004, Dyer Jr, 2003, Astrachan et al., 2002) Certainly, there appears to be an increasingly shared knowledge among scholars that introduction of professionalism in their firm family business, employer nonetheless exists for maintaining own family esteems and team spirit, these features are crucial to the point that something, or anyone that affects with this delicacy ought to ship the own family run organization into confusion (Aronoff and Ward, 2000). To be certain, there is way for all accounts on unquestionably shared knowledge amongst professionals about their lifestyle and close social followers of the family and maintain that they're sufficiently focal to be obviously included right into a which means of expert professional management (Hall and Nordqvist, 2008).

An expanded comprehension of expert administration in development business is vital on the grounds that there is an inclination in the writing to compare proficient chiefs with outer and non-owner supervisors (Chittoor and Das, 2007) implying that expert administration and family administration regularly are fundamentally unrelated. Indeed competition inside the writing is that professional non family directors must be obtained to present "objectivity" and "soundness"

to the capable company (Gersick et al., 1997, Marks et al., 2001, Schein, 1993), regardless of whether it is likewise perceived that coordinating outside nonfamily administration is challenging (Aronoff and Ward, 2000, Fletcher and Perry, 2002). In a nutshell, we contend that an improved thought of expert administration rules the writing, inciting an obsolete suspicion that professionally managed construction projects generally by relatives are proficient. Given the impressive number of privately course companies that are confronting the test of anchoring equipped best administration and that the tasks of finding a reasonable and practicable C.E.O are outstanding (Astrachan et al., 2002, Van Fleet et al., 2006).

2.3.1 PMCP Construction Managers:

(Gunhan and Arditi, 2005) characterizes certain particular prerequisites and proficiencies, that expert development director is specific at when put in an Professional development projects. Indicated underneath:

a) Construction chief must move with the thoughts of the organization and the Architectural/Engineering Company's agents, from the earliest starting point of the task. If necessary, basic feelings and proposals must be recommended on the outline of the arrangement to help enhancements. He should help in raising a proposal on the calendars, the innovation utilized in development and in addition their financial components.

b) Construction Manager ought to be available to proposal about choices for the outline and the development techniques, if basic. Check the variety of cost and undertaking time, in view of the option recommended.

c) Project advancement with time must be observed, to guarantee no additional cash is spent for work, without the information of the office administration.

d) Coordination of all the material and equipment procurement from every one of the temporary workers are to be managed. The check for any due installment to the temporary worker, or the items collected, are made by CM.

e) Performance of whatever other administrations, that are identified with indistinguishable undertaking from requested by the temporary worker are additionally led.

Another type of construction manager (CM) offers professional services from the start to the completion of a construction project (Blomquist and Müller, 2006). Most of these construction managers come from the positions of A / E companies or construction companies that could potentially hold dual parts under the leadership of the owner (Alinaitwe et al., 2009). Nevertheless, the client can rely on managing the entire construction project procedure by a solitary professional (Ali et al., 2013). Building managers, however, are valued by a few owners, but not by many, such as a few years ago A / E firms were discredited. Some client find that when there is a lot on the streak, construction managers too can try to ensure their own passion and not that of the owner (Huemann et al., 2007). It should also be clear to all involved in the construction phase that a higher cost is required for the gathering required to proceed with a risk query (Doogan, 2009). So company needs to select from an A / E organization in the light of low fees rather than capacity set-up, it receives what it deserves on a regular basis ; or if the owner needs the subcontractor to retain the costs of vulnerabilities in construction such as set-up situations, the cost of the agreement will be higher regardless of the competitive bid used to reach a written agreement (Janjua and Muhlbacher, 2016). Without common consideration and believe, an owner cannot expect the Construction Manager to be able to produce preferred results over various experts. Subsequently, an owner must understand his /

her own duty and the hazard that he / she wants to assign to him / herself and various project members (Larson and Gray, 2015)

2.3.2 PMCP adoption for Mega Projects

For mega or large-scale projects, the professional construction management is mostly updated, requiring total control (Chan et al., 2004). The administrative approach will change as the project progresses for each phase of the development task. It may be "functional organization" at a certain point in time, which later changes to "lattice association," that may later become "project organization." It is not always essential for the undertaking to have a similar application (Mir and Pinnington, 2014).

Matrix corporation of a construction division is a kind of project organization used at every stage of the organization's dealings (Rowlinson, 2001). At the point when such many small-scale projects are utilized, a matrix organization is actualized. A matrix organization is explained in Fig. 2-3.

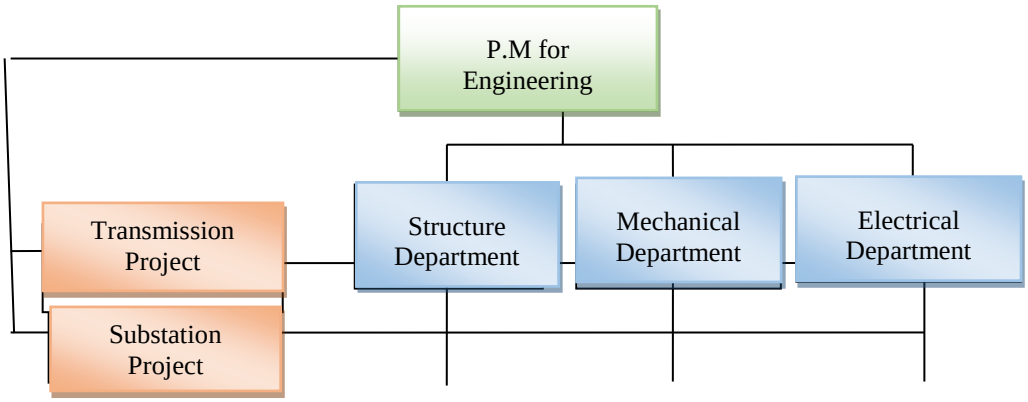

Figure 2-3: Representation of a Matric Organization

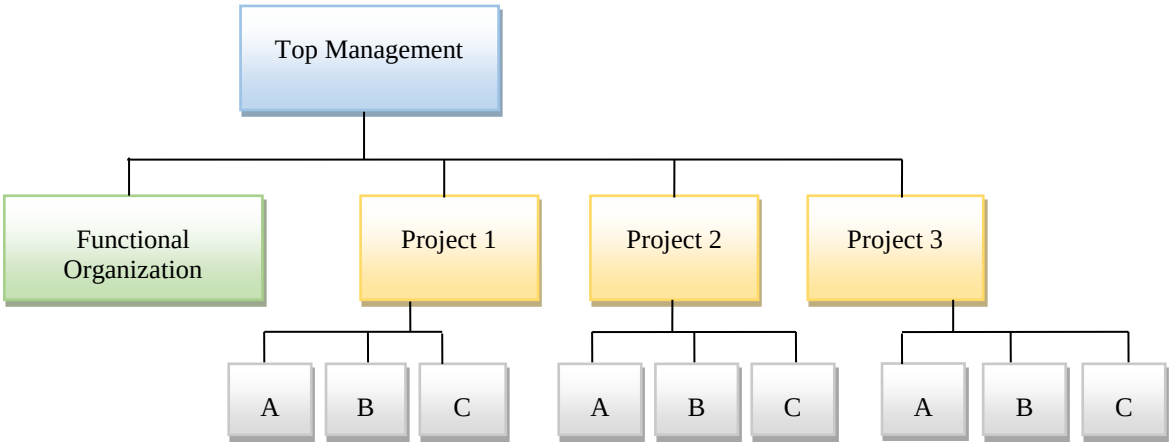

Figure 2-4: Representation of Project Oriented Organization

Inside the course of the general undertaking, the combination of the matrix, functional and the project organization can be utilized at the same time as appeared in Fig. 2-4. It is very hard to deal with the three in the meantime. This would truly make the hypothesis and additionally the administration framework troublesome yet should be actualized for the cost viability of the aggregate undertaking (Huemann et al., 2007). It is likewise seen that many large successful project organization have a solid sub-organization, which is of matrix compose (Rowlinson, 2001). This is where most of the control of the timetable and the fundamental cost obligation is put. This sub-organization is known as the "cost focus" or the "undertaking". This is taken care by the undertaking administrator himself. The cost focus framework includes individuals or members, taken from various units of the organization (Munns and Bjeirmi, 1996). Predominantly individuals gathered submit specialized answering to the higher experts in the association, of various units and offices. The last accomplishment in bringing cost-adequacy is by making these tasks sub-organization into a solitary group. This is completed by the initiative

claimed by the task supervisor. Unifying or decentralizing of the choice is urgent for the Organization of the mega projects (Nirenberg, 2003).

The bigger and more unpredictable the construction industry, the more officials with a more elevated amount of polished skill and outer learning are required (Kristof-Brown et al., 2005). Like in each business, construction industry requests this side additionally which must manage "match ups" happening in the recruiting process:

- ✓ Individual ability and talent with organizational ability prerequisites and
- ✓ Individual needs with the need satisfying attributes and characteristics of the job (DeRue and Ashford, 2010).

In the human asset administration setting these "match ups" are known as the 'individual employment fit' and 'individual association fit' (Kozlowski and Klein, 2000).

2.3.3 Authorization of PMCP:

Company faces a wide range of options when he decides to look for professional facilities to design and build a facility (Alldredge and Nilan, 2000). The type of services selected depends largely on the construction type and the expertise of the owner in dealing with different professionals in the previous projects of the company generally speaking, owners can participate in several common types of managed services together or in some variety (Yadollahi et al., 2014). Fig.2-5 below shows how services are evolved in the context of Professionalism.

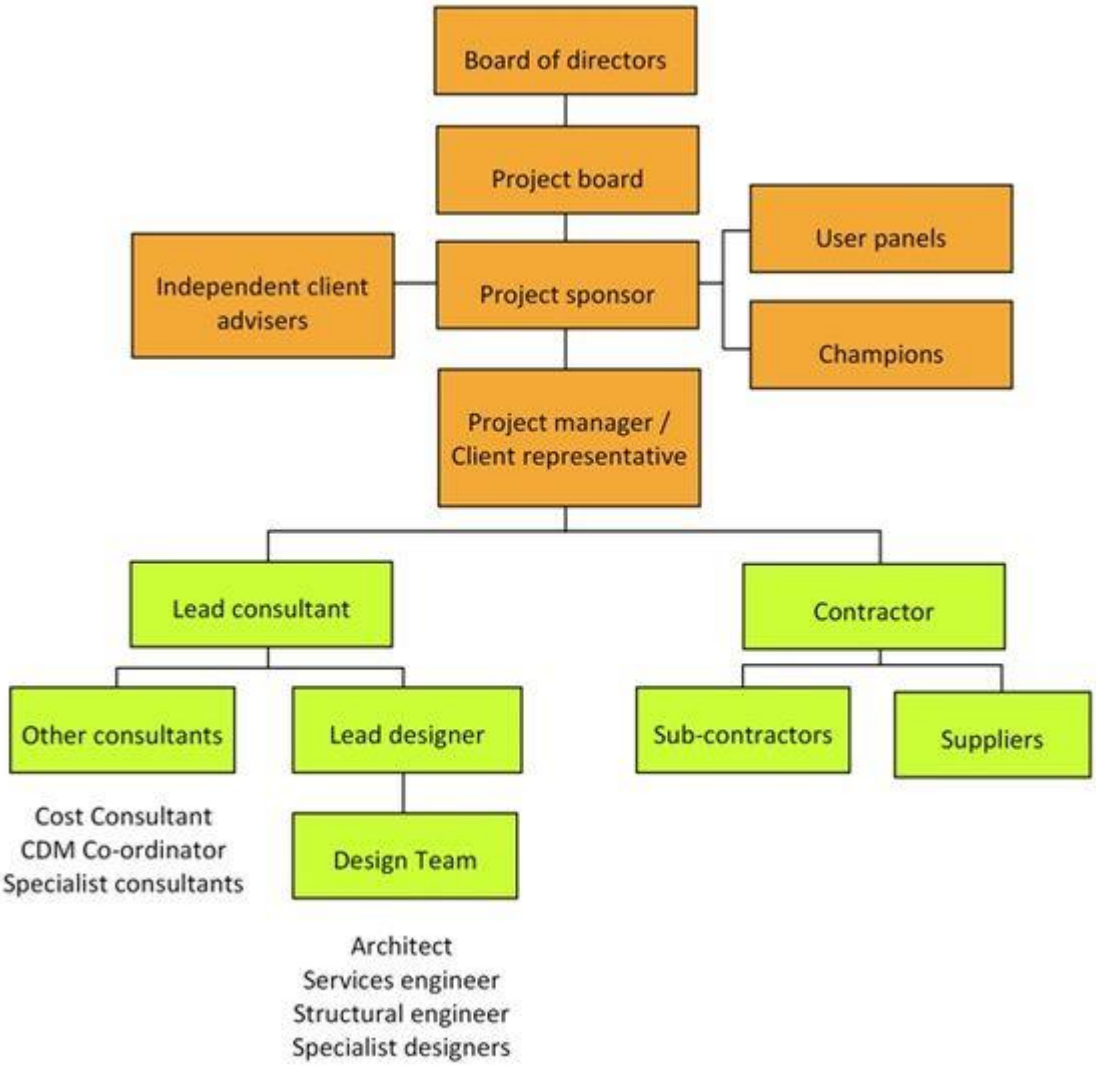

Figure 2-5: Layout of Professionally Managed Construction Projects System (Stewart and Spencer, 2006)

2.3.4 Professionally hired consultant firms

2.3.4.1 A/E firms:

In the construction of a preliminary design in a company for architecture and engineering, the owner usually draws as professional consultant. Following completion of the project's

engineering design and funding courses, the owner will enter into a construction agreement with a temporary general worker through a confrontational offer or arrangement (Singh et al., 2006). The manufacturing business will also be a builder, organizer and manufacturer of numerous sub-contractors who make various claims for publicity of their work as the A / E company completes the plan and also carries out adjacent quality controls during development (Yadollahi et al., 2014). Subsequently, the A/E firm goes about as the key proficient in the interest of the owner and directs the development to safeguard palatable outcomes. This training is most normal in building construction.

Previous few decades, for a few reasons especially for large-scale projects, this customary approach has turned out to be less common place (Yadollahi et al., 2014). The A / E companies, which owns as the main planning and inspection experts, have proved themselves to be more separated after the construction cycle which has been the result of weights to decrease expenditure on A / E companies, the risk of the case with regard to construction deformations and the lack of knowledge on major development procedures with regard to draftsman and expert design (Chittoor and Das, 2007). In many instances many A / E companies are not responsible for developing interest points again instead of creating a building scheme alongside the layout. In many instances they do not undertake periodic field reviews (Herscovitch and Meyer, 2002). In fact, such companies place a strong disclaimer on any store images they can inspect and often regard their representatives as viewers rather than as reviews (Yadollahi et al., 2014). The A / E company and the general contractor often advance in this way to become adversaries who take care of their own contentious benefits. So even the constructiveness of some construction plans can become a dispute problem (Redshaw, 2000). A / E company's determination for the general temporary employee regularly protects the interests of the

company at the expense of the owners ' and contractors ' interests so as to transfer them to the professionals (Hall and Nordqvist, 2008).

A few owners present valuable buildings to lower the construction cost, which seek to reduce the development costs by requiring a second design which may not cost so much as the first plan established via the A / E company. In reality, next scheme remains developed through the contractor following up completion of an agreement, while costs savings are distributed between the contractor and the manager due to the revision (Ofori, 2000). The company can maintain the costs of upgrading the growth benefits or reduce construction costs because of the re-design. (Stewart and Spencer, 2006). The A / E company may have developed a stronger layout which would, in any event, cost less if the owner were unwilling to pay greater costs to the A / E company or to better manage the scheme operation. This practice has, despite the importance of considerable engineering, compromised the share of the A / E company as the main specialist to monitor the company in the interests of the owner (Morgeson et al., 2005).

2.3.4.2 Design/Construct Firms (D/C firms):

The management of a design / construction company is a typical model in the industrial building industry, particularly for extensive operations (Sharma and Irving, 2005). By organizing design and building leadership in a lonely society, a large amount of the disputes between architects and builders can be avoided whilst models are almost checked for their construction (Müller and Jugdev, 2012). In every situation, a design / construction company owner drawing should protect against any plan to reduce the moment or cost to complete the project due to the nature of the constructed facility (Müller and Jugdev, 2012). In this type of design / construction method, it is also difficult to create use of competitive selling (Stewart, 2006).

The use of stage building for a big venture is one of the clearest highlights of the embedded design / construction method (Rowlinson, 2001). The project is classified into numerous stages in this operation, which can be individually described. Once the outline of the main phase has been finished, building can commence without standing firm to complete the second phase scheme and so on. If cooperation is properly practiced. The overall business range can be significantly reduced (Stewart and Spencer, 2006). A second favored point is to mishandle the probability of using the turnkey strategy, by which the proprietor may appoint the design / construction company to fulfill the predefined significance of the complete building (Hall and Nordqvist, 2008).

2.3.5 Operation and Maintenance Managers

Many owners maintain an unchanging employees for construction and help activities, others may wish to place such jobs in skilled executives (Larson and Gray, 2015). In addition, the use of external executives under agreements for the operation and aid of capital assets such as flats and office building should generally be reasonably established at the in-houses for tasks and maintenance in particular manufacturing facilities and services. Though, exceptions to these fundamental methods exist (Alldredge and Nilan, 2000). Open roads can, for example, be supported by personal companies. However, leaders may provide a variety of activities and maintenance administrations for a predetermined moment in order to understand the conditions of legal contracts (Guide, 2004). In this way, the owner can avoid providing internal control for the job, maintenance and maintenance of the equipment (Sy et al., 2005).

2.3.5.1 Facilities Management

A few owners and technicians are ready to add important strategic planning in the start, by means of reducing costs to achieve consistent increase in order to achieve greatest service across the working life cycle of a construction plant (Crawford et al., 2006). However, in spite of traditional planning and manufacturing facilities, some architectural / engineering and production management companies with Project control (PC) oriented skills and inside plan companies are offering such frontline and monitoring facilities. (Corkin and Burke, 2006). Facilities management is a means to organize, outline, construct and manage room in every type of system (Söderlund, 2004). It covers the development of corporate strategies, long-term numbers, property, inventories of room and initiatives (through outline, development and remodel), Design and assist tasks and inventory levels of furnishings and facilities (DeRue and Ashford, 2010).

