STUDY OF FACTORS AFFECTING THE TIME OVERRUNS IN BUILDING CONSRUCTION PROJECTS OF PAKISTAN

By

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Certified that the contents and form of thesis titled **“ STUDY OF FACTORS AFFECTING THE TIME OVERRUNS IN BUILDING CONSRUCTION PROJECTS OF PAKISTAN ”** submitted by Major Muhammad Ahmad have been found satisfactory for the requirement of the degree.

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DEDICATED

TO

MY FAMILY, TEACHERS AND COLLEAGUES

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ABSTRACT

Time, cost and quality are three traditional parameters extensively used to evaluate performance and judging success of the construction projects. These three measures are commonly known as “Iron Triangle” (Atkinson 1999). Especially “Time” becomes the most critical factor that has to be managed against the prescribed schedule, because in the absence of Successful Time Management, not only the use of any facility is denied to its particular users, but also it has an extra burden on “Cost” against the allocated budget as well.

Construction Industry plays an important role in economic development of any country as its activities represent a long-term investment. This Industry has a much more potential to contribute in GDP growth of Pakistan, but the potential growth is hampered by a number of issues, the Cost and Time overruns being the most important issue being faced by the Construction Industry of Pakistan. Though the causes of Cost and Time overruns vary from project to project, but it results in shear wastage of time, delayed project benefits conceived at the time of project planning and financial loss to exchequer of country (Gabriel, 2010).

Study of delay factors affecting Time overruns in building construction projects of Pakistan is considered as one of the important topic of Construction Engineering and Management. Hence it was decided to carry out a research in this field, to study these delay factors in Building Construction Projects and their ranking for Construction Industry of Pakistan.

This study includes survey of Forty Eight (48) building projects based on traditional procurement method to acquire the Clients, Consultant & Contractor’s feedback on factors affecting time overruns in building construction projects. Most projects related were from Twin cities (Rawalpindi/Islamabad) along with representative samples from all the four provinces. From a detailed study of past literature review of national as well as international studies, a list of Eighty Seven (87) key indicators causing delay or time overruns were outlined which were further grouped in Thirteen (13) Delay Factors that were more specific to Construction Industry of Pakistan.

After obtaining data from the field survey, reliability test of data was conducted in order to confirm the authenticity of the field data. Since the feed back was ascertained from all the three key stake holders, i-e Client, Consultant & Contractor, so individual ranking of these factors was ascertained using SPSS Software. This analysis resulted in concluding list of delay factors with respect to all three major stake holder's perspective, with a few minor variations. Percentage mutual agreement between these three key stake holders was also established in order to be sure about the results.

After ascertaining the overall ranking of delay factors, top four factors (a) Site Related Delays (b) Quality Related Delays (c) Management Related Delays, and (d) Finance Related Delays were established as the top ranking factors in order of priority. Further, study of these four top ranking delay factors was conducted basing on data for each key indicator in order to assess the most important indicator in each of three delays factors, causing in delay of building projects in Pakistan.

It was concluded that in Site Related Delays, site variations was the most important indicator for delays. Similarly in Quality Related Delays, inadequate quality resulting in work suspension/redoing was the most important indicator. In relation of Construction Management Related Delays, two indicators, poor planning & scheduling and schedule slippages were ascertained as the most dominating indicators pertaining to Construction Management Related Delays. In Finance related delays, poor accounting procedures was the most important key indicator.

Towards the end, basing on above conclusions, certain recommendations are made in order to eliminated delays and time overruns factors in building construction projects of Pakistan and ensure the timely completion of such projects in over to achieve the potential benefits as conceived at the beginning of the project.

Chapter 1

INTRODUCTION

1.1 BACKGROUND

Construction Industry plays a key role in the development of any country. There is a French dictum "where the construction industry prospers, everything prospers". Globally considered as the largest fragmented and complex nature of industry, it not only contributes a huge chunk to the country's Gross Domestic Product (GDP) but also offers employment opportunities to the labor force. Performance and success of this sector is very important for country's economic uplift and financial growth (Ali and Goraya 1998). The primary aim of any construction project is to achieve success. Different performance measures have been established to examine the project success (or failure). Time, cost and quality commonly is known as an "Iron Triangle" (Atkinson 1999).

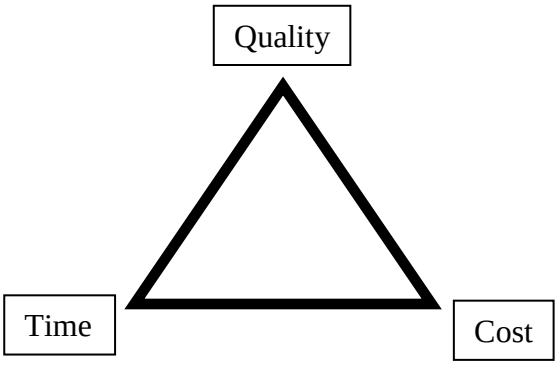

Figure 1.1: (Iron Triangle) Showing Time as one of the important pillar

Construction Industry in Pakistan is generally classified into buildings, highways, railroads, bridges, canals, dams, tunnels and airport projects. With such diverse nature of projects, variety of project players or stakeholders is imperative. Clients, consultants, contractors, sub-contractors and suppliers are the stakeholder's involved having their own objectives and priorities. Among them, key project participants are clients, consultants, and contractors.

In construction, DELAY could be defined as the time over-run either beyond completion date specified in the contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned

schedule and is considered as common problem in construction projects. Once this Delays or time over-run occurs, so to a Client, delay means loss of revenue though lack of production facilities and rent-able space or a dependence on present facilities. In some case, to a contractor, delay means overhead costs because of longer work period, higher material cost through inflation and due to labour cost increases(Sadi and Sadiq, 2005).

1.2 PROBLEM STATEMENT

In Pakistan, most of the building projects suffer due to Cost and Time overruns. Thus the potential benefits presumed at the time of project planning are either delayed considerably or sometime not achieved at all. The contributing factors can be many, yet the importance of harnessing the time and cost thus becomes more evident in order to complete a project successfully while achieving all it's goals and objectives. Internationally, a lot of research has been done on this topic in the recent past, yet in Pakistan, a lot more effort is required to be put in, in order to ascertain the true factors which are more specific to our own construction environment. Only by identifying these factors, ranking them and further study of high ranking factors in detail will make this effort justified. Such a study will also help to identify the critical factors causing delay in construction of building projects, thus enhancing the efficiency of construction process through counter measures.

1.3 RESEARCH OBJECTIVES

The main objectives of the present research study are:

a. To enlist factors affecting time overruns in building construction projects through review of international and national level literature and then updating the list of delay factors with respect to Construction Industry of Pakistan.

b. To ascertain ranking of these factors from the perspective of three major stake holders, Client, Consultant & Contractor as well as over all ranking.

c. Basing on the above efforts, making some recommendations to address key delay factors during course of building construction projects in Pakistan for improving efficiency of Construction Industry.

1.4 RESEARCH SIGNIFICANCE

Construction Industry contributes about 2.4 % GDP, considered third largest industry after agricultural and manufacturing industries in Pakistan. Unless some project is successful, the desired contribution to national economy can never be achieved. But unfortunately, these desired economical contribution and project objectives are mostly not achieved due to issues like Cost-overrun, time overrun, bad communication and coordination between the project participants, bad working relationship, lack of experience, etc. Yet the time and cost overruns remains the core issue. Carrying out research in this field and in order to identify and enlist the factors causing time overruns will surely make projects more successful and productive by increasing the efficiency of construction process. This will in turn, facilitate the achievement of over all project objectives and economical benefits. Recommendations suggested towards the end of study will surely help to reduce the delay & time over-runs and ensure timely completion of building construction projects in Pakistan with enhanced efficiency.

1.5 SCOPE OF THE RESEARCH STUDY

The scope of this research study is related to time over-runs, to outline the causes of delay in Building Construction Projects in Pakistan. A field survey of 48 building projects based on traditional procurement method was conducted to acquire the Clients, Consultant & Contractor's feedback on factors affecting time overruns. Mostly projects were taken from Twin Cities, Rawalpindi & Islamabad, however province wise representative projects were also picked in order to cater for the variations in causes of delay due to geographical factors.

1.6 ORGANIZATION OF THE THESIS

Chapter 1 provides a background and problem statement that developed the need of this research study. Study objectives, its significance and scope are also presented.

Chapter 2 is devoted to the literature survey. This chapter is further divided in two parts. In the first part, traditional procurement is discussed briefly thus highlighting the role and responsibilities of (3) key stake holders, Client, Consultant and Contractor. In the second part, affects of time over-runs on construction projects as discussed in many of the national as well as international literature and various rankings allocated to these delays by various authors are discussed in detail. Finally a list of delay factors is made suiting peculiar environment of Pakistan out of literature review.

Chapter 3 is concerned with the research methodology employed in the study. The process of survey design, selecting a study sample, sample size, development of a questionnaire for data gathering and conducting full scale survey is presented for further ranking of factors through statistical tools.

Chapter 4 describes the data analysis and results. The chapter is devoted to the testing of study intentions that arise from the research objectives. The purpose of these tests was used to determine the ranking of various factors towards delay, targeted in the questionnaire survey.

Chapter 5 is concerned with the conclusions and future recommendations. Conclusions and recommendations are drawn from key research findings. Future directions are also identified.

Survey questionnaires with list of building projects used in the administration of the survey can be found in the appendices. The appendices also contain copies of the tests done on Statistical Package for the Social Sciences (SPSS Ver. 18.0) for data analysis.

1.7 SUMMARY

Brief summary of the research study is introduced in this chapter. Starting by reviewing the past literature that developed a need of this research is highlighted. Significance and important aims & objectives are presented. Scope with outline of the thesis chapters is also discussed.

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, survey of the literature is presented and divided in to two sections. In the first section, widely used and most popular procurement method for construction projects in Pakistan i.e. traditional procurement method from definition to its importance has been examined. Traditional, also known as 'design-bid-build' method of procurement involves clients, consultants and contractors as three major stakeholders with their relationships and responsibilities are discussed in detail. Second part provides an insight about the adverse effects of delays on construction projects. Generally, time, cost and quality are extensively used parameters to determine the success of any project, yet time takes considerable importance because completing construction project in time is an indicator of efficiency.

2.2 TRADITIONAL PROCUREMENT METHOD

2.2.1 Introduction

When a decision is made to build a new construction project, a feasibility study is carried out by the client for the assessment of pros and cons and evaluation of several alternatives to undertake the project. The client also known as the owner/promoter/principal may be government agency or any private sector. Generally client appoints a project management team composed of technical staff with project manager/project director as a team head from in-house or from external organization. The project management team is selected for organizing and coordinating the project appraisal studies including making a decision to build, defining the project scope and financing of the construction project after a detailed analysis of cash flow forecasts. (Eldosouky 2001). Eldosouky (2001) further pointed out that after having selected the project management team and completing the project brief and feasibility, organization structure for the construction project

is considered on the basis of size and nature of the project, client in-house capability and experience in the construction industry. Project procurement systems (also called Project delivery methods) are used to define the project organization structure. Organization structures for a construction project are a framework of contractual and communication relationships between project players. They are designed to deliver construction projects within time, cost and quality (Uher & Davenport 2002). Different procurement systems are normally used for the construction projects as shown in the Figure 2.1 (Uher & Davenport 2002).