A common consideration for all companies involved in the current services is that, despite the use of PCs to help sketch and inspect construction, all have strong PC capabilities and substance of PC applications, the leadership includes the collection of PC records of building drawings, which can then be transferred to construction to management systems collected for building (Kristof-Brown et al., 2005). For property association planner, the digital file of operations enable schematic information to be obtained for long-range estimates, while supervisors use standard content such as rental / occupant documents, utilities etc for everyday operations (Larson and Gray, 2015)

2.4 Identification of factors effecting due to adoption of SMCP:

Self-managed construction projects are quickly moving toward the prominence of value hovers in both the well-known and authoritative writing (Kauffeld, 2006). Numerous studies have inspected competency of task administrators while in various affiliations, self-regulating and overseeing groups have been exhibited as a method for improving the execution and success of projects (Morgeson, 2005). (Hackman and Hackman, 2002) depicts that fruitful groups have the accompanying qualities: they fulfill outer and inward customers, create abilities for future execution, and individuals from those groups discover importance and fulfillment inside their group. SMCP has turned out to be progressively mainstream and generally homed in present day hierarchical situations. In this manner, it is viewed as a technique for enhancing profitability, inspiration, aptitudes, ingenuity and responsibility of representatives in an association (Burden and Burdett, 2005) which can be utilized to enhance the way toward accomplishing organizations objectives all the more proficiently and in this manner enhance the business and to get upper hand.

Subsequently, professional performance measurements may have at least one dimensions, and could be affected by different projects attributes (Larson and Gray, 2015). Large-scale construction projects represent a various challenge for effective finish. There is by all accounts no broad agreement among researchers on what are the critical factors (CFs) on professionally managed construction projects. Professionally managed projects will be regularly spread over a wide range of different tasks, which include detailed drawings well within scope, work schedules, financial management, determining what to do and selecting the project participants (Van Fleet et al., 2006). Wherever asset adequacy is enhanced through the procurement of employees, different activities are carried out through genuine coordination and management

in contracting activities, organizing, evaluating, planning and construction throughout the whole procedure and effectively improving strong correspondence between the professionals to resolve all possible disputes in an organization/firm (Huemann et al., 2007, Chittoor and Das, 2007, Blomquist and Müller, 2006).

Various factors were identified from 42 different research papers through detailed research, but the one with most occurrence has been taken for review such as; reluctance in timely Decisions, disagreements with Architect/Engineer design, size and value of project being large, non-Competitive bidding phase, lack of construction control meetings, negligence in identifying critical activities, optimum resource utilization, lack of coordinating abilities with client/contractor, poor monitoring and controlling, over sighting proper planning tools and techniques for risk management, lesser supervision over lower staff, poor commitment level with other parties of project, vested interest on quality and timely completion of project, severe conflicts among team members, inappropriate organizational structures & stability, lack of transparency in financial issues, lack of selecting key members at initial stages of construction phase, expertise insufficiency, pass by environmental impact assessments on site, accomplishment of project lacks user expectation & satisfaction and insufficient control over safety and health issues

Out of these 21 factors identified from literature, in the later part top 15 factors were top-listed after performing detailed content analysis which significantly affected the professionally managed construction projects. These factors are presented in Table. 2-1 shown below and are used for further analysis:

Table 2-1: Identification of factors effecting in selection of best management practices

S.No.	Factors affecting	References			
		2005-2000	2010-2006	2015-2011	2018-2016
1	**Reluctance in timely Decisions**	(Iyer and Jha, 2005, Dainty et al., 2004)	(Tuuli et al., 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Gluch, 2009, Alinaitwe et al., 2009, Kazaz et al., 2008, Gross and Jovanis, 2008)	(Hwang et al., 2015, Yadollahi et al., 2014, Ceric, 2014, Villa and Ariaratnam, 2013, Mostafavi et al., 2013, Slattery and Sumner, 2011, Grau et al., 2011)	(Hasnain et al., 2018, Zheng et al., 2016, Thevenin et al., 2016, Liu et al., 2016)
2	**Disagreements with Architect/Engineer design**	(Egbu, 2004, Chan et al., 2004, Hodgson, 2002, Chan et al., 2002, Ibbs and Kwak, 2000)	(Tuuli et al., 2010, Kazaz et al., 2008, Gross and Jovanis, 2008, Müller and Turner, 2007, Stewart, 2006, Burke et al., 2006)	(Mir and Pinnington, 2014, Villa and Ariaratnam, 2013, Hwang and Ng, 2013, Kog and Loh, 2011, Grau et al., 2011)	(Palikhe et al., 2018, Song et al., 2017, Martens and Carvalho, 2017, Jarkas, 2017, Thevenin et al., 2016, Liu et al., 2016)
3	**Size and value of Project being large**	(Iyer and Jha, 2005, Gedajlovic et al., 2004, Egbu, 2004, Dainty et al., 2004, Chan et al., 2002, Chan et al., 2001, Ibbs	(Tuuli et al., 2010, Nafday, 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Gluch, 2009, Alinaitwe et al., 2009,	(Hwang et al., 2015, Bausman et al., 2013, Ding et al., 2012, Slattery and Sumner, 2011)	(Palikhe et al., 2018, Song et al., 2017, Martens and Carvalho, 2017, Jarkas, 2017, Zheng et al., 2016)

		and Kwak, 2000)	Gross and Jovanis, 2008, Müller and Turner, 2007, Stewart, 2006)		
4	**Non-Competitive bidding phase**	(Iyer and Jha, 2005, Gedajlovic et al., 2004, Hodgson, 2002, Chan et al., 2001)	(Nafday, 2010, Gluch, 2009, Alinaitwe et al., 2009, Kazaz et al., 2008, Gross and Jovanis, 2008, Stewart, 2006, Burke et al., 2006)	(Hwang et al., 2015, Yadollahi et al., 2014, Mir and Pinnington, 2014, Ceric, 2014, Mostafavi et al., 2013, Hwang and Ng, 2013, Slattery and Sumner, 2011, Kog and Loh, 2011)	(Song et al., 2017, Zheng et al., 2016)
5	**Lack of Construction Control meetings**	(Chan et al., 2002, Chan et al., 2001)	(Tuuli et al., 2010, Nafday, 2010, Ling and Bui, 2009, Alinaitwe et al., 2009, Burke et al., 2006)	(Hwang et al., 2015, Yadollahi et al., 2014, Mir and Pinnington, 2014, Ceric, 2014, Mostafavi et al., 2013, Slattery and Sumner, 2011, Grau et al., 2011)	(Park et al., 2017, Jarkas, 2017, Thevenin et al., 2016)
6	**Negligence in identifying Critical activities**	(Iyer and Jha, 2005, Gunhan and Arditi, 2005, Dainty et al.,	(Tuuli et al., 2010, Nafday, 2010)	(Hwang et al., 2015, Hwang and Ng, 2013)	(Park et al., 2017, Martens and Carvalho, 2017,

		2004, Hodgson, 2002, Chan et al., 2002)			Thevenin et al., 2016)
7	**Optimum Resource utilization**	(Gunhan and Arditi, 2005, Gedajlovic et al., 2004)	(Tuuli et al., 2010, Kazaz et al., 2008, Burke et al., 2006)		(Palikhe et al., 2018, Hasnain et al., 2018, Park et al., 2017, Jarkas, 2017, Thevenin et al., 2016)
8	**Lack of coordinating abilities with client/contractor**	(Gedajlovic et al., 2004, Hodgson, 2002, Chan et al., 2002)	(Nafday, 2010, Gross and Jovanis, 2008, Burke et al., 2006)	(Hwang et al., 2015, Villa and Ariaratnam, 2013, Slattery and Sumner, 2011, Kog and Loh, 2011)	(Palikhe et al., 2018, Martens and Carvalho, 2017, Liu et al., 2016)
9	**Poor monitoring and Controlling**	(Iyer and Jha, 2005, Gunhan and Arditi, 2005, Egbu, 2004, Chan et al., 2001, Ibbs and Kwak, 2000)	(Nafday, 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Kazaz et al., 2008, Gross and Jovanis, 2008, Müller and Turner, 2007)	(Yadollahi et al., 2014, Mir and Pinnington, 2014, Slattery and Sumner, 2011, Grau et al., 2011)	(Song et al., 2017, Park et al., 2017, Jarkas, 2017, Liu et al., 2016)
10	**Over sighting proper planning tools and techniques for risk management**	(Iyer and Jha, 2005, Gunhan and Arditi, 2005, Chan et al., 2004, Chan et al., 2001,	(Tuuli et al., 2010, Ling and Bui, 2009, Kazaz et al., 2008)	(Ceric, 2014, Villa and Ariaratnam, 2013, Slattery and Sumner, 2011)	(Park et al., 2017, Martens and Carvalho, 2017, Zheng et al., 2016,

		Ibbs and Kwak, 2000)			Liu et al., 2016)
11	**Lesser supervision over lower staff**	(Iyer and Jha, 2005, Gedajlovic et al., 2004, Dainty et al., 2004, Chan et al., 2004)	(Burke et al., 2006)	(Hwang et al., 2015, Mir and Pinnington, 2014, Ceric, 2014, Hwang and Ng, 2013, Grau et al., 2011)	(Martens and Carvalho, 2017, Zheng et al., 2016)
12	**Poor commitment level with other parties of project**	(Gunhan and Arditi, 2005, Gedajlovic et al., 2004, Egbu, 2004, Chan et al., 2004, Hodgson, 2002, Ibbs and Kwak, 2000)	(Ling and Bui, 2009, Gluch, 2009, Alinaitwe et al., 2009, Müller and Turner, 2007)	(Hwang et al., 2015, Yadollahi et al., 2014, Villa and Ariaratnam, 2013, Mostafavi et al., 2013, Ding et al., 2012)	(Hasnain et al., 2018, Zheng et al., 2016, Thevenin et al., 2016)
13	**Vested interest on quality and timely completion of project**	(Gunhan and Arditi, 2005, Egbu, 2004)	(Nafday, 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Alinaitwe et al., 2009)	(Mir and Pinnington, 2014, Mostafavi et al., 2013, Hwang and Ng, 2013, Kog and Loh, 2011)	(Song et al., 2017, Jarkas, 2017, Thevenin et al., 2016)
14	**Severe conflicts among team members**	(Iyer and Jha, 2005, Hodgson, 2002, Chan et al., 2002, Chan et al., 2001)	(Tuuli et al., 2010, Nafday, 2010, Dangerfield et al., 2010, Alinaitwe et al., 2009, Kazaz et al., 2008)	(Hwang et al., 2015, Ceric, 2014, Villa and Ariaratnam, 2013, Mostafavi et al., 2013, Slattery and Sumner,	(Martens and Carvalho, 2017, Jarkas, 2017, Zheng et al., 2016)

				2011, Kog and Loh, 2011)	
15	**Inappropriate organizational structures & stability**	(Gunhan and Arditi, 2005, Chan et al., 2002, Chan et al., 2001, Ibbs and Kwak, 2000)	(Tuuli et al., 2010, Ling and Bui, 2009, Kazaz et al., 2008, Gross and Jovanis, 2008, Stewart, 2006)	(Hwang et al., 2015, Ceric, 2014, Slattery and Sumner, 2011)	(Palikhe et al., 2018, Song et al., 2017, Zheng et al., 2016, Thevenin et al., 2016, Liu et al., 2016)
16	**Lack of transparency in financial issues**	(Iyer and Jha, 2005, Gedajlovic et al., 2004, Egbu, 2004, Dainty et al., 2004, Chan et al., 2002, Ibbs and Kwak, 2000)	(Nafday, 2010, Gluch, 2009, Gross and Jovanis, 2008, Stewart, 2006)	(Mir and Pinnington, 2014, Ceric, 2014, Villa and Ariaratnam, 2013, Mostafavi et al., 2013, Grau et al., 2011)	(Song et al., 2017, Park et al., 2017, Martens and Carvalho, 2017)
17	**Lack of selecting key members at initial stages of construction phase**	(Iyer and Jha, 2005, Gunhan and Arditi, 2005, Dainty et al., 2004, Chan et al., 2004, Chan et al., 2001)	(Tuuli et al., 2010, Nafday, 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Gross and Jovanis, 2008, Müller and Turner, 2007, Burke et al., 2006)	(Ceric, 2014, Villa and Ariaratnam, 2013, Mostafavi et al., 2013, Ding et al., 2012, Slattery and Sumner, 2011, Grau et al., 2011)	(Palikhe et al., 2018, Hasnain et al., 2018, Song et al., 2017, Park et al., 2017, Jarkas, 2017, Zheng et al., 2016, Thevenin et al., 2016, Liu et al., 2016)
18	**Expertise insufficiency**	(Gunhan and Arditi, 2005, Dainty et al., 2004, Chan	(Tuuli et al., 2010, Nafday, 2010, Gluch,	(Hwang et al., 2015, Yadollahi et al., 2014,	(Song et al., 2017, Park et al., 2017, Jarkas, 2017,

		et al., 2004, Chan et al., 2002, Chan et al., 2001, Ibbs and Kwak, 2000)	2009, Alinaitwe et al., 2009, Gross and Jovanis, 2008, Stewart, 2006)	Villa and Ariaratnam, 2013, Bausman et al., 2013, Slattery and Sumner, 2011)	Thevenin et al., 2016, Liu et al., 2016)
19	**Pass by environmental impact assessments on site**	(Iyer and Jha, 2005, Gedajlovic et al., 2004, Dainty et al., 2004, Hodgson, 2002)	(Tuuli et al., 2010, Dangerfield et al., 2010, Gluch, 2009, Gross and Jovanis, 2008, Müller and Turner, 2007, Stewart, 2006, Burke et al., 2006)	(Hwang et al., 2015, Mir and Pinnington, 2014, Ceric, 2014, Hwang and Ng, 2013, Bausman et al., 2013, Slattery and Sumner, 2011)	(Song et al., 2017, Park et al., 2017, Zheng et al., 2016, Liu et al., 2016)
20	**Accomplishment of project lacks user expectation & satisfaction**	(Gunhan and Arditi, 2005, Gedajlovic et al., 2004, Egbu, 2004, Chan et al., 2004, Hodgson, 2002, Ibbs and Kwak, 2000)	(Ling and Bui, 2009, Gluch, 2009, Kazaz et al., 2008, Müller and Turner, 2007)	(Hwang et al., 2015, Yadollahi et al., 2014, Mostafavi et al., 2013, Ding et al., 2012)	(Hasnain et al., 2018)
21	**Insufficient control over safety and health issues**	(Gunhan and Arditi, 2005, Egbu, 2004)	(Nafday, 2010, Dangerfield et al., 2010, Ling and Bui, 2009, Alinaitwe et al., 2009)	(Mir and Pinnington, 2014, Hwang and Ng, 2013, Kog and Loh, 2011)	(Hasnain et al., 2018, Song et al., 2017, Thevenin et al., 2016)

2.5 Categorization of affecting effects:

Categorization is based on the nature of the identified influencing effects. Identified effects are grouped into 4 categories as per (Ling and Bui, 2009). These groups are as under

2.5.1 Project Manager (PM) Competencies:

PM competency is a hierarchical element that concentrates, and facilitates exercises identified task with the executives and can work in various extents of impact, running from the whole undertaking to a solitary explicit division. Among the creators and analysts on the subject, there is solid accord that an effective PM can adjust to various authoritative necessities(Dyer Jr, 2003). As a specialist organization, a PM has customers with explicit necessities that must be met through administrations/capacities performed by this authoritative element. Therefore, to meet such various necessities, a PM can give works that are arranged into five groups as indicated by their recurrence (Aubry et al., 2009):

- Checking and Controlling Project Performance
- Advancement of Project Management Competencies and Methodologies
- Multi-Project Management
- Authoritative Learning
- Key Management

Expertise deficiency was found as one of principle reason of PM competency (Al Khattab et al., 2007, Deng et al., 2001). Non-Competitive bidding phase (short offered time) can be legitimately impacted by the host government when they set principles for legally binding connections and advancement (Munns and Bjeirmi, 1996). The dangerous condition by implication influences the open segment development (Iankova and Katz, 2003). Therefore, reluctance in timely decisions impacts significantly on the project.

In global development projects misconduct of contractors is considered one of the most important sources of poor monitoring and budget related feedbacks. The offense of temporary workers, for example, natural contamination, mishaps and infringement of specialist's rights, locals' separation, restricted social assurance and unreasonable work rehearses are brutality causative acts (Deng et al., 2001). As of late led analyst (Aubry et al., 2009). demonstrate that the job of creating abilities in task the board is one of the principle administrations given by a PM competency level. Normally, for this situation, PM is viewed as a functioning specialist meaning to spread learning on task the board all through the association, building up the required abilities in customers with the goal that they are fruitful in their undertakings (Corkin and Burke, 2006). As a parameter to accomplish this objective, a PM has the Project Management Competency Development Framework (PMCDF) available to its, distributed by the Project Management Institute (PMI) (Fletcher and Perry, 2002). It incorporates definite data on which capabilities a venture administrator ought to have. Then again, when managing the capabilities required by PM experts, an information hole is seen in writing. While a portion of the capabilities of a task chief may likewise be material to PM individuals, numerous others are required when a PM is relied upon to perform jobs not the same as those played by an undertaking supervisor. In this manner, it is conceivable to presume that capabilities are pointed solely to PM experts, including specialized and social aptitudes explicit to each administration or capacity to be executed (Blomquist and Müller, 2006).

2.5.2 Coordination

Coordination is a sorting method for the supervision of assets with a view to achieving more operational efficiency for a task for which a diverse centralization measures are used to build informal Community (Al Khattab et al., 2007). These estimates are used to study the connection between the site and construction company since system importance affects an individual's ability to organize other people's tasks (Wilson, 2014). The procedure of development,

contingent upon the intricacy of the completed structure, requires an abnormal state of coordination among every one of the experts and exchange people from plan office to the building site until the undertaking is finished. In this way, Disagreements in Architect/Engineer configuration impacts the task achievement (Marks et al., 2001).

The people required at the higher supervisory crew comprise, fundamentally, of the task administrator, the development director, the business chief, the undertaking control supervisor, the quality chief, the plan supervisor, the natural and legacy administrator and the modeler (Munns and Bjeirmi, 1996). Under them are the bleeding edge director and supervisory staff which comprise of the development designs, the undertaking control builds, the venture draftsman, the quality designer and the electrical and administrations engineer (Kristof-Brown et al., 2005). Thus, choosing any of the above individuals at beginning time reflects poor coordination level in construction industry.

Expanding upon set up coordination hypotheses, we research contrasts in coordinative action between people with high and low system centralization with extreme clashes among colleagues (Janjua and Muhlbacher, 2016). In which focal research question may in this manner be stated as: Are midway 'well-associated' individuals ready to practice more noteworthy coordination inside the system structure. In the administration contracting game plan, the customer could have a functioning job in the acquirement framework, thus by lacking or having poor comprehension with customer/contractual worker may go into independent contracts with the fashioner, the development supervisor, and individual exchange temporary workers if so wanted (Hackman and Hackman, 2002). The customer could take on the legally binding job, while the development or venture chief gives the dynamic job of dealing with the different exchange contracts and guaranteeing that they all work easily and successfully together, or the

customer can have an administrator to oversee everything for their sake (Breton-Miller et al., 2004).

2.5.3 Performances

The organization's survival in contending development advertise relies upon the effective execution of undertakings (Dainty et al., 2004). Thusly, the last being the principle point of each development organization. Another, similarly significant, is a high proficiency of task usage being the attributes of an organization's aggressiveness in market (Tuuli et al., 2010). Also, the effective presentation will enable the organization to utilize their material, monetary and HR to accomplish higher quality, lastly higher benefits. Development organizations are generally executing a few developments extends in the meantime. Activities contrast by unpredictability, span, spending plan, assortment of works, and number of implementers (Gross and Jovanis, 2008). Additionally, differ the after effects of the undertakings: some of them have been actualized effectively, other ended with misfortunes or mishaps. To decide the reasons for some outcome the investigation of venture work process pointers ought to be performed (Mostafavi et al., 2013). The subjects of task execution and achievement factors are examining broadly by experts for quite a while. In this way, the accomplishment of the task as impermanent association is influenced by the (ideal asset use) and (viability of the personal stake on quality) and (auspicious finish of undertaking); and the achievement of the association additionally influenced by the (improper authoritative structures and security) (outside extent of venture) (Jarkas, 2017).

Well performing, effective and inventive development industry is vital factor in rising personal satisfaction, particularly in the light of low carbon future. The venture nature, the powerful task the executive’s apparatuses, and the reception of creative administration approaches are the

basic achievement factors for undertakings in development. (Kim et al., 2009) states that without adequate (command over security and medical problems), it is exceptionally hard to evaluate a general execution dimension of a built task in a sensible way, because in the development business, which is an unmistakable outline of extent of execution is missing, and the standard method and activities are not completely created (Deng et al., 2001). The task nature, the successful undertaking the executive's apparatuses, and the reception of (ecological effect evaluations on location) are the basic variables for activities in construction (Bird and Brush, 2002).

2.5.4 Project Control

Project Controls is not generally seen as technological capabilities in an expert capacity (Corkin and Burke, 2006). This is rather a potential that is essential for successful businesses and personalized results, for instance which convey estimated cost, established schedule and execution benefits.

"*Project Controls are the information gathering, information the executives and expository procedures used to foresee, comprehend and helpfully impact the time and cost results of a task or modified; through the correspondence of data in configurations that help viable administration and basic leadership*."

For the explanations, the field of project controls is considered in the following Fig.2-6:

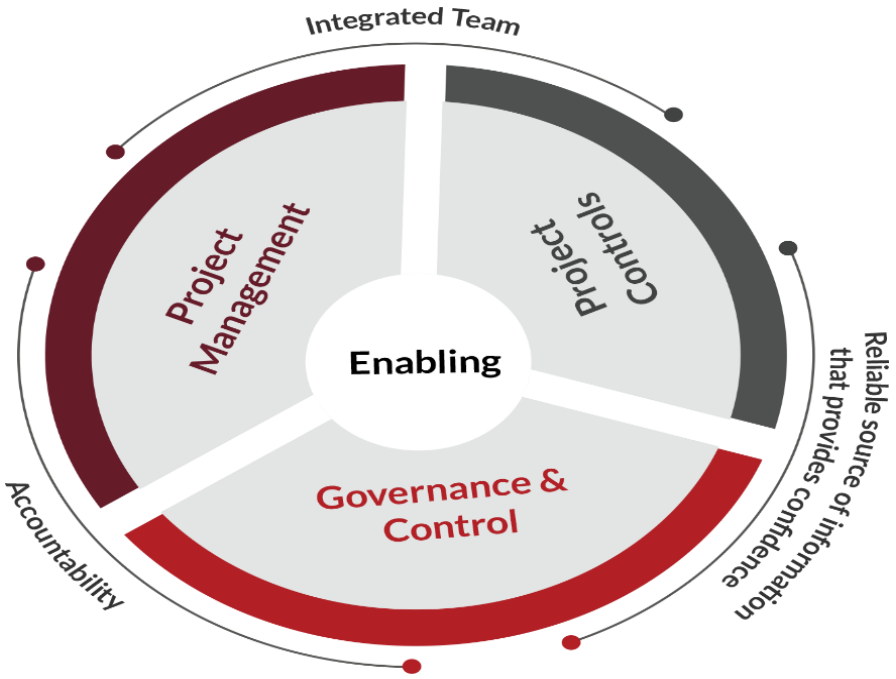

Figure 2-6: Project control cycle

(Nirenberg, 2003) Inside the project team, project control professionals are employed and are reliable to their team leader. They are the core of the Project Team. On the off chance that Project Management is worried about settling on educated and responsible choices venture controls is tied in with "advising, observing and dissecting" – to practice control it is fundamental that (size and estimation of task) are broke down well before (Fletcher and Perry, 2002). The data are produced and updated by Project Control experts to draw the project manager's attention to the aim that such controls (development control gatherings) are practicable in such a way as to maintain their stability (Dogbegah et al., 2011). Contingent on how Project Controls is seen will impact what is considered as the segment portions of the capacity. Here it is expected that venture controls are worried about evaluating starting benchmark execution measurements, deciding the status of the undertaking, assessing future capability of the task, recognizing any differences (pattern to current position and gauge to potential future position), and considering (appropriate arranging apparatuses and systems) for

hazard the board to be taken to recoup any positive fluctuation. Here change alludes to real contrasts recognized in venture control records and the potential varieties conceivable from undertaking dangers, issues and openings (Villa and Ariaratnam, 2013).

All development supervisors need involvement and (responsibility level) with different gatherings of undertaking, capacity and procedures of control inside tasks which is implanted in (venture control apparatuses and systems) (Rozenes et al., 2006). Task control strategies are essentially proposed to recognize straightforwardness in money related issues and recommend potential zones for price investment capitals. Such a trademark reflects the steered phase of project control (Kozlowski and Klein, 2000). The period when real cost investment funds can be implemented is when the company arranges and plans in the middle of genuine production, changes are probably going to defer the enterprise and lead to the task managers themselves having to combine a comprehensive view of the different reports on supervision of lower employees (Fletcher and Perry, 2002). Supervisors are frequently compelled to derive the human asset impacts, as opposed to being given guides for this process.

Table 2-2: Categorization of affecting factors

S. no	Group	Effects	Abbreviations
1	PM competency	Reluctance in timely Decisions	RTD
		Non-Competitive bidding phase (short bid time)	NCBP
		Negligence in identifying Critical activities	NICA
		Poor monitoring and Budget Feedbacks	PM&B
		Expertise insufficiency	EI
2	Coordination	Disagreements in A/E design	DA/ED

		Lack of coordinating abilities with client/contractor	LCA
		Severe conflicts among team members	SCTM
		Lack of selecting key members at early stages of construction phase	LSKM
		Accomplishment of project lacks user expectation & satisfaction	ALUES
3	Performances	Optimum Resource utilization	ORU
		Vested interest on quality and timely completion of project	VTQTC
		Inappropriate organizational structures & stability (outside scope of project)	IOSS
		Pass by environmental impact assessments on site	PBEIA
		Insufficient control over safety and health issues	ICSH
4	Project Control	Size and value of Project being large	S&VL
		Lack of Construction Control meetings	LCCT
		Over sighting proper planning tools and techniques for risk management	OPTT
		Lesser supervision over lower staff	LSOLS
		Poor commitment level with other parties of project	PCL
		Lack of transparency in financial issues	LTFI

After grouping of the identified affecting effects into 4 categories as shown in the Table.2-2, content analysis is carried out for better understanding. Out of these 42 publications, there are few papers which discuss the effects due to adoption of SMCP. For finding out the impact of each affecting factor, its appearance is checked. PM competency factors are identified from 26 research publications. Coordination, Performances and Project Control affecting factors are discovered from 12, 21 and 32 research publications, respectively. As mentioned above some papers are very particular to individual effects while some quote these effects collectively.

In the next step content analysis was carried out to have an idea about the relative importance given to each affecting factor by the academic experts and researchers. This content analysis is shown in Table.2-3. Furthermore, this analysis also helped in analyzing the evaluation of each effect over time, cost and quality based upon the publishing attention given to each factor. The normalized value for each factor is relatively high the reason being the handsome maturity of each effect identification and amount of less work being carried out on the said topic. The normalized score is the appearance fraction of the effect out of the 42 research papers read on the topic.

Table 2-3: Factors with their Occurrence and normalized literature score

S.no	Group	Effects	Abbreviations	IDs	Frequency	Normalized literature Score
1	PM competency	Reluctance in timely Decisions	RTD	PM 1	20	0.0736
		Non-Competitive bidding phase (short bid time)	NCBP	PM 2	21	0.0464
		Negligence in identifying Critical activities	NICA	PM 3	12	0.0265
		Poor monitoring and Budget Feedbacks	PM&B	PM 4	19	0.0700
		Expertise insufficiency	EI	PM 5	22	0.0486
2	Coordination	Disagreements in A/E design	DA/ED	CO1	22	0.0810

		Lack of coordinating abilities with client/contractor	LCA	CO2	13	0.0287
		Severe conflicts among team members	SCTM	CO3	18	0.0663
		Lack of selecting key members at early stages of construction phase	LSKM	CO4	26	0.0574
		Accomplishment of project lacks user expectation & satisfaction	ALUES	CO5	15	0.0331
3	Performances	Optimum Resource utilization	ORU	PF1	10	0.0368
		Vested interest on quality and timely	VIQTC	PF2	13	0.0479

		completion of project				
		Inappropriate organizational structures & stability (outside scope of project)	IOSS	PF3	17	0.0376
		Pass by environmental impact assessments on site	PBEIA	PF4	21	0.0464
		Insufficient control over safety and health issues	ICSH	PF5	12	0.0088
4	Project Control	Size and value of Project being large	S&VL	PC1	25	0.0920
		Lack of Construction Control meetings	LCCM	PC2	17	0.0376

		Over sighting proper planning tools and techniques for risk management	OPTT	PC3	15	0.0552
		Lesser supervision over lower staff	LSOLS	PC4	12	0.0265
		Poor commitment level with other parties of project	PCL	PC5	18	0.0398
		Lack of transparency in financial issues	LTFI	PC6	18	0.0398

It is observed from research publications during 2000-2018, that PM Competency and Project control were considered more as compared to Coordination and Performances effects. Therefore, an extensive literature is available on PM Competency and Project control during the described time. From the content analysis, affecting factors are prioritized based on the literature. In Table.2-4, ranking is done on the bases of top 6 appearances criticalities, through which we get top 16 affecting factors. See Table 2-2 for affecting effects.

Table 2-4: Ranking of identified factors in selection of best management practices

Ranking	Factors IDs	Abbreviations	No. of Factors	Score (%)
1	PC1	S&VL	1	90
2	CO1	DA/ED	1	80
3	PM1, PM4	RTD, PM&B	2	70
4	CO3, CO4	SCTM, LSKM	2	60
5	PC3, PF2, PM2, PF4, PM5	OPTT, VIQTC, NCBP, PBEIA, EI	5	50
6	PC5, PC6, PF1, PF3, PC2	PCL, LTFI, ORU, IOSS, LCCM	5	40

2.6 Impact of affecting factors on Project success:

Successful projects are defined in a way that matters in the construction sector. Since different stakeholders are involved in various phases of the construction project, local construction projects are unsupervised from the uncertain system. Customers, consultants, contractors, suppliers, etc (Banaitiene and Banaitis, 2012) are stakeholders involved with planning, designing and building complexities for the provision of resources. Cost, time and quality performance are primarily being used in terms of measuring the project success criteria (Phua and Rowlinson, 2004). These three project performance components were first identified by (Atkinson, 1999), who termed it as 'Iron Triangle' and integrated it in diagrammatic way which is shown in Fig. 2-7.

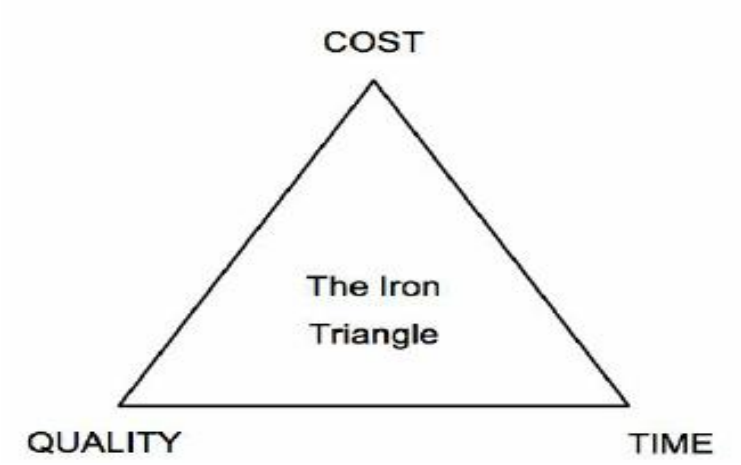

Figure 2-7*: Interdependency between cost, time and quality*

The effects of both local and international partners are significantly affected by professionally managed construction projects. For both the locally and internationally partners, the relationship with the host government is crucial. Most projects suffer from the detrimental selection mechanism in the traditional process of selecting best management practices. Organization has stated that a subjective skew in selection of best management practices could not achieve the same level of performance (Kashiwagi and Byfield, 2002). Complex and risky SMCP approach decisions result in misunderstanding, adaptive contractor behavior, reduced quality of work in a hostile relationship (Hall and Nordqvist, 2008). The owner does not always demonstrate "lowest price" selection criteria. The cost should be interspersed with the project specific criteria (PSC) to show the value of money. Sovereign value can be measured by the credentials of contractors that are' selection criteria' when best management practices are selected.

Most of the studies focus on increasing project long-term success by assessing key selection determinants (Cheng and Li, 2004). The insertion of significant elements in the selection process that meet the project's explicit needs to confirm the best practice for building the facility. Towards indicating the quality of contractor’s work, best value measures the past

record of his/her performance and as expected, the results show a drift from traditional SMCP approach to PMCP selection (Abdelrahman et al., 2008). Ultimately there is positive impacts on the project objectives.

2.7 Summary:

This chapter covers the literature review on effects due to SMCP adoption and related factors and eventually their effect on project success. It also focuses on critical affecting factors emerged as a hurdle in achieving project success. Affecting factors were identified through the extensive literature review and then further grouped into 4 groups. Content analysis was carried out to highlight the effects due to adoption SMCP on the bases of literature. A year-wise trend table was obtained to observe the identification of several affecting factor's year-wise

Chapter 3

RESEARCH METHODOLOGY

3.1 Introduction:

Literature review provides an overview of factors evaluating self-managed Vis a Vis professionally managed construction projects. Further relation of these attributes with productivity and efficiency needs improvement in decision making process. In effort to fulfill this need, research methodology will help to accomplish the aims and objectives of the research.

Research methodology is a body of literature that allows researchers to clarify procedures and assessment methods, show limitations and resources, identify their assumptions and consequences and connecting to the potential as the research advances (Miller and Salkind, 2002). The appropriation between research concepts, data type and methods of collection has important consequences on the results of the research. Detailed methodology of this research which is used to achieve the objectives set forth in chapter 1 is discussed in this chapter.

3.2 Research Strategy:

To achieve the desired aims and objectives of the study, survey (questionnaire based) was conducted since it offers the advantage of covering a large population (Nirenberg, 2003). And large sample sizes ensure generalization and interpretation of result for the entire population (Mostafavi et al., 2013). This study follows a 4-stage research methodology as graphically represented in

Fig.3-1 research methodology. Maximum effort is to be put to ensure a scientifically sound and conveniently replicable methodology. The details of methodology are explained in the subsequent sections.

To develop the survey instrument, 15 significant effects by the adoption of SMCP were identified through an extensive review and synthesis of literature. The sample selected for this study was randomly chosen from civil engineers of the developing countries. All three major stakeholders (client, consultant and contractor) were included in the survey. The questionnaire was floated and submitted online. But to enhance the coverage, physical copies were also distributed when visiting the respondents personally. Out of 170 invitations, 111 completed responses were received, giving a response rate of 67.3%. This sample size is larger than the minimum size of 96, ensuring representatives and significance (Idris, 1998, Dillman, 2000). Microsoft® Excel, Super Decision (v2.10) and SPSS® 23 were used for data analysis. Statistical tests including Cronbach's coefficient for reliability and Shapiro-Wilk test for normality of data were performed. Cronbach's alpha evaluates the internal steadiness and reliability of data. The numerical value for Cronbach's alpha is between zero to one and identifies whether all the items in a test measures the similar concept. Before applying other tests, the validity and internal reliability of data must be ensured (Dainty et al., 2004). And finally, the effect due to adoption of SMCP was modeled through Analytical Hierarchical process (AHP) analysis. Methodology flow chart for this study is given below:

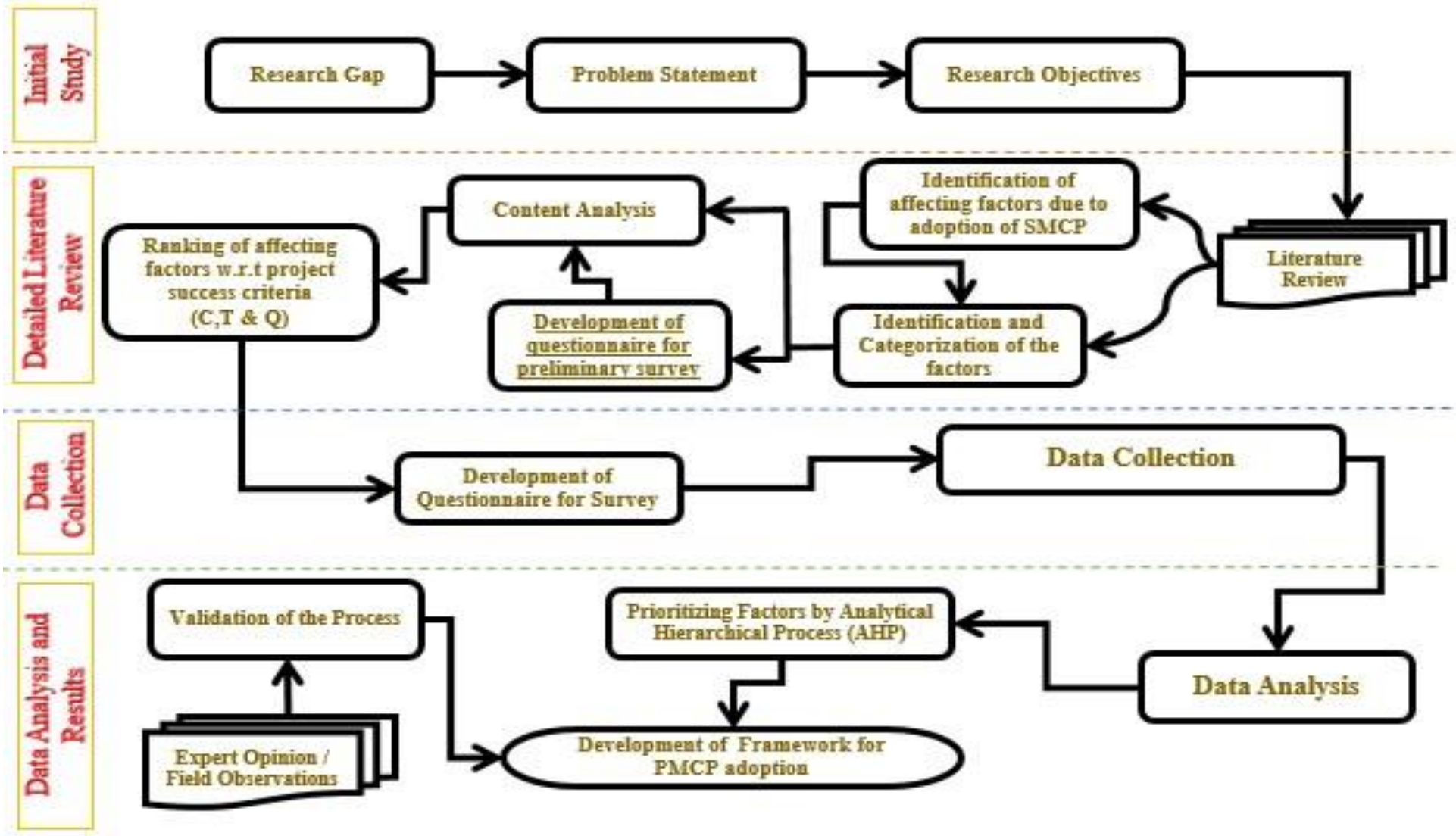

Figure 3-1: Methodology Framework

3.3 Procedures

The study is intended to provide a triangulation multi view (Wilson, 2014) of self-managed and professionally managed building projects with both a qualitative and a quantitative phase, each comprising distinct parts and steps. A wide range of guidelines, in situ observations, interviews, groups, search for literature, processes for rating and administration of questionnaires shall be combined with a view to drawing on the principled views of construction projects.