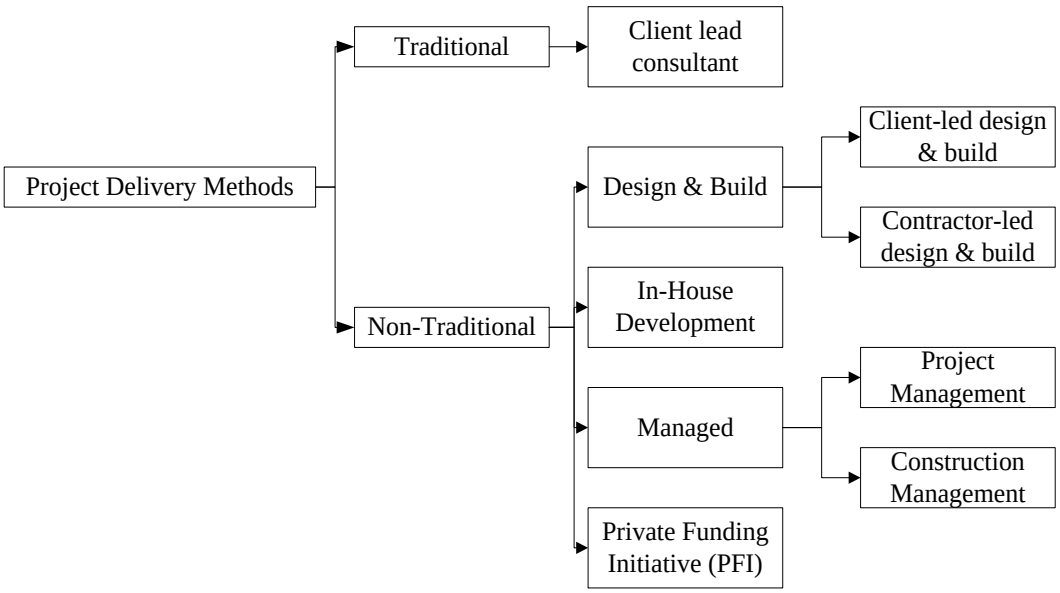

Figure 2.1: Construction project procurement systems

The traditional method of procurement has been widely used since 1960 and even today the most popular construction projects delivery method (Uher & Davenport 2002). It is generally preferred for public funded projects. Also referred to as "end-on' or 'design-bid-build' or 'sequential' method of procurement, it separates the construction stage from design stage with a condition that the design should be fully completed before the tender stage. In Pakistan, this method is most commonly used for public work projects and especially for building projects as it is mandatory to select this type of procurement method in order to ensure clear accountability and cost monitoring (Lodi et al, 2008).

2.2.2 Project participants

Construction projects require maximum utilization of manpower and construction materials. A variety of participants are responsible for the successful execution of construction projects as shown in the Figure 2.2 (reproduced from Schexnayder and Mayo 2003).

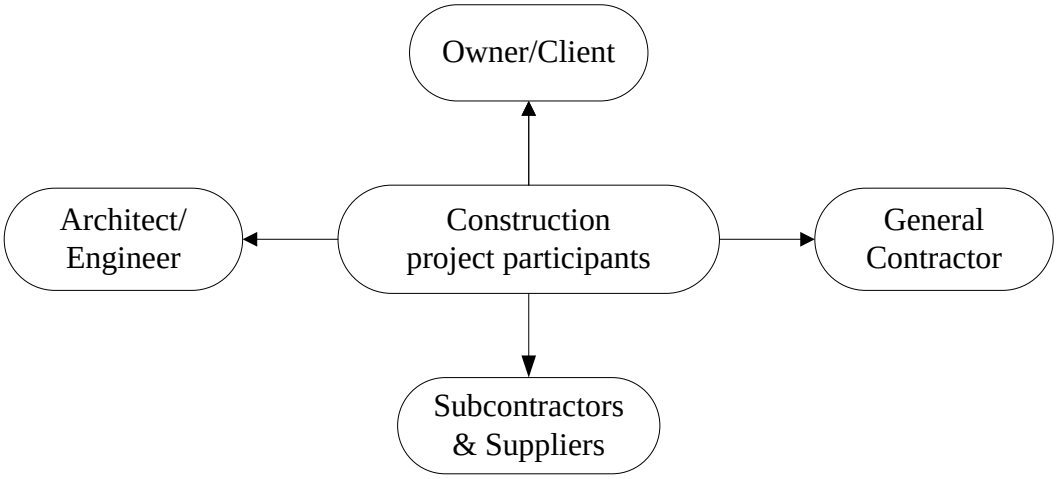

Figure 2.2: Project members for construction undertaking

In Pakistan, main project players involved in the construction industry are: clients, consultants, contractors, subcontractors and suppliers and their roles and responsibilities have been explained by Sengupta & Guha (2002) and Schexnayder & Mayo (2003).

2.2.2.1 Client

Client, also known as the owner is an individual or authority or corporate body (government department). The client make a decision to undertake the project and responsible for funding the project by preparing the payment schedule. Sometimes, the client is expected to arrange supply of power and water to the construction site. The client defines the purpose/need and scope of the work and retains the overall control of the construction projects.

2.2.2.2 Consultant

Consultants, generally are designers/architects or engineers (private or public organization). The consultants are selected based on knowledge and experience by the owner to prepare construction documents (bidding documents, drawings, technical specifications, and cost calculations) of the construction project. The involvement of the consultants during construction phase will depend on the project delivery method adopted by the owner. In design-bid-build, the owner generally designates the consultant to oversee the construction work at site. He is full in charge of designing and supervising the project on behalf of the client. He should be well trained in quality and workmanship requirements and assess quality of construction work. The consultant also verifies the progress payments submitted by the general contractor. The consultant should act as a professional and independent judge and provide technical advice and solutions to the client and contractor on the potential project problems.

2.2.2.3 Contractor

A person/individual or organization or group of people, assumes the responsibility of execution of construction activities based on required skills and competency. The contractor should control the construction costs, keep the project on schedule and interact with all project members on all matters and issues.

2.2.2.4 Subcontractors and suppliers

Sub-contractors are also called as specialty contractors. The contractors mostly sub-contract a large portion of work to the sub-contractors under a contract. Sub-contractors may be electrical, mechanical, steel fabrication, dry wall, painting and carpeting works specialists. They have no links with other project members. On the large building projects, 10 to 15 subcontractors are generally required. On the other hand, suppliers in the construction industry provide construction materials and have a contact with the contractors and subcontractors. They assist the general contractors in preparing the bids, shop drawings and fabrications. Material

suppliers may be electrical whole sellers, lumberyards, ready mixed concrete suppliers, plumbing supply stores etc. The project quality is highly dependent on quality of the suppliers used by the contractors.

2.2.3 Contractual relationships and responsibilities of key project participants

Clients, consultants and the contractors are the three main parties in traditional procurement method and their responsibilities and duties over the project life cycle are shown in the Figure 2.3 (Rashid et al, 2006).

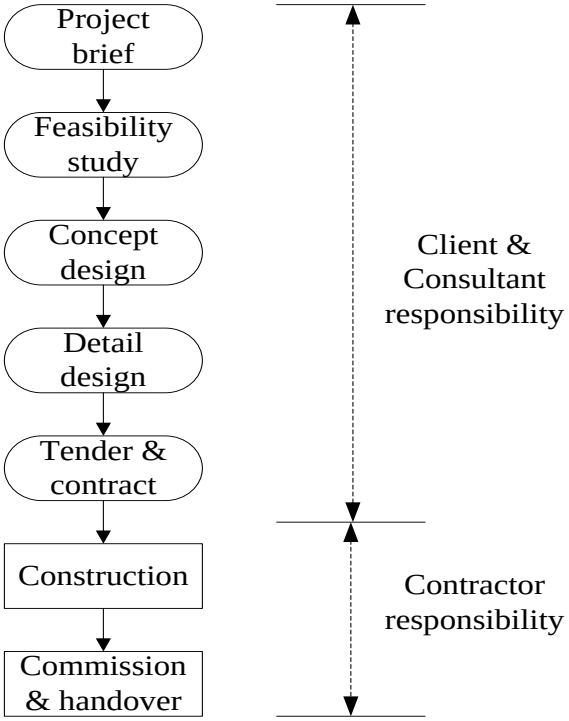

Figure 2.3: Process of traditional procurement method over project life cycle

2.2.3.1 Client responsibilities

The client develops a project brief and feasibility, defines the project scope, assumes the responsibility of funding the project and manages the construction process (Schexnayder & Mayo 2003). The client selects a best, qualified and experienced design consultant to provide design and supervision services on the basis of some negotiated fee. After completing the design and accepted by the client, the client then selects a contractor through competitive tendering process.

The client enters in to two contracts: one with a design consultant and other with a selected a contractor to build the project as designed. There is no contractual relationship between the consultant and the contractor (a characteristic of traditional procurement method); however a communication link exists between the two key project participants (Uher & Davenport 2002).

2.2.3.2 Consultant responsibilities

In traditional procurement method, the client selects a design consultant through competitive selection process so as to provide design, tendering and supervision services. The consultant should act as an agent of the client and administer the project on behalf of the client as a superintendent; however he must administer the contract as an impartial judge between the client and the contractor (Uher & Davenport 2002).

Main responsibilities of the design consultant defined by Eldosouky (2001) are as follows:

1. Review of the Master plan prepared by the client.
2. Planning and conducting Topographic survey and geotechnical investigations of the proposed site.
3. Preparation of conceptual & detail design.
4. Develop a project cash flow estimate.
5. Preparation and administration of tendering process including tender documentation, bids evaluation and recommendation for the selection of suitable contractors.
6. Preparation of construction drawings showing adequate technical details.
7. Provide adequate consultation and advice to the client during execution of the works.
8. Review and approval of Contractor’s submission plan and shop drawings.

9. Quality assurance and control of construction activities carried out by the contractor.
10. Verification and submission of contractor's interim payment certificates.
11. Evaluation and approval of variations and claims.
12. Final inspection and evaluation of the completed work.

2.2.3.3 Contractor responsibilities

The 'main or head' contract is in between the client and the contractor where contractor manages and undertakes the responsibility to build the project within stipulated time, cost and required quality standards. It is worth mentioning that contractor is not involved in the design process (Uher & Davenport 2002).

Main responsibilities of the contractor defined by Eldosouky (2001) are as follows:

1. Arrangement and organizing skilled site staff, plant, labor and all other resources to execute construction activities.
2. Fulfilling the contractual obligations and execute the construction activities as per planned program and technical specifications.
3. Maximum cooperation and communication among site staff members.
4. Identifying potential problems early to negate project time and cost delays.
5. Supply and arrangement of construction materials and other services.
6. Coordination with specialty contractors/subcontractors and suppliers.
7. Ensuring site safety.
8. Inspection/tests of construction materials delivered to the project site.
9. Updating of site records and other necessary documentation required by the consultant.

2.3 DELAY OR TIME OVER-RUN FACTORS IN BUILDING CONSTRUCTION PROJECTS

2.3.1 General

Success is an ultimate goal of any construction project. It is highly complex to describe whether a project is a success or failure (Chan et al. 2002a). Completing projects on time is an indicator of efficiency but construction process is subject to many variables and unpredictable factors, which result from many sources. These sources include the performance of parties, resources availability, environmental conditions, involvement of other parties and contractual relations. However, it rarely happen that a project is completed within the specified time (Sadi & Sadiq 2005).

2.3.2 Delays on Construction Industry

Time, cost and quality are three traditional parameters extensively used to evaluate performance and judging success of the construction projects. (Mohsini & Davidson 1992; Kerzner 2003; Takim et.al. 2003; Ankrah & Proverbs 2005 and Altmann 2005).

Construction Industry plays an important role in economic development of any country as its activities are long term. Construction Industry constitutes 10% of world GDP. The Construction Industry of Pakistan constitutes 2.4% of GDP and its direct and indirect contribution to GDP and employment rank second to agriculture and manufacture in Pakistan. The potential growth of Construction Industry is hampered by a number of issues, the cost and time overruns being the most important issue being faced by the Construction Industry of Pakistan. Though the causes of cost and time overruns vary from project to project, but it results in shear wastage of time, delayed project benefits conceived at the time of project planning and financial loss to the exchequer of country (Gabriel, 2010).

2.3.3 Adverse Affects of Delay and Time Overruns in Building Construction

In construction, delay could be defined as the time overrun either beyond completion date specified in the contract or beyond the date that both parties agreed

upon the delivery of the project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rentable space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead cost because of longer work period, higher material costs through inflation and due to labour cost increases (Sadi & Sadiq, 2005).

2.3.4 Delay and Time Overruns Factors through Literature Review

A detailed literature review was carried out in order to ascertain the past studies on the topic of Delay and Time Overruns. This included national as well as the international research work on the topic of delay. A lot of research in recent past is done on the topic of delay in order to ascertain the exact causes of project delays in building construction. Different author's carried out researches with their own methodologies in order to rank these factors. The purpose of these studies was mostly to enlist various Delay and Time overrun factors and their ranking.

Research carried out by Assaf et al (1995) determined (56) main cause of Time overrun in large construction projects. In the same study, these causes were further grouped in Nine Groups. These groups were showed different levels of importance to different parties.

In another research work carried out by Ghalfy (1995) the focus was kept on public water and sewage projects. In that study (6) different cause were outlined and then further classification was done. This research concluded at the end that Time overrun is more frequent in large and medium size projects, and considered very severe in case of small projects. There are many important causes of delay related to owner involvement, contractor performance and the early planning & design of the project. Financial problems, changes in the design and scope, delay in making decisions and approval by the owner, difficulties in obtaining the work permit and coordination & communication problems were the important causes.

There was yet another study that was conducted by Chan and Kumaraswamy (1997) on the potential delay factors in Hong Kong construction projects. They further evaluated the relative importance of (83) delay factors and then outlined the five principle factors: Poor risk Management and supervision, unforeseen site conditions, slow decision making, client-initiated variations and work variations.

In Indonesia, a research was carried out on 31 high rise projects by Kaming et al (1997) concluded that cost overruns occur more frequently and are more severe problem than time overruns. It was found that material cost increases due to inflation, inaccurate material estimation and degree of complexity are the major factors influencing cost overruns. On the other hand, design changes, poor labour productivity, inadequate planning and resources shortage are the important factors pertaining to time overruns.

Kumaraswamy and Chan (1998) carried out a further study in Hong Kong regarding causes of construction delays. They found that there was in difference in perceptions as to causes of delays by different groups of participants in building and civil engineering works. They suggested that biases of different industry groups might direct blame for delays to other groups.

Al-Momani (2000) investigated causes of delay in (130) public projects in Jordan. The main causes of delay were related to designer, user changes, weather, site conditions and increase in quantity. The study suggested that special attention to factors will help industry practitioners in minimizing contract disputes. Delays have strong relationship with failure and ineffective performance of contractors.

Some studies were also carried out in Saudia Arabia in the area of Delay factors and Time overruns in building construction. Ubaid (1991) suggested that the performance of contractors as one of the major causes of delay. In this study (13) major measures were considered. These measures are related to contractor resources and capabilities. Also Al-Barak (1993) discussed main causes of failure

in Construction Industry in Saudia Arabia by surveying (68) contractors and about (34) different causes of failure. The study concluded that lack of experience, poor estimation practices, bad decisions in regulating company's policy and national slump in the economy are the severe factors.

In Pakistan, Muneer and Goraya (1998) carried out a study to determined the causes of delay in the construction industry of Pakistan. In total (11) delay factors were identified. Then the response was sorted under grouping of client, consultant, contractor, labour, materials and construction machinery. The study ranked Scheduling, quality management and close coordination between the key stake holders can reduce the delays in building construction projects.

2.3.5 Selection of Key Indicators for Construction Industry of Pakistan

After going through the detailed study of international as well as national level studies a list of Key Indicators was outlined. During this process, it was ensured that maximum key indicators should form part of the list so that maximum dimension causing delays in building projects could be explored. Since the study was focused towards Pakistan Construction Industry, therefore, these indicators were downsized by elimination the least applicable indicators to Pakistan. Towards the end a total of eighty seven (87) key indicators for delay were selected for the field survey.

2.3.6 Grouping of Delay Factors

In order to ease the analysis part, grouping of these indicators was done. So, in this study eighty seven (87) key indicators were grouped in thirteen (13) Delay Factors. Each delay factor group was lined up with all the key indicator associated to that particular factor of delay.

2.4 SUMMARY

This chapter firstly discusses the importance of efficiency of construction industry in terms of time, cost and quality. Since the opinion was to be sorted for all the three key stake holders, client, contractor and consultant, so discussion on

traditional procurement method is done showing the key stakeholders involved in building construction and their roles and responsibilities. In the second part, the importance of time factor, then delay factors outlined and ranked in national as well as international studies are discussed. Subsequently, the development of key indicators for Pakistan and their grouping is discussed. The next chapter discusses the research methodology developed for this research study.

Chapter 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The purpose of this chapter is to discuss the methodology used for this study in order to achieve research aim and objectives that were outlined in Chapter 1. Based on research questions, survey method was chosen as a research strategy and whole survey design process has been extensively elaborated. The construction of a questionnaire, collection of data through field survey and data analysis strategy is also presented.

3.2 RESEARCH DESIGN

Research strategy defines the layout/design showing how the researchers are going to carry out their study to achieve and answer research questions (Saunders et.al. 2003). It comprises of sampling and questionnaire development, data collection sources and considering research constraints. The research strategy is selected on the basis of research aim/objectives. Three different approaches are considered acceptable for the research in construction management. These are: quantitative methods, qualitative methods and combination of both quantitative and qualitative commonly known as 'mixed mode approaches'. Quantitative research methods use deductive approach and associated with collection of data and statistical analysis. On the other hand, using inductive approach, qualitative methods draw the results from interviews or observations rather than using statistical procedures (Amjad 2004-2005). From 1983-1996, Construction, Engineering and Management (CEM) journals research papers showed that quantitative methods dominated and used by fifty seven percent (57%) of the researchers. Only eight percent (8%) utilized qualitative research methods and thirteen percent (13%) used mixed methodology (Loose et.al. 1996). Wing et.al. (1998) argued that quantitative approach of research in CEM produces more practical solutions. However, Association of Researchers for Construction

Management (ARCOM) proceedings from period 1991-2001 reveals that qualitative and mixed mode approaches have increased slightly. Seymour & Rooke (1995) and Seymour et.al. (1997) strongly supports the use of qualitative approach. Easterby-Smith et.al. (1991) believed that most research studies in management are based on mixed approach. Raftery et al. (1997) despite of criticism also advocated the use of mixed approach. Root et.al. (1997) argued that the choice between quantitative or qualitative methods is highly dependent on the research aim/objectives. Based on the above, the aim of this research study was to rank the delay factors on building projects by evaluating the input from client, consultant and contractor. For this purpose, data was required from different individual clients, consultants and contractors working on building projects. Quantitative approach was used for this research and survey method was selected for data collection.

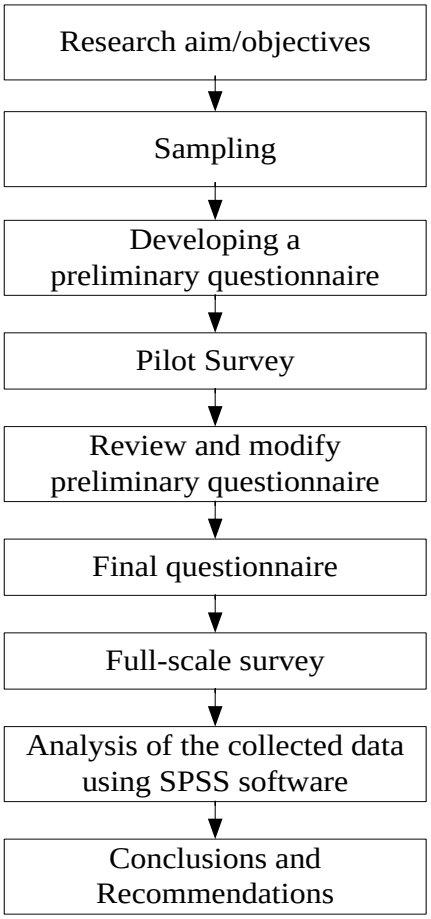

Figure 3.1: Research methodology flow chart

The research has been carried out on the steps shown in the Figure 3.1. To carry out the study, a delay factors questionnaire was developed. Pilot study was taken in to consideration and carried out for purpose of the questionnaire validation, refinement and improvement. Having done a feasibility survey, full scale survey was conducted by visiting building projects to get the feedback of all the three key stake holders on (87) key indicator grouped in (13). Finally, statistical analysis, by using SPSS, has been done for the collected data to rank the delay factors.

3.3 SURVEY DESIGN PROCESS

Survey is defined as "data collected from number of cases/projects through systematic measurement and then analyzed to yield the results (Marsh 1982). Trochim (1997) and Bryman (2004) argued that in applied social research, surveys are mostly carried out by questionnaire and interview surveys. Bryman (2004) referred surveys as cross-sectional studies and explained that the data collected from the surveys are generally quantitative in nature and can be used to correlate two or more variables. Trochim (1997) suggests that several issues should be kept in mind when a survey is chosen as a research strategy: a) population, b) sampling and c) question issues. The survey design selected for this research is shown in the Figure 3.2 (adopted from Shuwei 2009).