3.3.1 Phase 1 literature review:

In this phase an intense literature review is consulted, and numerous affecting effects are identified influencing construction projects in terms of its management styles i-e self-managed and professionally managed construction projects. According to their influencing factor they are further classified and prioritized.

3.3.2 Phase 2 Preliminary Surveys:

In this part of the research phase, focus is laid on the modification in the identified factors through literature review, by conducting field surveys (which included various data collection techniques). Initial questionnaires were developed which was rotated among the officials by an initial visit to the organization and observed, developed preliminary ideas about the work system; self-managed/professionally managed projects. Multiple interviews and discussions were conducted with employees at all levels. Extensive observations were made during their working hours.

3.3.3 Phase 3 Factors analysis and prioritization:

After thorough investigation, content analysis was performed on the factors identified through literature review and further validated through preliminary survey.

Top influencing effects were calculated and prioritized through detailed content analysis. Information gathered during our visits was used for preliminary identification of relevant effects variables in the situation, and combining with the literature search conducted, to identify relevant perspectives and measurement approaches, hence at the end of this part we developed a preliminary categorization system of affecting factors by adoption of SMCP over PMCP.

3.3.4 Phase 4 Interpretation for final data analysis and conclusion:

To carry out the data Analysis process efficiently and get authentic responses that tend more towards realistic grounds, it is of an immense importance that the response rate of respondents is as high as possible. Therefore, final questionnaire of the prioritized factors is to administer around to 150-200 employees, which would not only include elected internal team leaders, but also other directly/ indirectly members related to the cause. To achieve authenticity, the questionnaire was preferably mailed in soft form to the professional to fill it and they were made assured that any response provided by them would be held confidential and the respondents will be kept anonymous. Which removed any fear if there in regarding their organizations in which they are working.

3.4 Data Collection:

3.4.1 The Questionnaire

After effects identification, comprehensive surveys were developed for the evaluation of each affecting effect from the perspective of multinational firms working on international construction projects. Questionnaire was broken down into three core sections. The very first section collects general organizational information, organizational origin, organizational type, designation, qualification, and experience. Constructors from various countries around the world are among those surveyed. The second segment contains understanding of best management practices to the respondent. And how these factors influence the success in time and according to specification of financial goals of the project. Participants were asked to rate on the likert scale in the third and fourth sections for all determined affecting factors, w.r.t cost of the project, time and quality. Questionnaire survey was conducted for all 21 identified affecting effects instead of concentrating only on top 15 effects obtained from content analysis based on literature score, to have a broader opinion about aspect being faced in construction industry. In the next half question were asked to apprehend their influence of these effects w.r.t Cost (C), Quality (Q) and Time (T) in attaining project success. In the primary survey the impact of each individual affecting factor was asked on a likert scale of 1-5, where 1 is equal to very low effect and 5 equals to very high effect. Both these questionnaires i-e primary and secondary questionnaire have been shown in Appendix 1 and Appendix 2 respectively. After the field survey was completed, analysis was carried out to figure out critical affecting effects and lastly the analytical hierarchy process (AHP) was applied upon this data acquired.

3.4.2 AHP Introduction

The process of analytical hierarchy helps to create decision metrics through a classification with both qualitative and quantitative elements. Qualitatively, AHP degrade a problem of decision from the top overall objective to the final level usually with scenarios or alternatives that include several clusters, sub clusters and so on. Sub clusters/ clusters may include forces, characteristics, criteria, activities, targets, etc. Quantitatively, this calculates ' global' weights for assessment at the final level, by means of a comparison on pairs of elements at the cluster and sub-cluster levels. The relativity of the elements within a cluster is measured by a ratio scale in each pair-wise comparison. One of AHP's main functions is to calculate the consistency of the matrices so that they can be appropriate for evaluation. (Saaty, 1988).

3.4.3 AHP Methodology:

This study focuses mainly on the crucial effects by adopting the SMCP to keep the project within the budget, in accordance with schedule and the requirements. The Multi-Criteria Decisions Technique (MCDM) is extremely useful in resolving difficult issues which are not directly resolved. MCDM's key rule is that the strategy should be based on simple criteria that take more than one attribute into consideration (Cheng and Li, 2004). Since there are multiple factors which contribute towards more than one project success criterion. AHP is an approach to mathematical decisions (Saaty, 2008) to solving complex and ambiguous decision-making issues (Yang and Huang, 2000). AHP helps break down the complicated problem into a hierarchy of simplistic factors and sub-factors and makes measurement easier with the help of a comparative analysis (Saaty, 1988). One or more of AHP's most important characteristics is that both subjective and objective problem types can be applied (Cicmil, 2006). This technique

was primarily developed by decomposing a multi-criteria problem into distinct hierarchy levels with top hierarchy, mid-level as the criteria and sub-criteria and lower levels as an alternative design in the formation of the hierarchy (Saaty, 1988). Existing literature gives the appearance of how AHP is used in particular in the classification and priority of the various criteria and sub criteria (Chin and Pun, 2002)

3.4.4 AHP steps:

The stages of the AHP which are to be followed are as follows:

Step 1:

The first step is to clearly define and indicate the goals of the complex and ambiguous problem. The aim of this research is therefore to determine the success factor which will have a greater impact when the SMCP management system is implemented.

Step 2:

With help of group decision or survey technique, the multifaceted problem is broken up into a hierarchical structure. The hierarchical composition is broken down into several levels. The highest level-level hierarchy constitutes the objective of the problem that is evaluation of the selection of best practice management. In the next level, this target is sub-divided into different criteria. The criteria in current research correspond with cost, time and quality criteria for the success of the project. The criteria were further broken up into sub-criteria that show details of the criteria. All critical affecting factors are recognized as substrates of analysis in this research.

Step 3:

A comparison can be made by decision matrix in pairs to show the importance of one criterion compared with another. The decision-making matrix is based on a nine-point scale (Saaty, 1994). With the help of decision makers and experts the elements underlying the common node are compared to the other elements of that same node in the hierarchical structure. For example, if the node contains "n" elements, then n (n-1)/2 node is compared under that node. Let X1, X2, X3, ... Xn elements below the node "M" and their weight numbers are w1, w2, w3, … Wn. The pairwise comparison of these components in accordance to their comparative weights are shown in the form of a matrix, where Z is the comparison matrix (n xn) that represents pairwise comparisons among the components X1, X2, X3, …. Xn:

$$Z = \begin{array}{c} \\ X_1 \\ X_2 \\ \vdots \\ X_n \end{array} \begin{array}{c} \begin{array}{cccc} X_1 & X_2 & \cdots & X_n \end{array} \\ \begin{pmatrix} \frac{W_1}{W_2} & \frac{W_1}{W_2} & \cdots & \frac{W_1}{W_n} \\ \frac{W_2}{W_1} & \frac{W_2}{W_2} & \cdots & \frac{W_1}{W_n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{W_n}{W_1} & \frac{W_n}{W_2} & \cdots & \frac{W_n}{W_n} \end{pmatrix} \end{array} \qquad \text{Equation one}$$

$$Z = \begin{array}{c} \\ X_1 \\ X_2 \\ \vdots \\ X_n \end{array} \begin{array}{c} \begin{array}{cccc} X_1 & X_2 & \cdots & X_n \end{array} \\ \begin{pmatrix} a_{11} & a_{12} \ldots & a_{1n} \\ a_{21} & a_{22} \ldots & a_{2n} \\ \vdots & \vdots\vdots & \vdots \\ a_{n1} & a_{n2} \cdots & a_{nn} \\ & & \end{pmatrix} \end{array} \qquad \text{Equation two}$$

Where aij = wi/wj (i, j = 1, 2 … n) represents the explicit comparative significance among the pair of factors Xi and Xj. If i =j then aij = 1 and aij = 1/aji for aij>0.

Step 4:

The next step is to define the priority weights of elements through the maximum eigenvectors and eigenvalues after the formation of the decision-making matrix.

As mentioned by (Saaty, 1994): λmax

$$\lambda_{\max} = \sum_{i=1}^{i} a_{ij} \frac{W_j}{W_i}$$ Equation three

Step 5:

This step checks the consistency of the parallel comparisons. Comparing pairwise, the inconsistency is measured by the Consistency Index (CI) and the consistency ratio (CR) is measured and calculated with the help of given formula:

$$CI = \frac{\lambda_{\max} - n}{n-1}$$ Equation four

$$CR = \frac{CI}{RI}$$

Where n is the rank of matrix and consistency index (CI) and random index (RI) of matrices are generated randomly. The extreme acceptance limit of CI and RI is 0.1(Saaty, 1994). If the values exceed 0.1, this highlight that the pairwise comparison is inconsistent and hence it would be discarded. For different values of 'n', the values of RI are depicted in the Table. 3.1 (Saaty, 1994):

Table 3-1:Respective values of RI

N	2	3	4	5	6	7	8	9
RI	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Step 6:

Once the priority weights of every element, which is local weights of elements, are identified, the next step is to identify the overall weights which is global weights of all elements in relation to the objective defined in the AHP model.

Step 7:

Lastly but not the least, after calculating the global weights elements are repositioned in the ascending order rendering to the global prioritization.

3.5 Super Decisions

Super decision (v2.10) software is used to implement the approaches for different techniques defined by Dr. Thomas Saaty who developed multiple decision-making criteria (MCDM) for decision making with dependence and feedback.

The software was compiled by the Creative Decision Foundation's working team. AHP of the MCDM technique uses the basic mechanism of priority-based prioritization to evaluate element pairs or to prioritize direct measurements by normalization (Adams and Saaty, 2012). In the AHP, decision aspects are arranged from the top (goal) to bottom (criteria and alternatives of choice) in a hierarchical decision structure.

3.6 Tools and techniques used:

To achieve the defined objectives following different tools, techniques and sources are utilized as shown in the Table 3-2.

Table 3-2: Tools and techniques

S. No	Objectives	Tools and techniques	Source
1	**To identify and analyze factors affecting project objectives; i-e. Cost, Time & Quality, by adoption of SMCP**	▪ Literature review ▪ Preliminary survey ▪ Expert opinion	▪ Research papers ▪ Reports ▪ Articles ▪ Thesis ▪ Books
2	**To prioritize the influence of highlighted factors over Cost, Time and Quality using Multiple criteria decision making (MCDM) approach**	▪ Questionnaire survey ▪ Expert opinion ▪ Analytical hierarchical Process (AHP's)	▪ Research papers ▪ Thesis ▪ Experts opinion ▪ Technical professionals/ practitioners
3	**Development of a conceptual approach for adoption of PMCP.**	▪ Super Decision v2.10 (AHP tool) ▪ Expert opinion	▪ Research papers ▪ Technical professionals/ practitioners

3.7 Summary:

It has discussed the research methodology and the technique to be used for analysis. The methodology of the applied technique, AHP is also described in detail which results in the prioritization of affecting factors; therefore, achieving the goal of the research and the results were compiled as shown in the following chapter.

Chapter 4

RESULTS AND ANALYSIS

This section explains the results deduced after both questionnaire surveys. First half of the questionnaire consists of the organizational information, origin of organization, type of organization, designation, qualification and experience. Second half comprises of the questions based on effects by adoption SMCP. Formerly outcomes are attained after analyses. This chapter altogether gross up aims and objectives of the research.

4.1 General Information:

An overall of 170 diverse range of construction professionals were contacted for data collection, all were associated with multinational companies. 70% of the responses were collected from international countries. Origin of most responding individuals are from China, Malaysia, Turkey, India, South Africa and Bangladesh.

4.1.1 Preliminary survey

The purpose of conducting preliminary survey was to include the industry professional's input before performing content analysis. Preliminary survey questionnaire was circulated to 32 experts having industry field experience of more than 10 years. Based on the feedback of experts, industry normalized score was calculated by using mode values obtained from survey. Against weightages normalized industry and literature scores were combined. After factor comparisons, top 15 most significant affecting effects due to adoption of SMCP were finalized for further analysis. Expert's demographics are shown in Table.4-1.

Table 4-1: Primary Survey demographics

Organization type	No. of responses	Years of experience	Total no.	Educational level	Total no.
Consultant	12	**21 and above**	14	**M.Sc/M.Eng/M.Arch/P.G.Dip**	15
Prof. Engr	8	**16 to 20**	12	**B.Sc/B.Eng/B. Arch**	9
Contractor	7	**11 to 15**	6	**PhD/D.Eng**	8
Client	5				
Total	**32**				

4.2 Field data

4.2.1 Regional distribution of responses

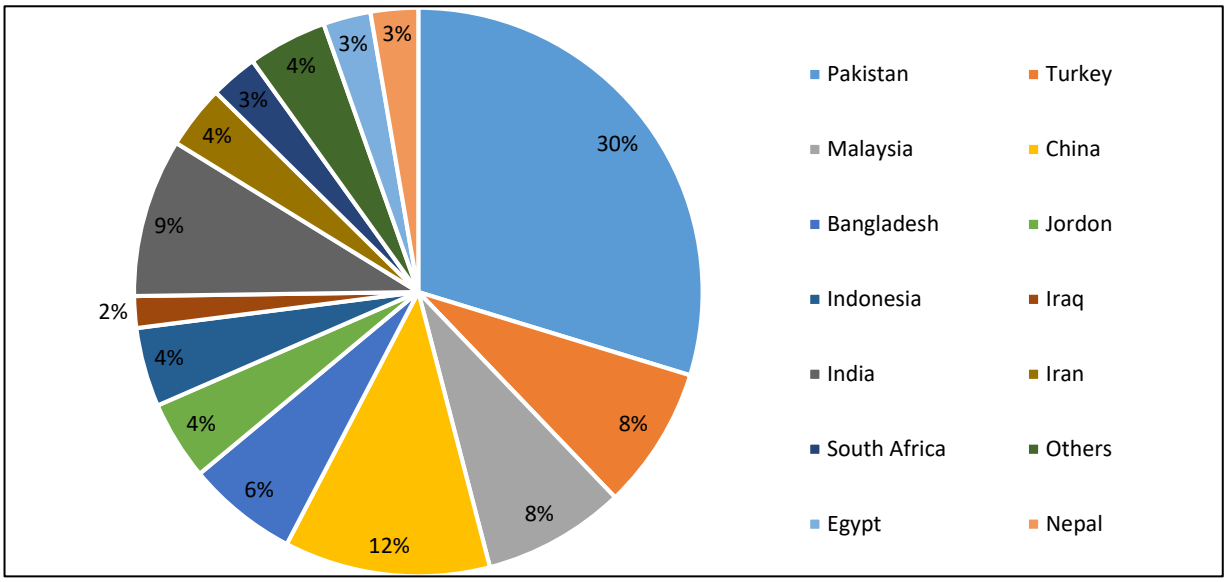

Figure 4-1 : Demographic survey

Total 111 survey responses were collected out of which 30% were national and 70% were international. Major countries participated in the survey include Pakistan, China, India, Turkey,

Malaysia, Bangladesh, Jordon, Indonesia, Iran, Iraq, South Africa, Egypt, Nepal and others as shown in Fig.4-1. All the responses were collected from developing countries.

4.2.2 Respondents profile

For response collection, diverse range of construction professionals were targeted including construction/project manager, planning engineer, architect/designer, general manager, contract administrator, project engineer/site engineer and many others. The major responses were received from project managers/construction managers (28.8%) and project engineers/site engineers (28.8%). Cumulatively, 55 respondents had an experience of more than 10 years indicating that 50% responses were received from highly experienced professionals. Only 21 responses were collected form professionals with experience less than 5 years contributing only 21% responses of the total sample.

From qualification perspective, a total of 67 responses were collected from M.Sc. holders and PhD holders indicating 60% response rate from highly qualified professionals. Whereas, 40% responses were received from professionals of B.Sc. /B.Eng. graduates. The questionnaire was filled by majority of professionals with high academic qualification and industry experience thus validating the reliability of their opinions. Consequently, the knowledge on adoption of SMCP and its effects on project success criteria in construction industry is significant as it reflects whether the project parties are well informed about the topic. The results show a moderate to advanced understanding of adoption of SMCP and its effects on project success criteria with 92% rate thus strengthening the confidence in quality of data. Table.4-2 provides comprehensive details about respondent's profiles.