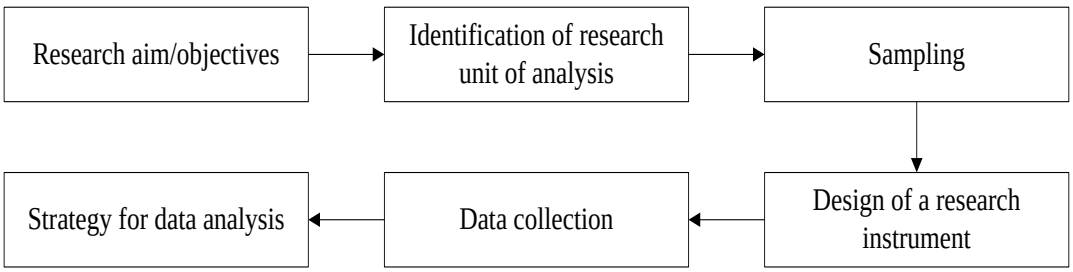

Figure 3.2: Research survey design process

3.3.1 Identification of research unit of analysis

The identification of unit of analysis is the central part of the survey design process and concerned with the data to be collected (Shuwei 2009). De Vaus

(2002) has highlighted the importance of unit of analysis and argued that it is directly associated with the aim/objectives of the research. The purpose of this research is to evaluate delay and time overrun factors on building projects based on traditional procurement method and rank these factors for construction industry of Pakistan. Each building project has been taken as a one case project. On each project, the opinion of all the three key stake holder client, contractor and consultant is achieved. Sampling has been done to identify the building projects based on traditional method of procurement from where the data is to be collected.

3.3.2 Sampling

Fellows and Liu (2003) defined the purpose of sampling as "*collection of data and carry out of the research components provided that the sample selected is a good representation of the study population*". Trochim (1997) argued that the process of sampling moves from study population to the sampling frame from which the research sample is selected. Study population and sampling frame have been explained by Saunders et.al. (2003) as "*population is a full set of cases from which a sample is drawn and sampling frame refers to a complete list of all the cases in the population".* It is important that the list of the cases should be clear, current and accurate (Shuwei 2009). If list is not available, the researcher can develop and complete the sampling frame (De Vaus 2002). On the basis of the sampling frame, sample is selected from the study population (Shuwei 2009). Two types of sampling techniques are widely used: probability and non-probability sampling. In probability sampling, the sample can be selected which is a true representative of a population. On the other hand, De Vaus (2002) argued that when sampling frame is not available or the population study is widely dispersed, non-probability sampling is suggested. Channels (1985) argued that if the data is to be collected from a small and accessible population, it is advisable to use all the cases in the population rather than to draw a sample. Johnson and Christensen (2004) also advocated that if the researcher is quite confident that he knows the total population, the complete population can be taken in the study. In this research, the study population is building projects (public and private) based on the traditional method which are already complete but which have a considerable time

overrun as agreed in the contract. It is also worth mentioning that feedback has been taken only for construction phase of the projects as the contractors are fully and formally involved at this stage in traditional procurement method. Due to limited time frame of study, mostly projects were selected from Twin Cities (Rawalpindi & Islamabad) however, representative sample of all the five provinces were also included to cater for the geographical factors, causing delay in building construction projects. List of sample building projects selected for survey is also attached at Appendix I.

3.3.3 Design of a research instrument

Based on the research aim/objectives i.e. to rank the delay factors for construction industry of Pakistan, a questionnaire was developed for full scale survey based on thorough past review of a literature, researcher experience on the building projects and after conducting a pilot survey. Measurement scale selection, attitude measurement and ranges of response category were taken in to consideration for the design of a questionnaire.

3.3.3.1 Selection of measurement scale

Measurement scale is generally divided in to four different levels, namely nominal, ordinal, interval and ratio (Reaves 1992 and Trochim 1997). In this research study, client, consultant and contractor's perception was to be measured, so it was suitable to select the ordinal scale (also called ranking scale) for its measurement.

3.3.3.2 Attitude measurement

Oppenheim (1992) argued that people's perception about some specific issue goes from low, through neutral to a degree of high level. Attitude measurement is suitable for measuring individuals' perception or feelings, called an attitude scale by Bell (2005). De Vaus (2002) and Saunders et al. (2003) have named attitude scale as numeric rating scale and semantic differential rating scale. There are four commonly used methods of attitude scaling in social research: the Bogardus, Thurstone, Likert and Guttmann (cumulative) scales (Oppenheim 1992;

Trochim 1997 and De Vaus 2002). Among them, Likert scale is widely used as it provides better reliability and is less laborious (Oppenheim 1992 and De Vaus 2002). Therefore, Likert scale was selected to take opinion of all the three key stake holder, client, consultant and contractor in this research.

3.3.3.3 Ranges of response category

Several researchers have recommended 7-point scale (Alwin 1997 and De Vaus 2002); however, the fine distinctions can confuse and requires precision with greater accuracy (Shuwei 2009). Therefore, based on the above, five point scale was adopted for the survey questionnaire to get feedback on each indicator and defined scales as 1 for Strongly Disagree, 2-Disagree, 3-Neither agree Nor Disagree, 4-Agree and 5-Strongly Agree to show their attitude towards each indicator contributing delay or time overruns in building construction projects of Pakistan.

3.3.3.4 Pilot study

The purpose of a pilot survey also known as feasibility survey is to test a questionnaire for its reliability, consistency and validity (Thompson 2010). De Vaus (2002) argued that while conducting a pilot survey, the emphasis should take on checking whether any problem exists with the questionnaire items, how long it will take to fill in and whether respondents are interested in filling the questionnaire. Another important issue is how many pilot surveys be carried out?. Shuwei (2009) believed that the number of pilot studies depends on research aim/objectives, size of the research study and available resources (time and money). For this purpose, a pilot survey has been carried out to test the questionnaire items as well as the whole questionnaire. A sample of Nine (9) projects recently completed at the campus of National University of Sciences and Technology, Sector H-12, Islamabad were selected. The questionnaires were delivered by hand to ensure maximum feedback. The responses provided by the respondents were helpful in refining and improving the questionnaire for conducting full scale survey. Also the results of the pilot surveys were also incorporated in the data analysis as well. As suggested by Saunders et al. (2003),

the questionnaire was also thoroughly discussed with colleagues and friends to pick any error and obtain the face validity of a questionnaire. After that, the questionnaire was refined and ready for carrying out a full scale survey. In the next section, questionnaire layout is presented.

3.3.3.5 Layout of a questionnaire

Shuwei (2009) suggested that the survey questionnaire should be clear, precise and attractive for the respondents to fill in and return it. In this research, the questionnaire was developed in easy and understandable form and also keeping in view the context of Pakistani construction industry environment. The questionnaire was attached with a covering letter (Appendix II and III), describing the main purpose of the study and ensuring the respondents that the information provided by them will be kept confidential and used for academic purposes only.

The questionnaire is divided in two parts, and the part I starts with the respondent's general information. It includes, his name, qualification, designation, working experience in construction industry, name of the employer, address and cell number etc. The second step is the general information about the firm (if applicable). This include the name of company, type (public/semi government/private), category of enlistment in Pakistan Engineering Council (PEC), working experience in construction industry, major projects executed, address and contact number. The third portion of general information is about the project. It includes, project title, type (residential/educational/commercial/industrial/institutional), then project durations showing start date, completion date, actual completion date, contractual duration, actual duration and actual duration and project cost as well.

The part II that is the main body of the questionnaire was divided in to thirteen (13) sub parts. These sub parts are actually the grouping of Delay Factors (13) that was obtained earlier through literature review as the most relevant list of delay or time overrun factors being faced by construction industry of Pakistan in

execution of building projects. List of these Major Delay Factor groups is as under :

Table 3.1: Delay Factors Grouping

Serial	Major Grouping of Delay Factor
1	Scope & Planning related Delays
2	Design & Drawing related Delays
3	Estimation related Delays
4	Contract related Delays
5	Site related Delays
6	Work Force related Delays
7	Construction Material and Equipment related Delays
8	Construction Management related Delays
9	Finance related Delays
10	Cost related Delays
11	Quality related Delays
12	Weather & Hazard related Delays
13	Government Related Delays

In each of the above group, there are several key indicators contributing delay to building construction. So respondent from each stake holder category, client, consultant & contractor was desired to give input against each key indicator in the questionnaire. (Appendix III)

3.3.4 Data collection

3.3.4.1 Full scale survey

Since the most of the selected building projects were accessible to the researcher, it was decided to deliver questionnaires to the respondents personally. Bell (2005) argued that delivering questionnaires to respondents by hand have distinct advantages: respondents can get a better understanding of the research purpose, questionnaires can be filled through face to face communication, any difficulty in the questionnaires can be sorted out easily and high response rate can be obtained. Therefore, building project sites in Islamabad and Rawalpindi region, plus the accessible projects of various provinces were visited and delivered questionnaires to the client, consultant and contractor's representatives personally. Some questionnaires were delivered via e-mail and got full response. Out of fifty

four (54), forty eight (48) valid responses were collected. Six (6) projects were eliminated from the list because one out of three key stake holders was unable to respond.

3.3.5 Strategy for data analysis

The survey data collected for this research is an ordinal one and uses a Likert scale; Cronbach's Alpha coefficient method was used to check the reliability of the collected data. Then descriptive statistics was used to calculate the mean scores. Further the formula of Relative Importance Index (RII) was used to rank the factor for each key stake holder client, consultant and contractor. The Rank Agreement Factor (RAF) and Percentage Agreement (PA) was further used to see the percentage of disagreement and agreement between all the three key stake holders regarding ranking of the (13) delay factors. After this an overall ranking of delay factors was determined. Four top ranking key factors were further studied in detail to see the most significant key indicator for these top ranking factors. All the analysis and results are presented in Chapter Four.

Chapter 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter, detailed analysis of the collected data is presented. For this purpose, the widely and most comprehensible software for practical statistical analysis was used i.e. SPSS Ver.18.0 (Statistical Package for the Social Sciences); since manual calculations cannot make an error-free analysis from a large amount of data (Gaur & Gaur 2009). In this research, the client, consultant and contractor, all the three key stake holders gave their perceptions about factors of delay in building construction projects. Different statistical tests such as reliability and descriptive statistics (mean, frequency etc.) calculation of Relative Importance Index (RII) for ranking of factors and percentage agreement between three parties is done in order to drive the overall ranking of delay factors in building construction Projects of Pakistan. Most significant key indicator in the four top ranking delay factors was also determined.

4.2 DEFINING VARIABLES

First of all for conducting statistical analysis on SPSS, delay factors were grouped and abbreviated for client, contractor and consultant

4.2.1 Major Grouping of the Delay Factors

Table 4.1: Major Grouping of Delay Factors in Building Construction

Serial	Delay Factor	Code
1	Scope & Planning related Delays	SP
2	Design & Drawing related Delays	DD
3	Estimation related Delays	ER
4	Contract related Delays	CT
5	Site related Delays	SR
6	Work Force related Delays	WF
7	Construction Material and Equipment related Delays	ME
8	Construction Management related Delays	MR
9	Finance related Delays	FR
10	Cost related Delays	CR
11	Quality related Delays	QR
12	Weather & Hazard related Delays	WR
13	Government Related Delays	GR

4.2.2 Indicators Constituting each Group of Delay Factors

Among the each Group of Delay Factors, there were numerous indicators that were attributing towards that particular delay factor. The tabulated list of key indicators in each delay factor group is shown in Tables 4.2 to 4.14:

Table 4.2 : SP - Scope & Planning Related Delays

Serial	Indicator	Code
1	Redesigning	SP1
2	Inadequate Pre-contract Study	SP2
3	Variation Orders	SP3
4	Additional Works	SP4
5	Inappropriate Selection of Project	SP5
6	Inadequate Feasibility Study of the Project	SP6
7	Ambitious Completion Period of the Project	SP7
8	Vague Conception Demand of Construction Material	SP8
9	Inadequate Pre-construction Study of the Project	SP9
10	Poor Planning and Scheduling	SP10
11	Prolong Time Period between Designing & Tendering/Award	SP11

Table 4.3 : DD - Design & Drawing Related Delays

Serial	Indicator	Code
1	Availability of Drawings	DD1
2	Drawings/Design Variations	DD2
3	Complicated Design of Civil Works	DD3
4	Complex Nature of the project	DD4
5	Misinterpretation of Drawings resulting in Suspension/Redoing	DD5
6	Absence of Build Ability in the Design	DD6
7	Frequent Issue of Supplementary Drawings	DD7

Table 4.4 : ER - Estimation Related Delays

Serial	Indicator	Code
1	In-accurate Cost Estimates	ER1
2	Use of Wrong method/ Schedule of estimates for Cost Estimation	ER2
3	Absence of Construction Cost data	ER3

Table 4.5 : CR - Contract Related Delays

Serial	Indicator	Code
1	Incomplete Contract Documentation	CT1
2	Work Suspension owning to Conflicts	CT2
3	Litigations	CT3
4	Low Bid Procurement method resulting in Un-realistic rates	CT4
5	Bureaucracy in Bidding/Tendering method	CT5
6	Disputes at Site	CT6
7	In-appropriate Contractual Procedure	CT7
8	In-adequate duration of Contract Period	CT8
9	Poor Contract Management	CT9
10	Re-tendering	CT10
11	Risk & Cost Contracts	CT11

Table 4.6 : SR - Site Related Delays

Serial	Indicator	Code
1	Problems in Land Acquisition	SR1
2	Site Variations	SR2
3	In-adequate Site Investigations	SR3
4	Encroachment of Land during Project Implementation	SR4

Table 4.7 : WF - Work Force Related Delays

Serial	Indicator	Code
1	Poor Workmanship	WF1
2	Non availability of Skilled Persons/Craftsmen	WF2
3	Inadequate contractor's Experience	WF3
4	Slackness on part of the Contractor	WF4
5	Labour Disputes/Strikes/Security Issues	WF5
6	Shortage of Labour/Skilled persons	WF6
7	Absence of Qualified Supervisory Staff	WF7

Table 4.8 : ME - Material & Equipment Related Delays

Serial	Indicator	Code
1	Non availability/Shortage of Local Materials	ME1
2	Delay in Procurement of Foreign Materials	ME2
3	Non availability of specialized equipment on site	ME3
4	Material Management Problems	ME4
5	Equipment Management Problems	ME5
6	Stealing and Wastage on Site	ME6
7	Delay in Transportation/Delivery of Construction Material	ME7

Table 4.9 : MR - Construction Management Related Delays

Serial	Indicator	Code
1	Slow Decision Making	MR1
2	Poor Planning and Scheduling	MR2
3	Poor Site Management	MR3
4	Un Suitable Contractor	MR4
5	Lack of Project Management Skills/Management Strategy	MR5
6	Schedule Slippages	MR6
7	In appropriate Procedures/Policies	MR7
8	Lack of Project Knowledge	MR8
9	Poor Project Supervision	MR9
10	In-adequate Site Inspections	MR10
11	In-appropriate Construction Methodology by the Contractor	MR11
12	In-adequate Project Monitoring System through Reports & Returns	MR12
13	Poor Financial Control on Site	MR13
14	Lack of Co-ordination between General & Sub Contractor	MR14
15	Lack of Co-ordination between Design Team & General Contractor	MR15

Table 4.10 : FR - Finance Related Delays

Serial	Indicator	Code
1	Delay in Payments by the Client	FR1
2	Delay in Processing/Request for payments by the Contractor	FR2
3	Poor Disbursement Procedure by the Client	FR3
4	Cash flow Problems by Contractor not being Financially Sound	FR4
5	In-adequate Client Financing	FR5
6	Poor Account Procedures	FR6
7	Mal-practices resulting in Pilferage and Wastage of Funds	FR7

Table 4.11 : CR - Cost Related Delays

Serial	Indicator	Code
1	Cost escalation/Inflation	CR1
2	Higher Transportation Cost	CR2
3	Higher Cost of Skilled Labour	CR3
4	Higher Machinery Hiring/Maintenance Cost	CR4
5	Fluctuating Prices of Raw Materials/Fitting Fixtures	CR5

Table 4.12 : QR - Quality Related Delays

Serial	Indicator	Code
1	In-adequate Quality resulting in Work Suspension/Redoing	QR1
2	Use of Substandard Materials/Fitting Fixtures	QR2

Table 4.13 : WR - Weather Related Delays

Serial	Indicator	Code
1	Adverse effects of Weather resulting in Delays	WR1
2	Earthquakes	WR2
3	Floods	WR3
4	Unforeseen Ground Conditions	WR4
5	Act of God/Accidents on site	WR5

Table 4.14 : GR - Government Related Delays

Serial	Indicator	Code
1	In-appropriate Government Policies/Procedures	GR1
2	Non-conducive Law & Order/ Security Situation	GR2
3	Lack of Coordination between Various Agencies	GR3

Before carrying out the descriptive statistics, calculations of Relative Importance Index (RII) and Mutual Agreement Percentage Analysis of three major stake holders, it is strongly recommended to assess the reliability of the collected data and discussed in the next section.

4.3 RELIABILITY ANALYSIS

Repeating any measurement that produces the same result is considered a reliable measurement (Gaur & Gaur 2009). Leech et al. (2005) argued that the reliability test is done to check whether each item in the scale is free from error of measurement. Hinton et al. (2004) have also defined reliability as a questionnaire tested to study any topic at different times and across different populations, if produces same results, the questionnaire is a ‘reliable one’.

Different methods are used to assess the reliability. Test-retest method is used to ideally measure the reliability. In this method, the measurement is done on the same object twice and comparing the results. If the results are same, the measurement is reliable. However, practically this method is quite difficult to establish the reliability (Hinton et al. 2004).

In SPSS, widely used methods for assessing reliability include Cohen's Kappa Coefficient for categorical data and Cronbach's Alpha for continuous data (Likert-scale type items). Among them, Cronbach's Alpha is most popular method (Hinton et al. 2004 and Leech et.al. 2005). Hinton et al. (2004) explained that Cronbach's Alpha value range from 0 (un-reliable) to 1 (reliable) with 0.75 being considered the most sensible value. They have also provided a guide line to assess the reliability of any data as shown in the Table 4.15.

Table 4.15: Guideline for Assessing Reliability Results

a.	0.9 & above	Excellent reliability	**b.**	0.7 to 0.9	High reliability
c.	0.5 to 0.7	Moderate reliability	**d.**	0.5 and below	Low reliability

In reliability analysis, un-dimensionality i.e. correlation of each item with the total scale can be checked as well. De Vaus (2002) and Hinton et al. (2004) argued that if the item-to scale coefficient is below 0.3, the item should be removed. Since the data gathered was based on Likert-scale; therefore Cronbach's Alpha method was used to check the reliability in this research. The summary of the reliability analysis conducted on SPSS is presented here and full results can be seen in the Appendix IV.

4.3.1 Delay Factors Data Reliability

Table 4.16 : Cronbach's Alpha for Delays Factors for Major Stake Holders

Serial	Delay Factor	Client	Consultant	Contractor
1	Scope & Planning related Delays	0.861	0.833	0.825
2	Design & Drawing related Delays	0.976	0.919	0.893
3	Estimation related Delays	0.908	0.899	0.678
4	Contract related Delays	0.964	0.918	0.954
5	Site related Delays	0.532	0.532	0.416
6	Work Force related Delays	0.955	0.885	0.924
7	Construction Material and Equipment related Delays	0.900	0.928	0.945
8	Construction Management related Delays	0.956	0.963	0.964
9	Finance related Delays	0.939	0.947	0.900
10	Cost related Delays	0.963	0.937	0.925
11	Quality related Delays	0.804	0.904	0.979
12	Weather & Hazard related Delays	0.861	0.855	0.599
13	Government Related Delays	0.962	0.481	0.444

As per the above table of Cronbach's Alpha values for all the major stake holders, Client, Contractor and consultant, all the values achieved were above 0.3, thus all the indicators in each group were retained basing on the reliability analysis.

4.4 DESCRIPTIVE ANALYSIS

Fifty Four (54) building construction projects were selected for this research all across Pakistan. It contained most of the projects from Twin Cities (Rawalpindi and Islamabad) along with the representative samples of all the Provinces. Out of fifty four (54), fifty eight (48) valid responses were collected.

4.4.1 Type of the Projects

Purely Building Projects were selected for the field includes the projects of traditional procurement method and also these were already completed in recent past with considerable delay. No on-going project was included in the list for the reason that the actual delay and causes can not be determined unless a project is fully completed. Similarly since the delay of projects is also dependent on certain geographical factors, so representative samples of each province were taken in order to determine the delay factors which are specific to Construction Industry of Pakistan.

4.4.2 Type of the Respondents

All the three key stake holders, client, consultant and contractors were consulted as part of field survey. This helped to ascertain the perspective of each stake holder regarding Delay Factors of Building Construction in Pakistan. After ascertaining individual ranking the Delay of factors of each stake holder, an overall ranking was established.