Table 4-2: Demographic characteristics of respondents

Profile	Frequency	Percentage
Total responses = 111		
Job title		
Construction/project manager	32	29%
Project/site engineer	32	29%
Planning engineer	9	8%
Architect/designer	10	9%
General manager	6	5%
Contract administrator	10	9%
Project director	9	8%
Others	3	3%
Experience (years)		
1 - 5	24	22%
6 - 10	32	29%
11 - 15	17	15%
16 - 20	15	14%
Above 20	23	21%
Education		
B.Eng./ B.Sc.	44	40%
MS/M.Sc.	62	55%
PhD/D. Eng.	5	5%
Understanding of stakeholder conflicts and project constraints		
No understanding at all	2	2%
Slight	14	12%
Moderate	60	54%
Advanced	35	32%

4.2.3 Reliability & Validity:

Measuring the internal consistency and reliability of data, the value of Cronbach's alpha was 0.863. Values ranging from 0.70-0.95 are acceptable for further analysis (Tavakol and Dennick, 2011). Therefore, the data used for present study is valid and reliable. Further, to check the normality of data, Shapiro-Wilk test was performed. The results highlighted a significance value of 0.062 which is less than 0.05, which indicates that the data is not normal, hence if further required non-parametric test are to be applied for analysis.

4.3 Ranking Critical factors affecting project success by adoption of SMCP:

Because of last section of the questionnaire, impacts of effects by adoption of SMCP on cost, time and quality were asked. After having literature and respondent score, total normalized scores were calculated for each affecting factor, to find critical affecting factors for each of the success criteria. Table. 4-3 shows factors score.

Among the factors identified, there were very few with low cumulative score, so omitting them would not greatly affect the overall evaluation and efficacy. These low-level factors will also induce these factors in the overall process due to the enormous complexity, so dismissing these factors and using the remaining factors was done as proposed by (Egemen and Mohamed, 2008). Therefore, factors dictating up-to 80% of the decision were considered most important which result out the total normalized score of each affecting factor, simultaneously cumulative score was then calculated.

Effects by the adoption of SMCP are calculated w.r.t each success criteria. Observing Table.4-3 we came to know that 4 factors become influential under PM Competency group contributing

to project objectives, while 3 factors under Coordination, 4 under Performances and 4 factors under Project Control group respectively. As the number of influencing factors in a category increases it reduces the severity for overall affecting factors.

Table 4-3 : Ranking of factors affecting in selection of best management practices

Ranking	Categorize	Abbreviations	Fq	Normalized Literature Score	Normalized Respondent Score	Normalized Total Score	Cumulative Normalized Score
1	**Project Control**	**S&VL**	25	0.0920	0.0746	0.0851	0.0851
2	**PM Competency**	**PM&B**	19	0.0700	0.0597	0.0659	0.1509
3	**Coordination**	**DA/ED**	22	0.0810	0.0299	0.0605	0.2115
4	**Coordination**	**SCTM**	18	0.0663	0.0448	0.0577	0.2691
5	**PM Competency**	**RTD**	20	0.0736	0.0299	0.0561	0.3253
6	**Coordination**	**LSKM**	26	0.0574	0.0448	0.0524	0.3776
7	**PM Competency**	**NCBP**	21	0.0464	0.0597	0.0517	0.4294
8	**Project Control**	**OPTT**	15	0.0552	0.0448	0.0510	0.4804
9	**Project Control**	**PCL**	18	0.0398	0.0597	0.0477	0.5281
10	**Performances**	**VIQTC**	13	0.0479	0.0448	0.0466	0.5748
11	**Performances**	**IOSS**	17	0.0376	0.0597	0.0464	0.6212
12	**Performances**	**ORU**	10	0.0368	0.0597	0.0460	0.6672
13	**Performances**	**PBEIA**	21	0.0464	0.0448	0.0457	0.7129
14	**Project Control**	**LTFI**	18	0.0398	0.0448	0.0418	0.7547
15	**PM Competency**	**EI**	22	0.0486	0.0299	0.0411	0.7958

4.4 Criteria score:

Respondents were questioned to rate influence of cost, time and quality in a project success. Table.4-4 illustrates their scores.

Table 4-4: Criteria Score

Project Success Criteria	Score (%)
Cost (CT)	30
Time (TM)	50
Quality (QT)	20

It is observed from affecting factors that there are few effects that are influencing project success criteria in one way or the other. An (AHP) technique is used to identify priority factors based on project success criteria. It is now clear that out of 21 affecting factors, top15 ones are more influential and will be prioritized accordingly using the said approach w.r.t to Project objectives. Eventually, prioritization is done for top affecting 15 factors influencing the success criteria. The objective of AHP is to identify the vital area for the effects that affect several criteria.

4.5 Prioritization of affecting factors contributing to a successful PMCP adoption using AHP:

Creative thought, recollection and the use of people's perceptions could well develop a hierarchy in a hierarchical approach (Saaty, 1994). The number of levels and structure is not specified in the hierarchical structure as it depends on the nature of the management choice (Akhavan and Zahedi, 2014). First, the study goal is defined to achieve the prerequisite structure for the goal

and criteria and sub-criteria are chosen to achieve this goal. A Hierarchy is formed at subsequent levels from the top goal to different level of criteria and sub-criteria. The method for selecting different levels of criteria and developing hierarchical composition has been proposed by (Saaty, 1994). Using these guidelines to achieve the goal, an AHP framework is formed. Fig.4-5 shows a hierarchy of decisions at three levels that incorporates these criteria and sub-criteria. Table.4-5 shows affecting factors with abbreviation, this is done in the analytical hierarchical process to facilitate factor handling.

Table 4-5: Critical affecting factors with abbreviation

Symbols (IDs)	**Factors**	**Abbreviations**
PC1	Size and value of Project being large	S&VL
PM4	Poor monitoring and Budgeting	PM&B
CO1	Disagreements with Architect/Engineer design	DA/ED
CO3	Severe conflicts among team members	SCTM
PM1	Reluctance in timely Decisions	RTD
CO4	Lack of selecting key members at initial stages of construction phase	LSKM
PM2	Non-Competitive bidding phase	NCBP
PC3	Over sighting proper planning tools and techniques for risk management	OPTT
PC5	Poor commitment level with other parties of project	PCL

PF2	Vested interest on quality and timely completion of project	VIQTC
PF3	Inappropriate organizational structures & stability	IOSS
PF1	Optimum Resource utilization	ORU
PF4	Pass by environmental impact assessments on site	PBEIA
PC6	Lack of transparency in financial issues	LTFI
PM5	Expertise insufficiency	EI

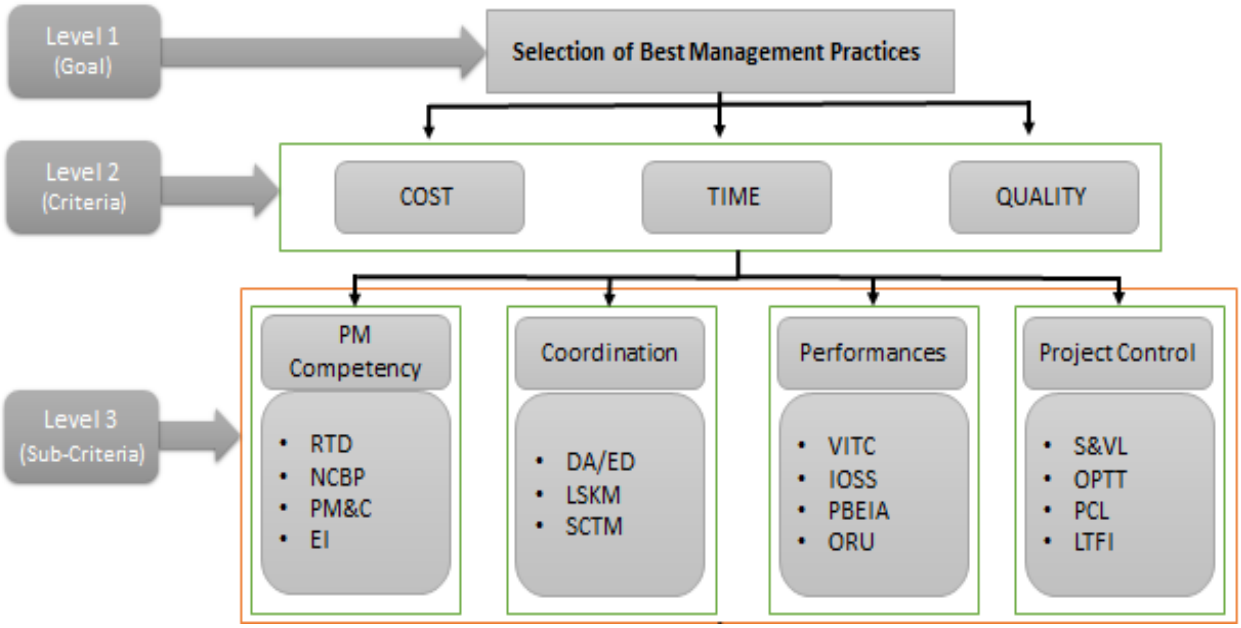

Figure 4-2: An AHP based model for determination of affecting factors priorities

4.5.1 Assigning Relative Weights:

Factors are compared in the AHP process by assigning their relative merits to a weight. After hierarchy was formed, a matrix of comparison was formed. This matrix is an individual respondent priority statement. All respondents were requested to make comparisons for criteria and factors very wisely by allocating its impact of the effects w.r.t criteria, later it is transformed

into a relative value on a 9-point scale proposed by (Saaty, 1994), keeping the model's goal or objective in mind. The comparison is focused on the relative significance of the factor' ith' over the factor ' jth.' The result of this pairwise comparison was a positive reciprocal matrix, with the diagonal aii= 1 with the reciprocal property of another factor. For example, if factor' i' is "p-times" more important than factor ' j' then factor ' j' is “1/p times" more important than factor' i' according to reciprocity rule. The scale of 1-9 is used to reveal the relative importance of a pair of affecting factors. Therefore, questions were asked on a scale of 1 to 9 in this case as shown in Table.4-6 (Saaty, 1994) shows the intensity of significance for each of the scale values.

Table 4-6: Comparison scale transformed into impact scale

Verbal Scale	**Intensity of importance**
Extreme effect	9
Very strong effect	7
Strong effect	5
Moderate effect	3
Equal effect	1
Intermediate effects	8,6,4,2

4.5.2 Pairwise comparison of Criteria:

Evaluation of all three success criteria of this study is performed in pairs with respect to the goal of successful selection of best management practices in the construction industry. It demonstrates each criterion's relative importance against the model's goal. Table.4-7 shows the synthesized matrix.

Table 4-7: Pairwise comparison of criteria

Consistency Ratio (0.046)	Cost	Time	Quality
Cost	1	1/2	3
Time	2	1	3
Quality	1/3	1/3	1

4.5.3 Pairwise comparison of Sub-Criteria (Categorizes):

All four sub-criteria pairwise comparison of this research w.r.t project objectives (Cost, Time and Quality) is also carried out. It highlights the relative importance of each sub-criterion against the project success criteria and ultimately to the best management selection as goal at the top of hierarchy. Below Table.4-8 shows the synthesized matrix.

Table 4-8: Pairwise comparison of sub-criteria

Consistency Ratio (0.065)	PM Competency	Coordination	Performances	Project Control
PM Competency	1	4	1/3	3
Coordination	1/4	1	1/4	1/2
Performances	3	4	1	3
Project Control	1/3	2	1/3	1

4.5.4 Pairwise comparison of affecting factors:

After the pairwise comparison of project success criteria, likewise comparison of affecting factors is also accomplished. The pairwise comparison considers: the factors of PM Competency; such as Expertise Insufficiency, Non-competitive bidding phase, poor monitoring and budgeting control and Reluctancy in timely decision was compared w.r.t "COST", then with "TIME" and with "QUALITY" criteria. Likewise, factors of Coordination; such as Disagreement with Engineer/Architect design, Lack of selecting key members at early stages and severe conflicts among team members was compared w.r.t "Cost" then with "TIME" and with "QUALITY" criteria. Performances factors; such as Inappropriate organizational structures, optimum resource utilization, pass by environmental impact assessment and vested interest on timely completion was compared w.r.t "Cost" then with "TIME" and with "QUALITY" criteria. And lastly Project control measures; such as size and value of project being large, poor commitment level, oversighting proper tools and techniques and lack of transparency in financial issues was compared w.r.t "Cost" then with "TIME" and with "QUALITY" criteria. Table 4-9, 4-10, 4-11 and 4-12 shows comparisons for 'Cost', Table 4-13, 4-14, 4-15 and 4-16 shows comparisons for 'Time' and 4-17, 4-18, 4-19 and 4-20 are showing comparisons for 'Quality'

Table 4-9: Pairwise comparison matrix of "PM Competency" factors w.r.t Cost

Consistency Ratio (0.063)	EI	NCBP	PMC	RTD
EI	1	2	1	1/2
NCBP	1/2	1	1/4	1/3
PMC	1	4	1	2
RTD	2	3	1/2	1

Table 4-10: Pairwise comparison matrix of "Coordination" factors w.r.t Cost

Consistency Ratio (0.075)	DA/ED	LSKM	SCTM
DA/ED	1	1/4	3
LSKM	4	1	5
SCTM	1/3	1/5	1

Table 4-11: Pairwise comparison matrix of "Performances" factors w.r.t Cost

Consistency Ratio (0.041)	IOSS	ORU	PBEIA	VITC
IOSS	1	1/5	2	1/4
ORU	5	1	5	2

PBEIA	1/2	1/5	1	1/3
VITC	4	1/2	3	1

Table 4-12: Pairwise comparison matrix of "Project Control" factors w.r.t Cost

Consistency Ratio (0.083)	**LTFI**	**OPTT**	**PCL**	**S&VL**
LTFI	1	2	3	1/3
OPTT	1/2	1	5	1/2
PCL	1/3	1/5	1	1/5
S&VL	3	2	5	1

Table 4-13:Pairwise comparison matrix of "PM Competency" factors w.r.t Time

Consistency Ratio (0.079)	**EI**	**NCBP**	**PMC**	**RTD**
EI	1	1/2	1/3	1/4
NCBP	2	1	2	1/4
PMC	3	1/2	1	1/3
RTD	4	4	3	1

Table 4-14:Pairwise comparison matrix of "Coordination" factors w.r.t Time

Consistency Ratio (0.016)	DA/ED	LSKM	SCTM
DA/ED	1	1/3	2
LSKM	3	1	4
SCTM	1/2	1/4	1

Table 4-15: Pairwise comparison matrix of "Performances" factors w.r.t Time

Consistency Ratio (0.080)	IOSS	ORU	PBEIA	VITC
IOSS	1	1/4	2	1/4
ORU	4	1	4	1/3
PBEIA	1/2	1/4	1	1/4
VITC	4	3	4	1

Table 4-16: Pairwise comparison matrix of "Project Control" factors w.r.t Time

Consistency Ratio (0.060)	LTFI	OPTT	PCL	S&VL
LTFI	1	1/4	1/3	1/4
OPTT	4	1	3	1/2

PCL	3	1/3	1	1/4
S&VL	4	2	4	1

Table 4-17: Pairwise comparison matrix of "PM Competency" factors w.r.t Quality

Consistency Ratio (0.069)	**EI**	**NCBP**	**PMC**	**RTD**
EI	1	2	4	2
NCBP	1/2	1	1/2	1/2
PMC	1/4	2	1	1
RTD	1/2	2	1	1

Table 4-18: Pairwise comparison matrix of "Coordination" factors w.r.t Quality

Consistency Ratio (0.064)	**DA/ED**	**LSKM**	**SCTM**
DA/ED	1	4	3
LSKM	1/4	1	1/3
SCTM	1/3	3	1

Table 4-19: Pairwise comparison matrix of "Performances" factors w.r.t Quality

Consistency Ratio (0.089)	IOSS	ORU	PBEIA	VITC
IOSS	1	1/5	1/3	1/4
ORU	5	1	4	5
PBEIA	3	1/4	1	1/2
VITC	4	1/5	2	1

Table 4-20:Pairwise comparison matrix of "Project Control" factors w.r.t Quality

Consistency Ratio (0.063)	LTFI	OPTT	PCL	S&VL
LTFI	1	1/5	1/2	1/4
OPTT	5	1	5	1/2
PCL	2	1/5	1	1/4
S&VL	4	2	4	1

4.5.5 Normalized Matrix:

Computing numbers that considers the overall values is normalization, this formulates in two steps:

- Firstly, in the reciprocal matrix the summation of each column is done.

- After which each matrix element is divided to the total sum (column) hence a normalized matrix is then obtained.

Note that the total sum of each column should be equal to one. The normalized matrix for these clusters are shown in Table 4-21 and 4-22, factors of PM Competency, Coordination, Performances and Project Control for COST are shown in Table 4-23, 4-24, 4-25 and 4-26 respectively. Normalized matrices of TIME for factors of PM Competency, Coordination, Performances and Project Control are shown in Table 4-27, 4-28, 4-29 and 4-30 respectively. Table 4-31, 4-32, 4-33 and 4-34 are showing normalized matrices PM Competency, Coordination, Performances and Project Control for QUALITY.