4.4.3 Ranking of the Delay Factors

One of the objectives of this study was to rank the Delay Factors. For this, first descriptive statistics is applied using SPSS to rank the Delay Factors using the Mean Scores, but then this ranking was further refined using Relative Importance

Index (RII) derived to summarize the importance of each Delay Factor was computed as :

$$RII = \frac{\sum w}{A \times N} \quad \text{..... Equation (4.1)}$$

Where : w = weighting as assigned by the each respondent in a range from 1 to 5, where 1 implies Strongly Disagree and 5 implies Strongly Agree; A = the highest weight (5); N = the total Number in the sample (this was forty eight in this study)

The RII's corresponding to all the key stake holders, client, consultant and contractor for each category of delay factor computed as per the field survey of forty eight (48) sample projects is tabulated below in Table 4.17 :

Table 4.17 : RII for each Delay Factor Category (All Key Stake Holders)

DELAY FACTORS	CIENT	RANK	CONSULTANT	RANK	CONRACTOR	RANK
Scope & Planning Related Delays	0.483	8	0.513	6	0.513	7
Design & Drawing Related Delays	0.483	8	0.529	5	0.529	5
Estimate Related Delays	0.417	11	0.488	10	0.488	10
Contract Related Delays	0.488	7	0.508	8	0.508	8
Site Related Delays	***0.608***	***2***	***0.604***	***1***	***0.604***	***1***
Work Force Related Delays	***0.571***	***3***	0.508	8	0.508	8
Material & Equipment Related Delays	0.467	10	0.479	11	0.479	11
Management Related Delays	***0.558***	***4***	***0.571***	***3***	***0.571***	***3***
Finance Related Delays	0.542	5	***0.567***	***4***	***0.567***	***4***
Cost Related Delays	0.533	6	0.517	7	0.517	6
Quality Related Delays	***0.621***	***1***	0.575	2	***0.575***	***2***
Weather Related Delays	0.408	13	0.442	12	0.442	12
Government Related Delays	0.417	11	0.425	13	0.425	13

4.4.4 Rank Agreement Factors (RAF) & Percentage Agreement (PA)

Rank Agreement Factors (RAF) were next computed using formula and methodology described by Okpala and Aniekwu (1988) to measure the agreement in ranking between groups of project key stake holders, client, consultant and contractors. The RAF can range from 0, indicating perfect agreement, to a higher

values indicating increasing disagreement. The percentage disagreement and Percentage Agreement are also calculated through formulae. Formulas related to these calculations are as under :

Absolute Difference = Di = | Ri1-Ri2| ……..…. Equation(4.2)

Where Ri1 = Ranking of First Group; Ri2 = Ranking of Second Group

Maximum Absolute Difference = Dmax = | Rj1-Rj2| …… …..…. Equation(4.3)

Where Rj1 = Ranking ; Rj2 = Ranking with absolute maximum difference

Rank Agreement Factor = RAF = ∑D/N …….. Equation(4.4)

Where D = Absolute difference ; N = Number of Categories

Percentage Disagreement = PD = $\frac{RAF}{RAFmax}$ or $\frac{Di/N}{Dmax/N}$ Equation (4.5)

Percentage Agreement = PA = 100% - PD ……..……...Equation (4.6)

These above formulae were used to establish the percentage agreement between all the three key stake holders client, consultant and contractor regarding ranking of major delay factors outlined using RII and following results were obtained as shown in Table 4.18 to 4.20:

Table 4.18 : Percentage Agreement (PA) between Client and Consultant

FACTOR NO	FACTOR	RII		ABS	FOR MAX ABS DIFF		ABS
		CLIENT (Ri1)	CONSULTANT (Ri2)		Rj1	Rj2	
1	SP	8	6	2	1	13	12
2	DD	8	5	3	2	12	10
3	ER	11	10	1	3	11	8
4	CT	7	8	1	4	10	6
5	SR	2	1	1	5	9	4
6	WF	3	8	5	6	8	2
7	ME	10	11	1	7	7	0
8	MR	4	3	1	8	6	2
9	FR	5	4	1	9	5	4
10	CR	6	7	1	10	4	6
11	QR	1	2	1	11	3	8
12	WR	13	12	1	12	2	10
13	GR	11	13	2	13	1	12
			Di=	21	Dmax=		84

Di/N = 1.615 Dmax/N = 6.462

Percentage Disagreement = 25 % Percentage Agreement = 75 %

Table 4.19 : Percentage Agreement (PA) between Consultant and Contractor

FACTOR NO	FACTOR	RII		ABS	FOR MAX ABS DIFF		ABS
		CONSULTANT (Ri1)	CONTRACTOR (Ri2)		Rj1	Rj2	
1	SP	6	7	1	1	13	12
2	DD	5	5	0	2	12	10
3	ER	10	10	0	3	11	8
4	CT	8	8	0	4	10	6
5	SR	1	1	0	5	9	4
6	WF	8	8	0	6	8	2
7	ME	11	11	0	7	7	0
8	MR	3	3	0	8	6	2
9	FR	4	4	0	9	5	4
10	CR	7	6	1	10	4	6
11	QR	2	2	0	11	3	8
12	WR	12	12	0	12	2	10
13	GR	13	13	0	13	1	12
			Di=	2	Dmax=		84

Di/N = 0.154 Dmax/N = 6.462

Percentage Disagreement = 2 % Percentage Agreement = 98 %

Table 4.20 : Percentage Agreement (PA) between Client and Contractor

FACTOR NO	FACTOR	RII		ABS	FOR MAX ABS DIFF		ABS
		CLIENT (Ri1)	CONTRACTOR (Ri2)		Rj1	Rj2	
1	SP	8	7	1	1	13	12
2	DD	8	5	3	2	12	10
3	ER	11	10	1	3	11	8
4	CT	7	8	1	4	10	6
5	SR	2	1	1	5	9	4
6	WF	3	8	5	6	8	2
7	ME	10	11	1	7	7	0
8	MR	4	3	1	8	6	2
9	FR	5	4	1	9	5	4
10	CR	6	6	0	10	4	6
11	QR	1	2	1	11	3	8
12	WR	13	12	1	12	2	10
13	GR	11	13	2	13	1	12
			Di=	19	Dmax=		84

Di/N = 1.462 Dmax/N = 6.462

Percentage Disagreement = 23 % Percentage Agreement = 77 %

These overall results of Percentage Agreement (PA) between all the three key stake holders, client, consultant and contractor are plotted as shown in Fig 4.1 :

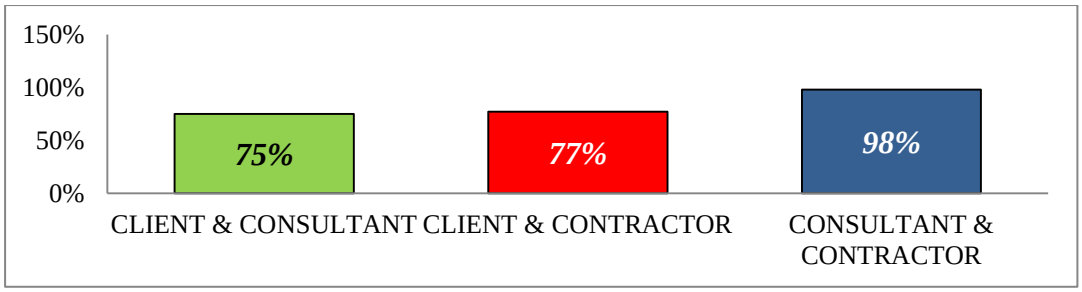

Figure 4.1 : Percentage Agreement (PA) between Key Stake Holders

After obtaining the Percentage Agreement (PA) between all the three key stake holders opinion about Delay Factors it was observed that there was maximum (98%) agreement between Consultant and Contractor. The Percentage Agreement (PA) between Client and Contractor was (77%) and between Client and Consultant it was (75%). This implies that the results obtained from RII for ranking of each category of delay factor for each key stake holder holds good percentages of mutual agreement between each other.

Basing on these results, the overall ranking of Delay factors was obtained which is outlined in Table 4.21 :

Table 4.21 : Over all Ranking of Delay / Time overrun Factors

DELAY FACTORS	OVER ALL RII	OVER ALL RANKING
Scope & Planning Related Delays	0.503	8
Design & Drawing Related Delays	0.514	7
Estimate Related Delays	0.464	11
Contract Related Delays	0.501	9
Site Related Delays	***0.605***	***1***
Work Force Related Delays	0.529	5
Material & Equipment Related Delays	0.475	10
Management Related Delays	***0.567***	***3***
Finance Related Delays	***0.559***	***4***
Cost Related Delays	0.522	6
Quality Related Delays	***0.590***	***2***
Weather Related Delays	0.431	12
Government Related Delays	0.422	13

Again the analysis of key indicator of four top ranking delays factors was done using Relative Importance Index (RII) and results of significant indicator in each Delay Factor was concluded as shown in Table 4.22 :

Table 4.22 : Significant Key Indicators in Top Ranking Delay Factors

RANKING	DELAY FACTORS	SIGNIFICANT KEY INDICATORS
I	**Site Related Delays**	• Site Variations
II	**Quality Related Delays**	• Inadequate Quality Resulting in Work Suspension/Redoing
III	**Management Related Delays**	• Poor Planning and Scheduling • Schedule Slippages
IV	**Finance Related Delays**	• Poor Accounting Procedures

4.8 SUMMARY

In this chapter, detailed statistical analysis has been presented. Following the pre-defined data analysis strategy, the data analysis carried out includes: reliability test, descriptive statistics, relative importance RII, rank agreement factor (RAF) and percentage Agreement (PA) thus presenting a final ranking of delay factors of building construction in Construction Industry of Pakistan. Significant Key Indicator in each Delay Factor is also ascertained. In the next chapter, the conclusions and recommendations are made based on results of the data analysis.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS & RECOMMENDATIONS

5.1.1 Conclusions

As stated as an objective of this study, after the analysis of thirteen (13) Delay Factors using statistical procedures, following rankings were ascertained :

1. Site Related Delays
2. Quality Related Delays
3. Construction Management Related Delays
4. Finance Related Delays
5. Work Force Related Delays
6. Cost Related Delays
7. Design and Drawing Related Delays
8. Scope and Planning Related Delays
9. Contract Related Delays
10. Material and Equipment Related Delays
11. Estimates Related Delays
12. Weather Related Delays
13. Government Related Delays

Further, study of top four ranking delay factors was conducted basing on data for each key indicator in order to assess the most important indicator in each of four delays factors, causing in delay of building projects in Pakistan.

It was concluded that in Site Related Delays, site variations was the most important sub factor for delays. Similarly in Quality Related Delays, inadequate quality resulting in work suspension/redoing was the most important sub factor. In relation of Construction Management Related Delays, two sub factors, poor

planning & scheduling and schedule slippages were ascertained as the most dominating sub factors pertaining to Construction Management Related Delays. In Finance related delays, poor accounting procedures was the most important sub factor.

5.1.1 Recommendations

Some recommendations are enlisted based on the research findings and conclusions. These will help to reduce delays in construction process and will enhance the efficiency of Construction Industry of Pakistan for Building Construction :

1. Site Related Delays is the most significant delays factor, that delays a particular project. In site related delays, site variations are the most significant factor of delay. Hence, it is recommended that thorough site investigation must be done at the time of project planning to ensure un-interrupted and efficient construction process. Similarly, other site related factors like land acquisition and issues of encroachments etc are also to be addressed to reduce the delay.

2. Quality Related Delays are the next important delay factor. In-adequate quality Resulting in work suspension/redoing is detrimental to Project Progress in Building Construction. Similarly sub standard construction materials and fitting fixtures not meeting desired specifications results in disputes at site, thus delaying the project. So it is recommended that focus on Quality Standards in Construction be brought at Government Level in order to ensure, timely and quality construction work with reduced cost.