Table 4-21: Normalized matrix of Criteria

Consistency Ratio (0.046)	**Cost**	**Time**	**Quality**	**Priority Vector**
Cost	0.30	0.27	0.43	0.33
Time	0.60	0.55	0.43	0.52
Quality	0.10	0.18	0.14	0.14

Table 4-22: Normalized matrix of Sub- Criteria

Consistency Ratio (0.065)	**PM Competency**	**Coordination**	**Performances**	**Project Control**	**Priority Vector**
PM Competency	0.22	0.36	0.17	0.40	0.29

Coordination	0.05	0.09	0.13	0.07	0.09
Performances	0.65	0.36	0.52	0.40	0.48
Project Control	0.07	0.18	0.17	0.13	0.14

Table 4-23: Normalized matrix of "PM Competency" factors w.r.t Cost

Consistency Ratio (0.063)	**EI**	**NCBP**	**PMC**	**RTD**	**Priority Vector**
EI	0.22	0.20	0.36	0.13	0.23
NCBP	0.11	0.10	0.09	0.09	0.10
PMC	0.22	0.40	0.36	0.52	0.38
RTD	0.44	0.30	0.18	0.26	0.30

Table 4-24:Normalized matrix of "Coordination" factors w.r.t Cost

Consistency Ratio (0.075)	**DA/ED**	**LSKM**	**SCTM**	**Priority Vector**
DA/ED	0.19	0.17	0.33	0.23
LSKM	0.75	0.69	0.56	0.67
SCTM	0.06	0.14	0.11	0.10

Table 4-25:Normalized matrix of "Performances" factors w.r.t Cost

Consistency Ratio (0.041)	IOSS	ORU	PBEIA	VITC	Priority Vector
IOSS	0.10	0.11	0.18	0.07	0.11
ORU	0.48	0.53	0.45	0.56	0.50
PBEIA	0.05	0.11	0.09	0.09	0.08
VITC	0.38	0.26	0.27	0.28	0.30

Table 4-26: Normalized matrix of "Project Control" factors w.r.t Cost

Consistency Ratio (0.083)	LTFI	OPTT	PCL	S&VL	Priority Vector
LTFI	0.21	0.38	0.21	0.16	0.24
OPTT	0.10	0.19	0.36	0.25	0.22
PCL	0.07	0.04	0.07	0.10	0.07
S&VL	0.62	0.38	0.36	0.49	0.46

Table 4-27: Normalized matrix of "PM Competency" factors w.r.t Time

Consistency Ratio (0.079)	EI	NCBP	PMC	RTD	Priority Vector
EI	0.10	0.08	0.05	0.14	0.09

NCBP	0.20	0.17	0.32	0.14	0.20
PMC	0.30	0.08	0.16	0.18	0.18
RTD	0.40	0.67	0.47	0.55	0.52

Table 4-28: Normalized matrix of "Coordination" factors w.r.t Time

Consistency Ratio (0.016)	**DA/ED**	**LSKM**	**SCTM**	**Priority Vector**
DA/ED	0.22	0.21	0.29	0.24
LSKM	0.67	0.63	0.57	0.62
SCTM	0.11	0.16	0.14	0.14

Table 4-29: Normalized matrix of "Performances" factors w.r.t Time

Consistency Ratio (0.080)	**IOSS**	**ORU**	**PBEIA**	**VITC**	**Priority Vector**
IOSS	0.11	0.06	0.18	0.14	0.12
ORU	0.42	0.22	0.36	0.18	0.30
PBEIA	0.05	0.06	0.09	0.14	0.08
VITC	0.42	0.67	0.36	0.55	0.50

Table 4-30: Normalized matrix of "Project Control" factors w.r.t Time

Consistency Ratio (0.060)	LTFI	OPTT	PCL	S&VL	Priority Vector
LTFI	0.08	0.07	0.04	0.13	0.08
OPTT	0.33	0.28	0.36	0.25	0.31
PCL	0.25	0.09	0.12	0.13	0.15
S&VL	0.33	0.56	0.48	0.50	0.47

Table 4-31: Normalized matrix of "PM Competency" factors w.r.t Quality

Consistency Ratio (0.069)	EI	NCBP	PMC	RTD	Priority Vector
EI	0.44	0.29	0.62	0.44	0.45
NCBP	0.22	0.14	0.08	0.11	0.14
PMC	0.11	0.29	0.15	0.22	0.19
RTD	0.22	0.29	0.15	0.22	0.22

Table 4-32: Normalized matrix of "Coordination" factors w.r.t Quality

Consistency Ratio (0.064)	DA/ED	LSKM	SCTM	Priority Vector
DA/ED	0.63	0.50	0.69	0.61

LSKM	0.16	0.13	0.08	0.12
SCTM	0.21	0.38	0.23	0.27

Table 4-33: Normalized matrix of "Performances" factors w.r.t Quality

Consistency Ratio (0.089)	**IOSS**	**ORU**	**PBEIA**	**VITC**	**Priority Vector**
IOSS	0.08	0.12	0.05	0.04	0.07
ORU	0.38	0.61	0.55	0.74	0.57
PBEIA	0.23	0.15	0.14	0.07	0.15
VITC	0.31	0.12	0.27	0.15	0.21

Table 4-34: Normalized matrix of "Project Control" factors w.r.t Quality

Consistency Ratio (0.063)	**LTFI**	**OPTT**	**PCL**	**S&VL**	**Priority Vector**
LTFI	0.08	0.06	0.05	0.13	0.08
OPTT	0.42	0.29	0.48	0.25	0.36
PCL	0.17	0.06	0.10	0.13	0.11
S&VL	0.33	0.59	0.38	0.50	0.45

4.5.6 Local weights and Global weights calculations:

The following step is to compute the local weights for criteria and sub-criteria independently. They represent the relative value of the element in relation to the other element placed immediately above the level of hierarchy. The decision-makers focus now is on the virtual value of each element with respect to the primary goal of the hierarchy after calculating these values for the above node and are known as global weights. The local weight and global weight of the hierarchical structure are consistent and should equal to one (Saaty, 2008). Global significances are calculated for all hierarchical elements by weighing the local priorities of their parents by global priorities assigned to their parent elements i.e. the preceding level (Davies et al., 1994).

4.5.7 Criteria and Sub-Criteria Ranking:

Purpose of the hierarchy model is to clearly classify the influence of all the key factors, the affecting factor should be rearranged in an ascending order, because it is then easy for executives to recognize which aspects affect decision making most. Table. 4-35 shows the priority weights of each factor.

Table 4-35: Priority weights for criteria, sub-criteria and factors

Criteria	Local Weights for Criteria	Groups	Local Weights for Sub-Criteria	Factors	Local Weights of factors	Global Weights
Cost	0.333	*PM Competency*	0.284	Expertise insufficiency	0.229	0.022
				Non-Competitive Bidding Phase (short bid time)	0.097	0.009
				Poor Monitoring & Budget feedbacks	0.377	0.036

				Reluctance in timely Decisions	0.297	0.028
		Coordination	0.083	Disagreement in Architectural/ Engineering Drawings	0.231	0.006
				Lack of selecting key members at early stage	0.665	0.018
				Severe Conflicts among team members	0.104	0.003
		Performances	0.499	Inappropriate organizational Structures & Stability	0.113	0.019
				Optimum Resource Utilization	0.504	0.084
				Pass by environmental impact assessment on site	0.084	0.014
				Vested interest on quality and timely completion of project	0.299	0.050
		Project Control	0.134	Lack of transparency in financial issues	0.242	0.011
				Over sighting proper tools & Techniques for risk management	0.225	0.010
				Poor commitment level	0.069	0.003
				Size & value of project being large	0.464	0.021
Time	0.525	*PM Competency*	0.284	Expertise insufficiency	0.093	0.014
				Non-Competitive Bidding Phase (short bid time)	0.205	0.031
				Poor Monitoring & Budget feedbacks	0.181	0.028

				Reluctance in timely Decisions	0.521	0.079
		Coordination	0.083	Disagreement in Architectural/ Engineering Drawings	0.239	0.011
				Lack of selecting key members at early stage	0.623	0.028
				Severe Conflicts among team members	0.137	0.006
		Performances	0.499	Inappropriate organizational Structures & Stability	0.120	0.032
				Optimum Resource Utilization	0.297	0.080
				Pass by environmental impact assessment on site	0.084	0.023
				Vested interest on quality and timely completion of project	0.499	0.134
		Project Control	0.134	Lack of transparency in financial issues	0.080	0.006
				Over sighting proper tools & Techniques for risk management	0.306	0.022
				Poor commitment level	0.147	0.011
				Size & value of project being large	0.468	0.034
Quality	0.142	*PM Competency*	0.284	Expertise insufficiency	0.447	0.016
				Non-Competitive Bidding Phase (short bid time)	0.138	0.005
				Poor Monitoring & Budget feedbacks	0.193	0.007

				Reluctance in timely Decisions	0.221	0.008
		Coordination	0.083	Disagreement in Architectural/ Engineering Drawings	0.608	0.007
				Lack of selecting key members at early stage	0.120	0.001
				Severe Conflicts among team members	0.272	0.003
		Performances	0.499	Inappropriate organizational Structures & Stability	0.070	0.005
				Optimum Resource Utilization	0.569	0.037
				Pass by environmental impact assessment on site	0.148	0.010
				Vested interest on quality and timely completion of project	0.212	0.014
		Project Control	0.134	Lack of transparency in financial issues	0.079	0.001
				Over sighting proper tools & Techniques for risk management	0.359	0.006
				Poor commitment level	0.111	0.002
				Size & value of project being large	0.451	0.008

This research provides a method for ranking the critical factors that could significantly affect in cost, time and quality for a successful selection of best management practices in construction project. For this purpose, analytical hierarchy process is used to rank those factors by comparing

their significance upon each other. This technique seems to accomplish sophisticated results that are based purely on the assignation of participants of the absolute priorities of each criterion. AHP demonstrates pairwise comparison of criteria, then of sub-criteria and at last for factors which are illustrated as shown in tables above. After performing sequential steps, the local & global weights of all factors are calculated as shown in Table 4-35. Very next column presents the local weights of success criteria which show that TIME with overall weight of 53.7 % stands at the top position. The weightage of time is approximately twice than the weightage of COST i.e. 33.3% and five times more than QUALITY i.e. 13.1%. The results reveal that despite all three primary project success criteria, the success of adoption/selection of best management practice is majorly based on the timely accomplishment of the project. The priorities of the affecting factors with respect to project success criteria are illustrated in following charts:

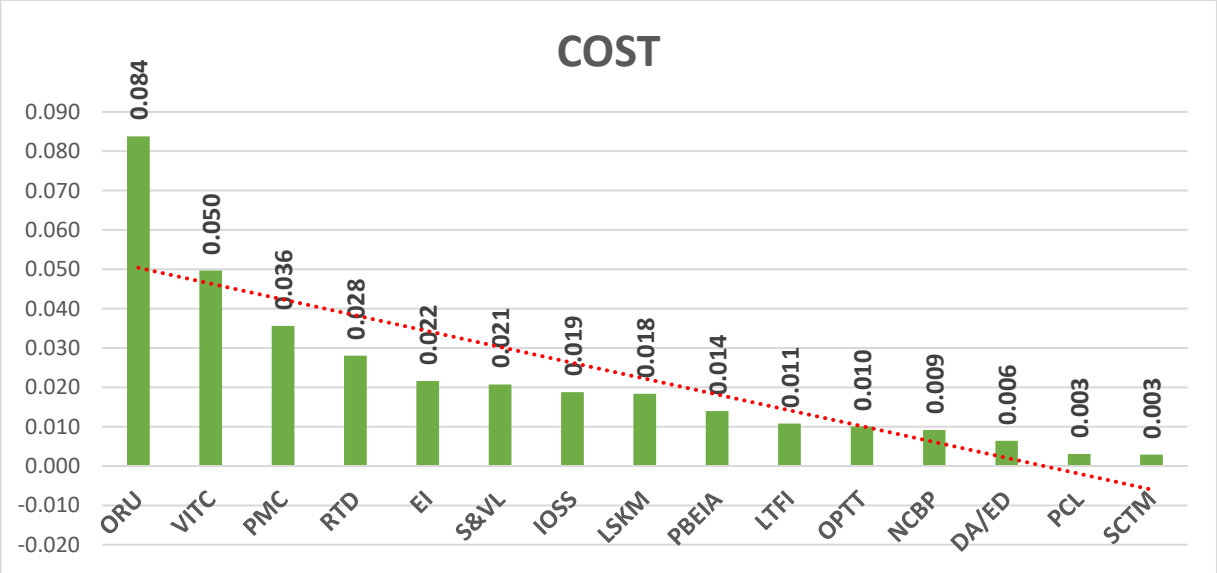

Figure 4-3: Bar Chart of prioritization of factors affecting "Cost"

From Table 4-35 we know that 'COST' posses 33.3% success on selecting best management practices in construction project. Cost is most significantly affected by optimum resource

utilization (0.084), whereas affecting factors such as; vested interest on timely completion of project (0.050) acquire distinctively higher weight than other mentioned factors hence its significance must also be considered for selecting best management practice within approved price. Prioritization of cost-influencing factors was demonstrated in Fig. 4-6. Poor monitoring and budgeting control (0.036), reluctancy on timely decisions (0.028), expertise Insufficiency (0.022), size & value of project being large (0.021), lack of inappropriate organizational Structures & Stability (0.019), lack of selecting key members at early stage (0.018), pass by environmental impact assessment (0.014) and lack of transparency in financial issues (0.011) are equally important for cost.

Over sighting proper tools & techniques for risk management (.010), non-competitive bidding phase (.009), disagreement in architectural/ engineering drawings (.006), poor commitment level (0.003) and severe conflicts among team members (0.003) are least affecting factors for cost. The graphical depiction clearly illustrates the priority level of all factors that affect in "Selecting best management practice" which will support the clients in making inclusive decision for adoption of PMCP. From this it is inferred that from these affecting factors, two of the factors among which ORU is most affecting factor while VITC should be considered next to important factor while deciding and adopting best management practice for cost.

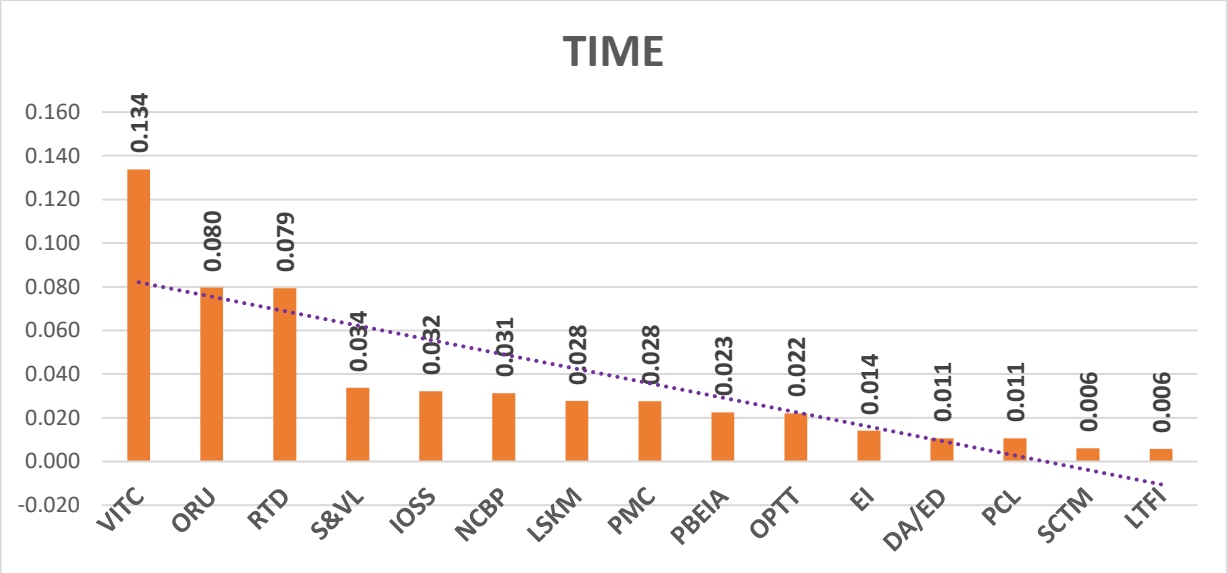

Figure 4-4: Bar Chart of prioritization of factors affecting "Time"

As described earlier, 'TIME' is at top possessing 52.5% success on selecting best management practice. And for time the most significant factor is vested interest on quality and timely completion of project with overall weight of (0.134), indicating importance for the key stakeholders to be on schedule right from the start and consciously monitor and observe project to avoid loses such as float and overall delays. Whereas factors like optimum resource utilization and reluctancy on timely decisions are significantly affecting time with scoring (0.080 and 0.079) respectively. Therefore, it is dire need to address the issue well before in selecting best management practice.

The ranking of affecting factors influencing time has been shown in Fig. 4-7. The graphic description clearly shows the priority level of all-important time-affecting factors. The factors such as size & value of project being large, inappropriate organizational structures & stability, non-competitive bidding phase (short bid time), lack of selecting key members at early stage, poor monitoring & budget control, pass by environmental impact assessment on site, over

sighting proper tools & techniques for risk management possessing weights (0.034, 0.032, 0.031, 0.028, 0.028, 0.023 and 0.022 respectively) moderately effects in selecting best management practice for time. While other factors such as expertise insufficiency (0.014), disagreement in architectural/ engineering drawings (0.011), poor commitment level (0.011), severe conflicts among team members (0.006) and lack of transparency in financial issues (0.006) have very least effect on time of a project.

Hence from this it can is determined that from these critical affecting factors, three of factors among which VITC is most affecting factor while ORU and RTD should be considered next to important factor while deciding and adopting best management practice for time.

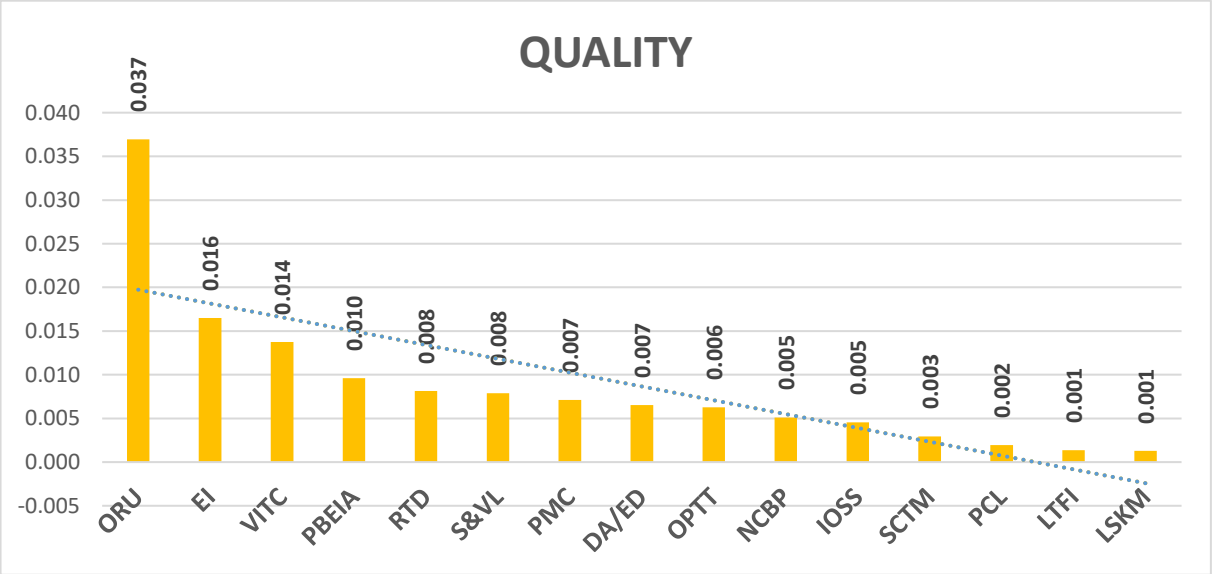

Figure 4-5: Bar Chart of prioritization of factors affecting "Quality"

'QUALITY' is the lastly considered criteria for a successful selection of best management practice in a construction project with a share of 14.2%. The most significant factor for quality is optimum resource utilization (0.037). Which shows that without professional consultation leads to utilizes maximum projects resources making conditions overstressing, ultimately in the

end compromising effect on the quality. Next to it factors such as expertise insufficiency, vested interest on quality and timely completion of project, pass by environmental impact assessment on site, reluctance in timely decisions, size & value of project being large, poor monitoring & budget control, disagreement in architectural/ engineering drawings, over sighting proper tools & techniques for risk management, non-competitive bidding phase (short bid time) and inappropriate organizational structures & stability; weighting (0.016, 0.0014, 0.010. 0.008, 0.008, 0.007, 0.007, 0.006, 0.005 and 0.005 respectively) stands equally vital, as e.g. large sized construction projects do require expert skills to acquire quality standards. The ranking of affecting factors influencing quality has been shown in Fig. 4-8. The graphical demonstration clearly depicts the priority-level of all influencing and affecting factors for quality.

The factors such as severe conflicts among team members (0.003), poor commitment level (0.002), lack of transparency in financial issues (0.001) and lack of selecting key members at early stage (0.001) have the least effect on quality of a project.

Thus, from this it is destined that from these critical affecting factors, one factors ORU is most affecting factor while EI, VITC, PBEIA, RTD, S&VL, PMC, DA/ED, OPTT, NCBP and IOSS should be considered moderately important factors while deciding and adopting best management practice for quality.

Optimum resource utilization results in most important affecting factor for cost, time and quality thus it must be noted considerable that professionals are to be involved early in the project to overcome the excess use of resources, since using most of resources leads to extend project lifecycle cost, pursuing it to become overstressing condition ultimately affecting quality standards and as the cost increases, the new intern payment certificated (IPC) needs to be revised resulting in increase of time for a project. A trend of significance is also seen for a factor; vested

interest on quality and timely completion of a project as it significantly effects two of the project success criteria i-e, cost and time, while equally effects time as well. Hence, it's obvious the more the interest level shifts from quality and timely completion of project the more budget overruns and quality is compromised leading to non-standardized completion of project which eventually runs over schedule routines. Last but not the least, reluctancy in timely decision is emerged as one of the significantly affecting factor for time while it equally effects cost and quality as well which indicates that if key members are unable to take timely decisions e.g. decisions related to procurement of machinery, this may lead to loss of substantial work affecting schedule routine for the upcoming activities and ultimately cost overruns as in increase in utilities plus to overcome cost deficiency quality is compromised in the end.

4.6 Selection of Alternatives for Best Management Practice using Analytical Hierarchical Process (AHP):

After prioritizing affecting factors distinctly for cost, time and quality, the final ranking of criteria is done form literature study and pilot survey as shown in Table 4.35. The table shows that level of significance of each effect which could affect in decision making. AHP has been then applied on project success criteria that are Cost, Time and Quality.

To validate the multi-criteria complexion of best management selection, responses have been collected to evaluate the effects of SMCP viz a viz PMCP. The effects and their grouping that are mentioned previously are based upon the results of study carried out which are used in the decision making of best management practice. This study focuses to apply the AHP on the responses collected from individuals related to construction industry from developing countries. As per the basic requirement of management practices, organization should tend to opt for adoption of PMCP over SMCP. The main objective of the client is to complete the project within

a predetermined time, approved budget and standardized quality. To manage and carry the project successfully, the best management practice affecting sub-criterion factors of (PM competency, coordination, performances and project control) play a substantial role. All companies strive to achieve project goals by adjusting these effects, while the level of consequence of these factors varies according to the necessities of client and project circumstances.

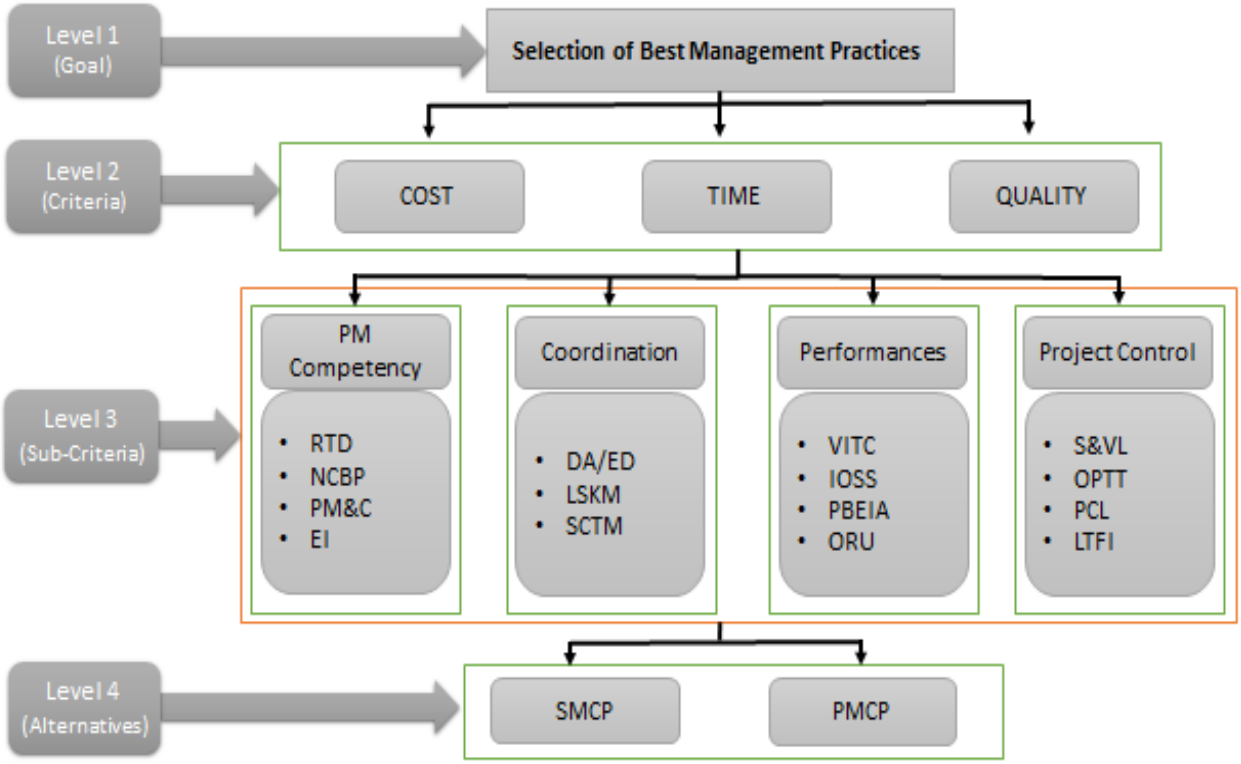

Figure 4-6: AHP structure for selection of best management practices

These factors were used by AHP to assess the appropriateness of decision-making alternatives, whether SMCP or PMCP, respectively. The AHP structure of these three criteria and four sub-criteria along with their alternatives are shown in Fig.4-9. The connections are made linear and simplified for better communication and understanding. In the following sections detailed discussion analysis using AHP for alternatives of best management practice are presented.

4.6.1 Comparison w.r.t Alternatives:

This process compares the relative importance and preferences in between elements (e.g. criteria) in relation to the next element (e.g. the goal) in the level set above to set preferences for comparing the elements. The very next stage is to relate the factors w.r.t alternative (PMCP and SMCP), which will indicate that to reduce the influence of the identified factors which alternative is preferred over another for selection of best management practice after comparing all the criteria, sub-criteria and factors.

4.6.2 Super matrix:

Super matrices are the result of pairwise comparison. This includes unweighted, weighted and limiting super matrix derived from @Super Decision v2.10. These all super matrices are included in Appendix 3.

4.6.3 Final Selection:

After super matrix formation, analytical hierarchical process (AHP) yields the priorities of alternatives. The following chart shows the priorities for selection of best management practices which validates their hierarchy from least significant to the most significant one that has been considered for adoption of best management practice.

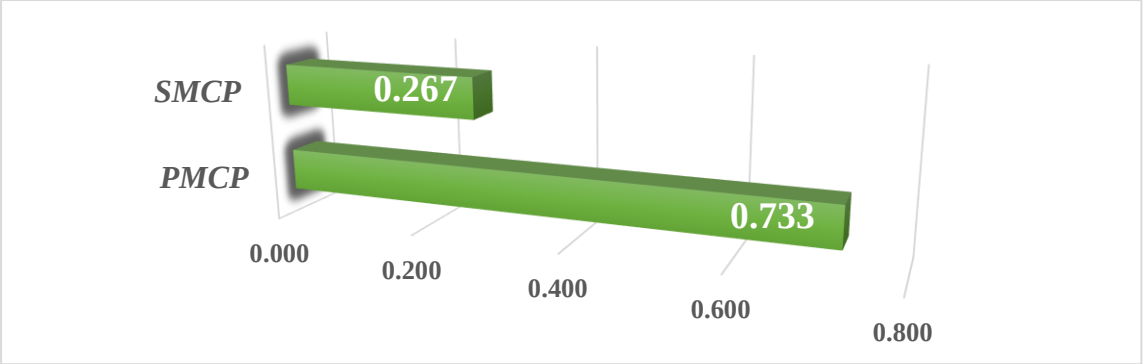

Figure 4-7: Bar Chart of Priorities of Alternatives

After applying this technique, above chart results are found. As shown in Fig. 4-10, since it is a process of decision-making with multiple criteria in which one alternative must be selected, in comparison between two, the overall score for adoption of Professionally managed construction projects (PMCP) is found almost three times better than self-managed construction project (SMCP) while selecting the best management practice in construction industry with an overall score of 0.728 (73%), while the other alternative i-e, SMCP attaining a score of 0.272 (27%). Therefore, the result shows that PMCP is to be adopted as its not only capable of carrying out the project within budget, time and standardized quality but rather more efficient in levels of PM competency, coordination, performances and overall project control. It demonstrates the value of each effects for the decision makers for adoption of PMCP. It can be stated that documentation and competence of PMCP was so strong that it led the decision makers into believing in their responsiveness and proficiency.

4.6.4 Equation for MCDM using AHP:

The overall relevance of each factor was determined by means of AHP, showing the extent to which, each factor is important in selecting best management practices. The equation for an MCDM of best management selection was established from the prioritization of factors as shown:

Best Management Practice Score $$(C') = \sum_{i=1}^{15} a_i . X_1$$

In this equation 'ai' are the coefficients which focusses the value of factors which are determined in previous section. 'Xi' are the variables and their values ranging from 1,2,3, .5. The user will integrate the values of variables conditional upon selection of best management practice concerning that factor.

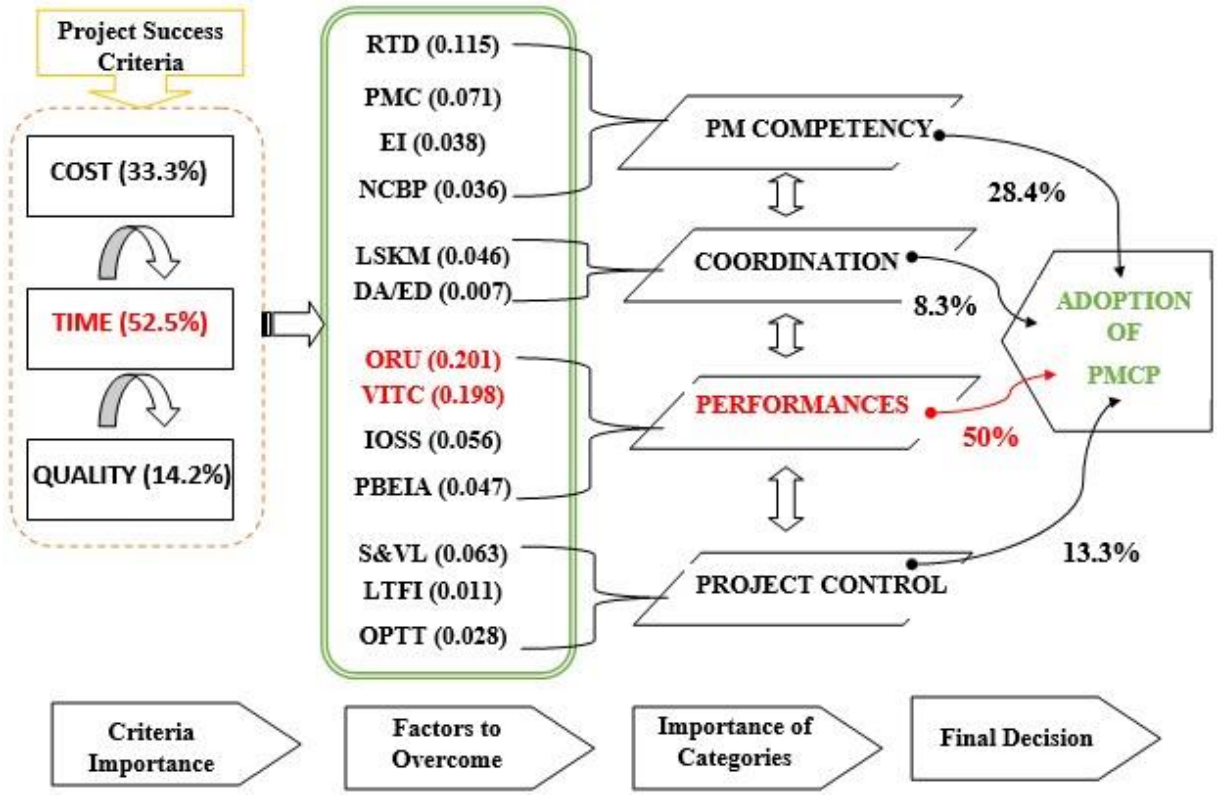

Figure 4-8: Conceptual Approach for adoption of PMCP

4.7 Validation of Conceptual Approach:

The conceptual approach in the Fig 4-8 was validated through criteria-based approach (Aziz et al., 2006) which focused on appropriateness (quality of being applicable & suitable for the construction industry), comprehensiveness (condition of including all affecting factors for successful adoption), accuracy (confidence on taking on the precision of results) and relevance (how closely the conceptual approach is related to their appropriateness).

Twelve construction industry experts were reached out, who evaluated it by foreseeing the incorporation of conceptual approach in the different stages of construction projects & considering the criteria. Positive response on overall usability; it undertakes the adoption of

PMCP, affecting factors as means, overcoming the effects and monitors the best management practice w.r.t project success criteria.

4.8 Summary:

This chapter summarizes the results of the analysis done by using an AHP technique. It also explains the general information of the professionals and the international and local firms being involved in selection of best management practice. The prioritization of all affecting factors has been done in this chapter and a conceptual approach as shown in Fig.4-8 for selection of best management practice i-e PMCP has been evaluated using AHP, which was the main goal for the research.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Literature Review from 2000-2018:

Literature was reviewed for affecting effects identification in construction projects. Various trends have been seen in these effects' identification during this time span. It has been observed from literature that a good number of research studies have been conducted on coordination, project control and PM competency depicting these three categories vital in achieving project success. Content analysis was carried out of which resulted in 21 critical affecting effects based on literature. A year-wise identification of effects has been shown, which tells that maximum of affecting effects have been identified in year 2004, 2013 and 2017. Coordination, Project Control and PM competency effects were identified throughout the span due to their considerable effects on adoption of SMCP. Literature has given a trend of yearly identification of these affecting effects.

Literature has shown the influence of affecting effects on project success. Therefore, this study has focused on the influence of these effects on project success triangle i.e. cost, quality and time. Construction is dynamic by nature, and the complexity enhances in complex construction projects owing to the contribution of many stakeholders. The uncertain environment, governmental stability, frequently changing policies and local suppliers augments the complication for international firm to cope up with local matters.

A total of 21 effects were identified after removing the low-ranking factors. These effects were collectively for cost, time and quality. It has been shown in Table. 2-1. These 21 effects were

then categorized into four different categories as shown in Table.2-37. And were found critical by their reoccurrence in the research papers through content analysis in detailed literature.

There were 6 effects in Project Control, 5 each for PM competency, Coordination and Performances. From these critical effects, few risks were critical for more than one criterion. For example, in coordination factor lack of selecting key members at early stages was critical for all the three success factors, therefore its priority is checked through an AHP method which tells that lack of selecting key members at early stages is critical for time then for cost and lastly for quality. For obtaining such priorities AHP method was applied.

5.2 Determination of priorities of affecting factors contributing in adoption of SMCP:

The main aim of this study is the identification and prioritization of affecting effects by using an AHP technique. Fifteen critical effects have been used for prioritization through AHP method. The relative importance of all these factors and their relative impact on success criteria have been identified by applying an AHP technique. Results indicate that critical effects have big influence on Time, therefore occupy the top priority in success criteria. Results have shown relatively low significance on other two success criteria.

AHP methodology has been proposed because of its application and justification in various real-world complex applications. The methodology and hierarchical structure are simple and can be easily understood at the operational level. It maintains the transparency in decisions by decomposing the complex issues into simple hierarchical structure. AHP assists the group decision makers to identify the complex relationship among the elements of the concerned problem. Therefore, AHP was adopted for prioritizing the best management practice factors according to the specific objective or goal.

The study presents a conceptual approach of affecting factors along with their global weights to the local and international firms. It is not possible to deal with all the factors at the same time. So, with the prioritization gives a thorough understanding that on which criteria they must work upon depending on their own requirements. Therefore, this relative significance of effects can be very helpful for selection of best management practice while controlling these effects for a construction project.

The proposed AHP model is simple to use and the computations can be run using available software that is Super Decisions or can be done using spread sheet program. This hierarchy structure allows the user to readily determine the relative contribution and significance of the identified effects for prioritization.

Out of 21 affecting effects due to adoption of SMCP, 15 were top ranked through content analysis which influenced more because of its occurrence and through primary survey. AHP technique was used for the prioritization of following effects; Size and value of Project being large (S&VL), Poor monitoring and Budgeting (PM&B), Disagreements with Architect/Engineer design (DA/ED), Severe conflicts among team members (SCTM), Reluctance in timely Decisions (RTD), Lack of selecting key members at initial stages of construction phase (LSKM), Non-Competitive bidding phase (NCBP), Over sighting proper planning tools and techniques for risk management (OPTT), Poor commitment level with other parties of project (PCL), Vested interest on quality and timely completion of project (VIQTC), Inappropriate organizational structures & stability (IOSS), Optimum Resource utilization (ORU), Pass by environmental impact assessments on site (PBEIA), Lack of transparency in financial issues (LTFI) and Expertise insufficiency (EI). The prioritization of critical affecting effects has been done with respect to cost, time and quality.

The top most critical effects encountered for completing a project within schedule are VITC (0.134), ORU (0.080) and RTD (0.079). Factors those must be observed keenly for achieving project completion within budget are ORU (0.084) and VITC (0.050). While for maintaining standard quality ORU (0.037) must be reduced to its lowest value.