3. Construction Management Related delays are again yet another important delay factor. It has attributes like poor planning and scheduling, schedule slippage, poor site management, Inadequate Site supervision & inspection and lack of coordination among various project participants. Therefore enhancing Construction Management Skills at national level will surely improve the efficiency of Construction Industry. Similarly, the law and act

to penalize the contractor for delayed work needs to be further strengthened.

4. Funds act as a fuel to the construction project. Not the least, Financial Related Delays are yet another important delay reasons. It has issues like, poor accounting procedures, delay in payments, poor disbursement procedures, cash flow problems and Mal-practices resulting in pilferage and wastage of funds. Therefore it is suggested that timely, transparent and fluent supply of funds be ensured to avoid un necessary delays in construction projects in Pakistan.

5.2 FUTURE DIRECTIONS

The scope of this thesis was to enlist and rank the delay factors for building construction in Pakistan, however delay in each project vary in terms of time. In case if this time factor is taken as one variable against all the delay factors, then a Delay Formula can be formulated for Construction Industry of Pakistan using statistical tools like Multiple Linear Regression etc.

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APPENDIX: I LIST OF BUILDING PROJECTS BASED ON TRADITIONAL PROCUREMENT METHOD

SER	*TITLE OF THE PROJECT*
1.	200 BED DISTRICT HEADQUARTER HOSPITAL AT D I KHAN
2.	ADVISORY SERVICES FOR BALOCHISTAN BOARD OF INTERMEDIATE AND SECONDARY EDUCATION QUETTA
3.	AYUB MEDICAL COLLEGE AND HOSPITAL COMPLEX, ABBOTTABAD
4.	BALOCHISTAN PUBLIC SERVICE COMMISION OFFICE BUILDING AT QUETTA
5.	BOARD OF INTERMEIATE & SECONDARY EDUCATION OFFICE BUILDING, LAHORE.
6.	ACADEMIC BLOCK FOR WOMEN, IIUI ISLAMABAD
7.	FORIGN SERVICES ACADEMY, F 5, ISLAMABAD
8.	NATIONAL BANK BUILDING, G-5, ISLABABAD.
9.	NEW PAKISTAN SECRETARIAT BUILDING, G-5, ISLAMABAD.
10.	PHA APARTMENTS, G 11/3, ISLAMABAD.
11.	PIPS BUILDING, ISLAMABAD
12.	PPMI BUILDING, H-8, ISLAMABAD.
13.	PT – TELE HOUSE, MAUVE AREA, G-10 ISLAMABAD
14.	QUAID-E-AZAM INTERNATIONAL, HOSPITAL, RAWALPINDI.
15.	RAWALPINDI INSTITUE OF CARDIALOGY, RAWALPINDI.
16.	TRANSIT ACCOMODATION AT LTU, F-6/3, ISLAMABAD
17.	WORKERS WELFARE FUND (WWF) SECRETARIAT, MAUVE AREA, G – 10, ISLAMABAD.
18.	ACADEMIC BLOCK I, CIIT, CHAK SHAHZAD, ISLAMABAD
19.	LIBRARY BUILDING, CIIT, CHAKSHAHZAD, ISLAMABAD.
20.	COLLEGE OF PHYSICIANS & SURGEONS, PAKISTAN SUB OFFICE AT MULTAN
21.	FGEHF APARTMENTS PACKAGE V, ISLAMABAD
22.	FGEHF APARTMENTS, PACKAGE IV, ISLAMABAD
23.	STOCK EXCHANGE TOWER, ISLAMABAD
24.	DIAGNOSTIC CENTER AT KARACHI
25.	DIVISIONAL HEADQUARTERS COMPLEX, MARDAN
26.	ENGINEERING SERVICES FOR GYNAE-OBSTET BLOCK LADY READING HOSPITAL PESHAWER
27.	FACULTY CAFETERIA AT NUST H-12 ISLAMABAD
28.	GYNEA/OBSTT & PAEDS BLOCK FOR LADY READING HOSPITAL AT PESHAWER
29.	HOSTLES AT NUST H-12 ISLAMABAD
30.	HOSTLES AT NUST H-12 ISLAMABAD
31.	ISLAMIC CENTRE AT SUKKAR
32.	MEDICAL TOWER AT PIMS ISLAMABAD
33.	NATIONAL HIGHWAY AUTHORITY'S NEW OFFICE BUILDING AT ISLAMABAD
34.	NAVY HOUSING SCHEME CLIFTON KARACHI
35.	NBS BUILDING AT NUST H-12 ISLAMABAD
36.	NESPAK HOUSE, LAHORE
37.	NEW OFFICE BUILDING FOR SBP AT MUZAFFARABAD (AJ&K)
38.	NICE BUILDING AT NUST H-12 ISLAMABAD
39.	NIT AND IESE BUILDING AT NUST H-12 ISLAMABAD
40.	PAKISTAN INSURANCE CORPORATION BUILDING, KARACHI
41.	PERSHAWER SECRETARIAT COMPLEX
42.	PTET TELE TOWER PROJ, BLUE AREA, ISLAMABAD.
43.	PUNJAB WORKERS WELFARE BOARD DEVELOPMENT SCHEMES, CHAKWAL
44.	RESIDENTIAL COMMUNITY AT AES POWERPLANK LALPIR, MUZAFFARGARH
45.	SCME BUILDING AT NUST H-12 ISLAMABAD
46.	SECRETARIAT BUILDING AT GILGIT
47.	SEECS BUILDING AT NUST H-12 ISLAMABAD
48.	STATE LIFE INSURANCE CORPORATION BUILDING AT LARKANA

APPENDIX: II **Questionnaire Covering Letter**

SCHOOL OF CIVIL & ENVIRONMENTAL ENGINEERING (SCEE)

Dear Sir,

Most of the building construction projects in construction Industry of Pakistan suffer delay and time overruns. Projects are completed much beyond the scheduled completion date due to various reasons.

In partial fulfillment of the requirements for the degree of Master of Science in Construction, Engineering & Management from NUST, H-12, Islamabad, the undersigned intends to conduct a enlist and rank the delay factors for building construction in Pakistan. As a representative of the client/consultant/contractor, you are kindly requested to take few minutes from your valuable time to add your input to identify the likely cause of project delays in building constructio .

All the information provided in this regard will only be used for academic purposes and kept confidential.

Thanks for your support and cooperation in advance.

Yours Sincerely,

Major MUHAMMAD AHMAD
Post Graduate Student- Construction Engineering & Management
Cell. No: 0321-6172055
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FIELD SURVEY TO STUDY "FACTORS AFFECTING TIME OVERRUNS IN BUILDING PROJECTS IN PAKISTAN"

DISCLAIMER

THE INFORMATION OBTAINED THROUGH THIS SURVEY IS FOR RESEARCH/LITERARY PURPOSES ONLY. ANY CONFIDENTIAL INFORMATION INVOLVING ANY PERSON, APPOINTMENT, DEPARTMENT, ORGANIZSATION, PUBLIC OR PRIVATE AGENCY SHALL NOT BE DISCLOSED TO ANY PRINT MEDIA OR ANY UN-AUTHORIZED SOURCE.

THE STUDENT

Major **MUHAMMAD AHMAD**
BE (CIVIL), MBA (MIS)
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Associate Professor
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School of Civil & Environmental Engineering (SCEE)
National University of Sciences & Technology (NUST)
NUST Islamabad Campus
Sector H - 12
Islamabad, ICT - 44000

GENERAL INFORMATION

1. GENERAL INFORMATION ABOUT PERSON FILLING THIS SURVERY FORM
a. Name:
b. Qualifications :
c. Designation:
d. Working experience in Construction Industry:
e. Name of the Employer:
f. Address:
g. Cell No:

2. GENERAL INFORMATION ABOUT THE FIRM (IF APPLICABLE)				
a. Name of company:				
b. Type: ☐ Public ☐ Semi Government ☐ Private				
c. Category of Enlistment in PEC:				
d. Working Experience in Construction Industry (years) :				
e. Project Type mostly executed : ☐ Residential ☐ Educational ☐ Commercial ☐ Industrial ☐ Institutional				
f. Major projects executed				
Serial	Name of Project	Cost	Completed/Ongoing	Time overruns (if
j. Address:				
k. Contact No:				

3. GENERAL INFORMATION ABOUT PROJECT								
a. Project Title:								
b. Project Type: ☐ Residential ☐ Educational ☐ Commercial ☐ Industrial								
c. Project Description :								
c. Project Durations :								
Start Date	Contractual Completion Date	Actual Completion Date	Contract Duration		Actual Duration		Actual Delay	
			Years	Months	Years	Months	Years	Months
d. Project Cost (Millions):								

1. SCOPE / PLANNING RELATED						
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Re-designing	1	2	3	4	5
b.	In-adequate Pre-contract Study	1	2	3	4	5
c.	Variation Orders	1	2	3	4	5
d.	Additional Works	1	2	3	4	5
e.	Inappropriate Selection of the Project	1	2	3	4	5
f.	Inadequate feasibility study of the Project	1	2	3	4	5
g.	Ambitious Completion Period of the project	1	2	3	4	5
h.	Vague Conception of Demand of Construction Material	1	2	3	4	5
i.	Inadequate pre-construction study of the Project	1	2	3	4	5
j.	Poor Planning and Scheduling by the contractor	1	2	3	4	5
k.	Prolong time period between designing & tendering/award of the contract	1	2	3	4	5

2. DESIGN / DRAWING RELATED						
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Availability of Drawings	1	2	3	4	5
b.	Drawings/Design Variations	1	2	3	4	5
c.	Complicated Design	1	2	3	4	5

	of Civil works					
d.	Complex nature of the project	1	2	3	4	5
e.	Misinterpretation of Drawings resulting in suspension and redoing of the work	1	2	3	4	5
f.	Absence of Build ability in the design	1	2	3	4	5
g.	Frequent issue of supplementary drawings	1	2	3	4	5

3.	**ESTIMATION RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	In-accurate cost estimates	1	2	3	4	5
b.	Use of Wrong method / "Schedule of Estimates" for cost estimation	1	2	3	4	5
c.	Absence of construction cost data	1	2	3	4	5

4.	**CONTRACT RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Incomplete contract documentation	1	2	3	4	5
b.	Work suspension owning to conflicts	1	2	3	4	5
c.	Litigations	1	2	3	4	5
d.	Low Bid Procurement method resulting in un-realistic rates	1	2	3	4	5
e.	Bureaucracy in Bidding/ Tendering method	1	2	3	4	5
f.	Disputes at site	1	2	3	4	5
g.	In-appropriate	1	2	3	4	5

	contractual procedure					
h.	In-adequate duration of contract period	1	2	3	4	5
i.	Poor Contract Management	1	2	3	4	5
j.	Re-tendering	1	2	3	4	5
k.	Risk & Cost Contracts	1	2	3	4	5