The study reveals that categorize such as Performances and PM competency have superior impacts on the success of a project. As it's clear from results optimum resource utilization results in most significant factor for cost, time and quality therefore it must be noted considerable that professionals are to be involved early in the project to overcome the excess use of resources, since using most of resources leads to extend project lifecycle cost, pursuing it to become overstressing condition ultimately affecting quality standards and as the cost increases, the new intern payment certificated (IPC) needs to be revised resulting in increase of time for a project. A trend of significance is also seen for a factor; vested interest on quality and timely completion of a project as it significantly effects two of the project success criteria i-e, cost and time, while equally effects time as well. Hence, it's obvious the more the interest level shifts from quality and timely completion of project the more budget overruns and quality is compromised leading to non-standardized completion of project which eventually runs over schedule routines. Last but not the least, reluctancy in timely decision is emerged as one of the significantly affecting factor for time while it equally effects cost and quality as well which indicates that if key members are unable to take timely decisions e.g. decisions related to procurement of machinery, this may lead to loss of substantial work affecting schedule routine for the upcoming activities and ultimately cost overruns as in increase in utilities plus to overcome cost deficiency quality is compromised in the end.

5.3 PMCP adoption using Analytical Hierarchical Process:

Best management practice selection has been a critical issue since always. Its evaluation carried out not only in terms of technical aspects, but also financial capacity guarantees proper utilization of resources and paves way for project success. The clients, especially public organizations are prone to accepting the temporary benefited management style i-e SMCP. Because of variability and competitiveness issues of construction industry, it is not deniable that selection of best management practice is vital to project success. SMCP viz a viz PMCP are evaluated in terms of many factors affecting like PM competency, performances, coordination and project control w.r.t to project success criteria such as Cost, Time and Quality. Among these criteria, time has remained the most dominant criterion based on which best management practice is selected. This multi-criteria decision making can benefit from AHP which can help to improve the selection process and obtain the best decision by considering multiple criteria that are mentioned previously. This technique not only reduces the overall amount of time required for the selection process but also extends the functionality of MCDM that involve interdependent relationships.

The holistic approach of adoption of PMCP in terms of construction projects constitutes quality, time and cost, and suggests a balance among these factors for successful project management selection. It is implied that no factor must be so over-estimated that the overall efficiency of project is compromised.

AHP has been applied to the data collected from 111 responses for decision making on multiple attributes of alternatives (PMCP/SMCP). In the competitive selection process, accurate choice of management style is complex. Careful consideration upon all the criteria should be done to avoid a biased decision. Therefore, after applying MCDM technique, the results of selection of

best management practice are further refined and validated. Since majority of data collected analysis shows the trend for adoption of PMCP as an uninformed and better decision made, AHP validates the decision-making process of selection of best management practice which is the ultimate pathway for successful project execution. Most of the results reveal that the construction projects were procured by analyzing the best management practice on their competencies in terms of financial capacities. However, this was achieved rather intuitively and unscientifically. Therefore, it is recommended that best management practice decision making should be benefitted using AHP. The practical implications of this study facilitate the decision makers in identifying and assessing best management practice through figuring out their effects and significance with respect to project objectives. It can act as a decision support system in selection of best management practice in public as well as private construction projects. The research methodology proposed in this study can be applied specifically to other construction projects like dams, highway roads, commercial and residential buildings as well. This will allow insight into comparison of decision criteria in the different segments of construction industry.

5.4 Findings:

The findings of this research suggested that the affecting effects are associate with the success of the construction projects. The identified affecting effects were grouped into four groups then integrated in a comprehensive survey that was designed to rate their effect on cost, time and quality. The study reveals that category of Performances affect the highest with over 50% influencing effect on best project management selection however following up categories were PM competency, project control and coordination based on their importance respectively.

The research has identified top most critical effects encountered for completing a project within schedule which are VITC (0.134), ORU (0.080) and RTD (0.079). Factors those must be observed keenly for achieving project completion within budget are ORU (0.084) and VITC (0.050). While for maintaining standard quality ORU (0.037) must be reduced to its lowest value.

The growth of global construction has created new business opportunities for both local and international firms. This study investigated 21 types of the affecting effects that international and local firms face in construction industry. The impact of these effects was investigated by a comprehensive survey from experts who have experience of construction project and industry. This study found prioritization of critical effects for cost, quality and time for a successful selection of best management practice in a construction project. This ranking will facilitate construction organization to manage their budget, duration and quality requirements keeping in view critical effects. Prioritization have been done by applying AHP technique by comparing the significance of critical effects upon project success criteria. This prioritization also provides an ease for the visualization of effects along with a logical and systematic way to deal with them. This can help the decision makers to evaluate the affecting effects encountered, thus highlight the prioritization to be adopted to manage them for the adoption of PMCP. This study will not only help international construction industry but also local construction industry to overcome failure in project success in terms of success criteria defined i-e cost, time and quality.

5.5 Recommendations:

In recommendation, the user can model their problems by controlling the number of elements considered in each of the categories. In this research, total of fifteen factors grouped in four

categories have been used for decision making up to third hierarchy level. The number of indicators and their categorization could be modified depending upon the strength of decision problem. This is the flexibility of model that number of indicators and hierarchy level could be easily adjusted. The more comprehensive decision could be made by improving the subjective input for comparison. The model that requires higher complexity requires greater input effort by the user.

In this research, data has been collected generally from construction industry, which have been further undertaken for MCDM. For future research, the scope of PMCP adoption through AHP, is not limited. The number of indicators and alternatives, and their hierarchy level can be altered for different divisions of construction projects. The limitation of this model is that it only applies for two management practices in construction industry that is SMCP and PMCP.

It is recommended that the constructors intending to adopt PMCP management practice can achieve the project goals by controlling affecting effects identified. In this research three of the success criteria were considered which incorporates fifteen factors categorized into four. The number of the criteria and categorization could be modified. Similar study can be performed for specific types of the construction projects, such as highway projects, dams, high rise buildings etc. A research can then be carried out to determine the influence of affecting effects on all the critical success factors of construction project.

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Appendix 1

Factors affecting Construction Projects due to adoption of SMCP

This Preliminary survey is being carried out among Professional Engineers, Clients, Consultants and Contractors. This form assesses the factors that significantly affect construction projects by adoption of Self-managed construction projects (SMCP) over Professionally managed construction projects (PMCP). Please assign scores ranging from 0 to 5 to the said factors corresponding to their significance in construction industry.

The scales of comparison have been shown in following table

Verbal Scale	**Intensity**
Not Significant at all	0
Very Low Significance	1
Low Significance	2
Moderate Significance	3
High Significance	4
Very High Significance	5

Country of Residence: _____

Experience in years: _____

Field of work: _____

Designation: _____

Qualification: _____

Topic understandings: _____

Sr. No.	**Question**	**Score**
Significance of Project Success Criteria		
1	How much "COST" does affect project success through practices of SMCP	0 1 2 3 4 5
2	How much "TIME" does affect project success through practices of SMCP	0 1 2 3 4 5

3	How much "QUALITY" does affect project success through practices of SMCP	0 1 2 3 4 5
Significance of affecting factors		
1	How much "Reluctance in timely Decisions" does affect Construction Projects through SMCP.	0 1 2 3 4 5
2	How much "Disagreements in A/E design" does affect Construction Projects through SMCP.	0 1 2 3 4 5
3	How much "Size and value of Project being large" does affect Construction Projects through SMCP.	0 1 2 3 4 5
4	How much "Non-Competitive bidding phase" does affect Construction Projects through SMCP.	0 1 2 3 4 5
5	How much "Lack of Construction Control meetings" does affect Construction Projects through SMCP.	0 1 2 3 4 5
6	How much "Negligence in identifying Critical activities" does affect Construction Projects through SMCP.	0 1 2 3 4 5
7	How much "Optimum Resource utilization" does affect Construction Projects through SMCP.	0 1 2 3 4 5
8	How much "Lack of coordinating abilities with client/contractor" does affect Construction Projects through SMCP.	0 1 2 3 4 5
9	How much "Poor monitoring and Budget Feedbacks" does affect Construction Projects through SMCP.	0 1 2 3 4 5
10	How much "Oversighting proper planning tools and techniques for risk management" does affect Construction Projects through SMCP.	0 1 2 3 4 5
11	How much "Lesser supervision over lower staff" does affect Construction Projects through SMCP.	0 1 2 3 4 5
12	How much "Poor commitment level with other parties of project" does affect Construction Projects through SMCP.	0 1 2 3 4 5
13	How much "Vested interest on quality and timely completion of project" does affect Construction Projects through SMCP.	0 1 2 3 4 5
14	How much "Severe conflicts among team members" does affect Construction Projects through SMCP.	0 1 2 3 4 5
15	How much "Inappropriate organizational structures & stability (outside scope of project)" does affect Construction Projects through SMCP.	0 1 2 3 4 5
16	How much "Lack of transparency in financial issues" does affect Construction Projects through SMCP.	0 1 2 3 4 5

17	How much “Lack of selecting key members at initial stages of construction phase” does affect Construction Projects through SMCP.	0 1 2 3 4 5
18	How much “Expertise insufficiency” does affect Construction Projects through SMCP.	0 1 2 3 4 5
19	How much “Pass by environmental impact assessments on site” does affect Construction Projects through SMCP.	0 1 2 3 4 5
20	How much “User Expectation & Satisfaction” does affect Construction Projects through SMCP.	0 1 2 3 4 5
21	How much “Insufficient control over safety and health issues” does affect Construction Projects through SMCP.	0 1 2 3 4 5

Appendix 2

Prioritizing factors affecting project success criteria in selection of best management Practices

This survey is intended to collect responses of researchers and professionals for prioritizing factors effects on project success criteria (i-e, cost, time & quality) by adoption of self-managed construction projects (SMCP) over Professionally managed construction projects (PMCP). For this purpose, some factors of PM competency, Performance, Coordination and Project control will be presented to you. Please contribute to this survey and help us develop a conceptual approach for adoption of PMCP. Your response to this survey is highly appreciated.

SECTION 1

1. Name: _____
2. Organization: _____
3. Origin of Organization: _____
4. Type of Organization: _____
5. Designation: _____
6. Qualification: _____
7. Experience in years: _____
8. Rate your understanding level for the adoption of best management practices

0 %	20%	40%	60%	80%	100%

The scales of comparison have been shown in following table:

Verbal Scale	Intensity of importance
Extremely effecting	9
Very strongly effecting	7
Strongly effecting	5
Moderately effecting	3
Equally effecting	1
Intermediate importance	8,6,4,2

SECTION 2

1. Criteria Comparison:

How much does one project success criteria effect the other by adoption of SMCP																
COST								Equal	**TIME**							
9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
COST								Equal	**QUALITY**							
9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
TIME								Equal	**QUALITY**							
9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

2. Sub-Criteria Comparison:

Project Success Criteria	How much does one category effect the other by adoption of SMCP															
	PM Competency								Equal	Coordination						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	PM Competency								Equal	Performance						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	PM Competency								Equal	Project Control						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Coordination								Equal	Performance						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Coordination								Equal	Project Control”						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Performance								Equal	Project Control”						
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

3. Pairwise Factors Comparison

- **Comparison of affecting factors in PM Competency**

Project Success Criteria	How much does one factor effect the other by adoption of SMCP															
	Reluctance in timely decisions (RTD)								Equal	Non-competitive bidding phase (NCBP)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Reluctance in timely decisions (RTD)								Equal	Poor Monitoring & Controlling (PMC)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Reluctance in timely decisions (RTD)								Equal	Expertise Insufficiency (EI)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Non-competitive bidding phase (NCBP)								Equal	Poor Monitoring & Controlling (PMC)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Non-competitive bidding phase (NCBP)								Equal	Expertise Insufficiency (EI)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Poor Monitoring & Controlling (PMC)								Equal	Expertise Insufficiency (EI)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9

- **Comparison of affecting factors in Coordination**

Project Success Criteria	How much does one factor effect the other by adoption of SMCP															
	Disagreement in Architect/ Engineer Design (DA/ED)								Equal	Lack of selection of key members at initial stages of Construction Phase (LSKM)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Disagreement in Architect/ Engineer Design (DA/ED)								Equal	Severe conflicts among team members (SCTM)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
	Lack of selection of key members at initial stages of Construction Phase (LSKM)								Equal	Severe conflicts among team members (SCTM)						
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9

Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

- **Comparison of affecting factors in Performances**

Project Success Criteria	How much does one factor effect the other by adoption of SMCP																
	Optimum Resource utilization (ORU)								Equal	Vested interest on quality and timely completion of project (VITC)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Optimum Resource utilization (ORU)								Equal	Inappropriate organizational structures & stability (IOSS)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Optimum Resource utilization (ORU)								Equal	Pass by environmental impact assessments on site (PBEIA)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Vested interest on quality and timely completion of project (VITC)								Equal	Inappropriate organizational structures & stability (IOSS)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Vested interest on quality and timely completion of project (VITC)								Equal	Pass by environmental impact assessments on site (PBEIA)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Inappropriate organizational structures & stability (IOSS)								Equal	Pass by environmental impact assessments on site (PBEIA)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

- **Comparison of affecting factors in Project Control**

Project Success Criteria	How much does one factor effect the other by adoption of SMCP																
	Size and value of Project being large (S&VL)								Equal	Oversighting proper planning tools and techniques (OPTT)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Size and value of Project being large (S&VL)								Equal	Poor commitment level with other parties (PCL)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Size and value of Project being large (S&VL)								Equal	Lack of transparency in financial issues (LTFI)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Oversighting proper planning tools and techniques (OPTT)								Equal	Poor commitment level with other parties (PCL)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Oversighting proper planning tools and techniques (OPTT)								Equal	Lack of transparency in financial issues (LTFI)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Poor commitment level with other parties (PCL)								Equal	Lack of transparency in financial issues (LTFI)							
Cost	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Time	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Quality	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

SECTION 3

4. Alternative's Comparison

	To reduce the effects of the identified factors how much and which alternative is best selected for management practices in construction industry.																
Effecting Factors	**Professionally managed construction projects (PMCP)**								Equal	**Self-managed construction projects (SMCP)**							
EI	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
NCBP	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PMC	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
RTD	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
DA/ED	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
LSKM	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
SCTM	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
IOSS	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
ORU	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PBEIA	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
VITC	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
LTFI	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
OPTT	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PCL	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
S&VL	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Appendix 3

Unweighted Super Matrix

	Goal	CT	QT	TM	EI	NCBP	PMC	RTD	DA/ED	LSKM	SCTM	IOSS	ORU	PBEIA	VITC	LTFI	OPTT	PCL	S&V	PMCP	SMCP
Goal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CT	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
QT	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TM	0.528	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EI	0.000	0.228	0.459	0.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NCBP	0.000	0.097	0.136	0.206	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMC	0.000	0.380	0.189	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RTD	0.000	0.295	0.217	0.531	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DA/ED	0.000	0.226	0.614	0.238	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LSKM	0.000	0.674	0.117	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SCTM	0.000	0.101	0.268	0.137	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IOSS	0.000	0.110	0.067	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ORU	0.000	0.505	0.590	0.293	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PBEIA	0.000	0.083	0.139	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VITC	0.000	0.303	0.204	0.514	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LTFI	0.000	0.246	0.076	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OPTT	0.000	0.217	0.360	0.308	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PCL	0.000	0.068	0.107	0.143	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S&V	0.000	0.469	0.458	0.473	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMCP	0.000	0.000	0.000	0.000	0.900	0.875	0.833	0.833	0.833	0.875	0.250	0.875	0.875	0.833	0.500	0.750	0.833	0.750	0.167	0.000	0.000
SMCP	0.000	0.000	0.000	0.000	0.100	0.125	0.167	0.167	0.167	0.125	0.750	0.125	0.125	0.167	0.500	0.250	0.167	0.250	0.833	0.000	0.000

Weighted Super Matrix

	Goal	CT	QT	TM	EI	NCBP	PMC	RTD	DA/ED	LSKM	SCTM	IOSS	ORU	PBEIA	VITC	LTFI	OPTT	PCL	S&V	PMCP	SMCP
Goal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CT	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
QT	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TM	0.528	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EI	0.000	0.065	0.130	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NCBP	0.000	0.027	0.038	0.058	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMC	0.000	0.108	0.054	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RTD	0.000	0.084	0.061	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DA/ED	0.000	0.019	0.051	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LSKM	0.000	0.056	0.010	0.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SCTM	0.000	0.008	0.022	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IOSS	0.000	0.055	0.033	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ORU	0.000	0.252	0.295	0.146	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PBEIA	0.000	0.041	0.069	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VITC	0.000	0.151	0.102	0.256	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LTFI	0.000	0.033	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OPTT	0.000	0.029	0.048	0.041	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PCL	0.000	0.009	0.014	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S&V	0.000	0.063	0.061	0.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMCP	0.000	0.000	0.000	0.000	0.900	0.875	0.833	0.833	0.833	0.875	0.250	0.875	0.875	0.833	0.500	0.750	0.833	0.750	0.167	0.000	0.000
SMCP	0.000	0.000	0.000	0.000	0.100	0.125	0.167	0.167	0.167	0.125	0.750	0.125	0.125	0.167	0.500	0.250	0.167	0.250	0.833	0.000	0.000

Limiting Super Matrix

	Goal	CT	QT	TM	EI	NCBP	PMC	RTD	DA/ED	LSKM	SCTM	IOSS	ORU	PBEIA	VITC	LTFI	OPTT	PCL	S&V	PMCP	SMCP
Goal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CT	0.111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
QT	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TM	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EI	0.018	0.032	0.065	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NCBP	0.015	0.014	0.019	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMC	0.023	0.054	0.027	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RTD	0.039	0.042	0.031	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DA/ED	0.008	0.009	0.025	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LSKM	0.016	0.028	0.005	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SCTM	0.004	0.004	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IOSS	0.018	0.027	0.017	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ORU	0.067	0.126	0.147	0.073	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PBEIA	0.015	0.021	0.035	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VITC	0.067	0.076	0.051	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LTFI	0.006	0.017	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OPTT	0.013	0.015	0.024	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PCL	0.005	0.005	0.007	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S&V	0.021	0.032	0.031	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMCP	0.244	0.377	0.384	0.356	0.900	0.875	0.833	0.833	0.833	0.875	0.250	0.875	0.875	0.833	0.500	0.750	0.833	0.750	0.167	0.000	0.000
SMCP	0.089	0.123	0.116	0.144	0.100	0.125	0.167	0.167	0.167	0.125	0.750	0.125	0.125	0.167	0.500	0.250	0.167	0.250	0.833	0.000	0.000