5.	**SITE RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Problems in Land Acquisition	1	2	3	4	5
b.	Site Variations	1	2	3	4	5
c.	In-adequate Site Investigation	1	2	3	4	5
d.	Encroachment of Land during Project Implementation	1	2	3	4	5

6.	**WORK FORCE RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Poor workmanship	1	2	3	4	5
b.	Non availability of skilled persons / craftsmen	1	2	3	4	5
c.	Inadequate contactor's experience	1	2	3	4	5
d.	Slackness on part of the Contractor	1	2	3	4	5
e.	Labour Disputes / Strikes / Security Issues	1	2	3	4	5
f.	Shortage of labor/ Skilled Persons	1	2	3	4	5
g.	Absence of Qualified Supervisory Staff	1	2	3	4	5

7.	CONSTRUCTION MATERIAL/EQUIPMENT RELATED					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Non availability / shortage of local materials	1	2	3	4	5
b.	Delay in procurement of foreign materials	1	2	3	4	5
c.	Non availability of specialized equipment on site at appropriate time	1	2	3	4	5
d.	Material Management Problems	1	2	3	4	5
e.	Equipment Management Problems	1	2	3	4	5
f.	Stealing and Wastage on Site	1	2	3	4	5
g.	Delay in Transportation/ Delivery of Construction Material	1	2	3	4	5

8.	CONSTRUCTION MANAGEMENT RELATED					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Slow decision Making	1	2	3	4	5
b.	Poor Planning and Scheduling by the Contractor	1	2	3	4	5
c.	Poor Site Management	1	2	3	4	5
d.	Un suitable Contractor	1	2	3	4	5
e.	Lack of Project Management Skills / Management Strategy by the contractor	1	2	3	4	5

f.	Schedule Slippage by the Contractor	1	2	3	4	5
g.	In appropriate Procedures/policies	1	2	3	4	5
h.	Lack of Project Knowledge	1	2	3	4	5
i.	Poor Project Supervision	1	2	3	4	5
j.	Inadequate Site Inspections	1	2	3	4	5
k.	In-appropriate construction methodology by the Contractor	1	2	3	4	5
l.	Inadequate project monitoring system through reports & returns	1	2	3	4	5
m.	Poor financial control on site by the contractor	1	2	3	4	5
n.	Lack of co-ordination between Prime contractor and Sub contractor	1	2	3	4	5
o.	Lack of co-ordination between Design team and Contractor	1	2	3	4	5

9.	**FINANCE RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Delay in Payments by the Client	1	2	3	4	5
b.	Delay in Processing/ Request for payments by the contractor	1	2	3	4	5
c.	Poor disbursement procedure by the client	1	2	3	4	5
d.	Cash flow problems by Contractor because of not being	1	2	3	4	5

	financially sound					
e.	Inadequate client financing	1	2	3	4	5
f.	Poor accounting procedure					
g.	Mal-practices resulting in pilferage and wastage of funds	1	2	3	4	5

10.	**COST RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Cost escalation / Inflation	1	2	3	4	5
b.	Higher Transportation Cost	1	2	3	4	5
c.	Higher Cost of Skilled Labor	1	2	3	4	5
d.	Higher Machinery hiring/ Maintenance Cost	1	2	3	4	5
e.	Fluctuating Prices of Raw Materials/ fitting fixtures	1	2	3	4	5

11.	**QUALITY RELATED**					
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	In-adequate Quality resulting in work suspension/redoing	1	2	3	4	5
b.	Use of sub standard material/ fittings fixtures not meeting the desired specifications	1	2	3	4	5

12. WEATHER RELATED						
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	Adverse effects of weather resulting in Delay	1	2	3	4	5
b.	Earthquakes	1	2	3	4	5
c.	Floods	1	2	3	4	5
d.	Unforeseen ground conditions	1	2	3	4	5
e.	Accidents on site	1	2	3	4	5

13. GOVERNMENT RELATED						
Serial	Factor	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
a.	In appropriate government Policies / Procedures	1	2	3	4	5
b.	Non-conducive Law & Order / Security Situation	1	2	3	4	5
c.	Lack of coordination between various Agencies	1	2	3	4	5

APPENDIX: IV : Reliability Analysis in SPSS Ver.18.0

Reliability Analysis - CLIENT

Case Processing Summary

		N	%
Cases	Valid	48	100.0
	Excluded	0	.0
	Total	48	100.0

FACTOR 1

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.861	.880	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SP - RE DESIGNING	24.45833	35.743	.540	.754	.851
SP - INADEQUATE PRE CONTRACT STUDY	24.47917	35.617	.618	.921	.845
SP - VARIATION ORDERS	23.83333	32.865	.615	.807	.846
SP - ADDITIONAL WORKS	23.75000	35.170	.480	.841	.857
SP - INAPPROPERIATE SELECTION	24.47917	37.957	.497	.910	.854
SP - INADEQUATE FEASIBILITY STUDY	24.60417	34.712	.741	.958	.837
SP - AMBITIOUS COMPLETION PERIOD	24.45833	35.998	.532	.785	.851

SP - VAGUE MATERIAL DEMAND CONCEPT	24.47917	38.085	.587	.654	.851
SP - INADEQUATE PRE-CONSTRUCTION STUDY	24.54167	34.509	.711	.929	.838
SP - POOR PLANNING & SCHEDULLING	23.50000	35.787	.348	.789	.873
SP - DELAY BETWEEN TENDERING & EXECUTION	24.70833	35.275	.708	.786	.840

FACTOR 2

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.976	.978	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
DD - AVAILABILITY OF DRAWINGS	15.5000	49.532	.944	.938	.972
DD - DESIGN/DRAWING VARIATIONS	15.0208	48.617	.822	.892	.979
DD - COMPLICATED DESIGN OF CIV WORKS	15.1875	44.283	.932	.948	.972
DD - COMPLEX NATURE OF PROJECT	15.3542	46.914	.894	.942	.974
DD - MISINTERPRETATION OF DRAWINGS	15.2083	47.658	.932	.952	.971
DD - ABSENCE OF BUILD ABILITY IN DESIGN	15.6042	47.776	.953	.967	.970
DD - FREQUENT ISSUE OF SUPPLEMENTRY DWGS	15.3750	44.920	.957	.935	.969

FACTOR 3

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.908	.908	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ER - INACCURATE COST ESTIMATES	4.3750	3.218	.833	.722	.855
ER - USE OF WRONG METHOD/SCH OF RATES	4.2708	3.478	.763	.586	.911
ER - ABSENCE OF CONSTRUCTION COST DATA	4.2708	2.797	.864	.759	.829

FACTOR 4

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.964	.963	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CT - INCOMPLETE CONTRACT DOCUMENTATION	25.7917	73.743	.903	.890	.959

CT - WORK SUSPENSION OWNING TO CONFLICTS	25.3125	69.794	.865	.974	.959
CT - LITIGATIONS	25.6875	69.453	.917	.908	.957
CT - LOW BID PROCUREMENT/UN REALISTIC RATES	25.5833	72.163	.879	.884	.959
CT - BUREACRACY IN BIDDING/TENDERING	25.5625	74.719	.730	.822	.963
CT - DISPUTES AT SITES	25.3958	76.585	.603	.945	.967
CT - IN APPROPERIATE CONTRACTUAL PROCEDURE	25.5208	69.574	.922	.965	.957
CT - IN ADEQUATE CONTRACT DURATION	25.4375	72.719	.873	.967	.959
CT - POOR CONTRACT MANAGEMENT	25.1458	78.936	.565	.665	.968
CT - RE TENDERING	25.6667	70.312	.920	.939	.957
CT - RISK & COST CONTRACTS	25.5208	70.766	.907	.976	.958

FACTOR 5

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.532	.868	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SR - PROBLEMS IN LAND ACQUISITION	8.8542	14.638	.455	.300	.930
SR - SITE VARIATIONS	9.6667	64.950	.649	.649	.432
SR - IN ADEQUATE SITE INVESTIGATION	9.8750	62.027	.678	.890	.394

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SR - PROBLEMS IN LAND ACQUISITION	8.8542	14.638	.455	.300	.930
SR - SITE VARIATIONS	9.6667	64.950	.649	.649	.432
SR - IN ADEQUATE SITE INVESTIGATION	9.8750	62.027	.678	.890	.394
SR - ENCROACHMENTS DURING IMPLEMENTATION	9.7917	65.232	.550	.853	.445

FACTOR 6

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.955	.952	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
WF - POOR WORKMANSHIP	16.4792	42.638	.954	.946	.938
WF - NON AVAL OF SKILLED PERSONS/CRAFTSMEN	16.4167	43.099	.930	.906	.941
WF - INADEQUATE CONTRACTOR'S EXPERIENCE	16.5625	44.422	.875	.807	.945
WF - SLACKNESS ON PART OF CONTRACTOR	16.4792	41.063	.920	.915	.942

WF - LABOUR DISPUTES/STRIKES/SECURITY ISSUES	17.2708	54.627	.472	.583	.971
WF - SHORTAGE OF LABOUR/SKILLED PERSONS	16.4583	40.722	.936	.960	.941
WF - ABSENCE OF QUALIFIED SUPERVISORY STAFF	17.2083	47.402	.839	.872	.949

FACTOR 7

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.900	.913	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ME - NON AVAILIBILITY/SHORTAGE OF LOCAL MATERIALS	14.5000	19.915	.735	.690	.883
ME - DELAY IN PROCUREMENT OF FOREIGN MATERIALS	14.9583	21.147	.759	.865	.881
ME - NON AVAILIBILITY OF SPECIALIZED EQPT ON SITE	15.0625	21.507	.779	.700	.880
ME - MATERIAL MANAGEMENT PROBLEMS	14.0417	21.232	.458	.574	.925
ME - EQUIPMENT MANAGEMENT PROBLEMS	14.7917	21.785	.712	.892	.886
ME - STEALING AND WASTAGE ON SITE	15.0000	20.596	.855	.835	.871

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ME - NON AVAILIBILITY/SHORTAGE OF LOCAL MATERIALS	14.5000	19.915	.735	.690	.883
ME - DELAY IN PROCUREMENT OF FOREIGN MATERIALS	14.9583	21.147	.759	.865	.881
ME - NON AVAILIBILITY OF SPECIALIZED EQPT ON SITE	15.0625	21.507	.779	.700	.880
ME - MATERIAL MANAGEMENT PROBLEMS	14.0417	21.232	.458	.574	.925
ME - EQUIPMENT MANAGEMENT PROBLEMS	14.7917	21.785	.712	.892	.886
ME - STEALING AND WASTAGE ON SITE	15.0000	20.596	.855	.835	.871
ME - DELAY IN TRANSPORTATION/DELIVERY OF MATERIAL	14.8958	19.755	.813	.782	.873

FACTOR 8

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.956	.956	15

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MR - SLOW DECISION MAKING	41.5208	152.468	.610	.863	.955
MR - POOR PLANNING AND SCHEDULING BY CONTRACTOR	40.6250	143.261	.827	.964	.951
MR - POOR SITE MANAGEMENT	40.7500	132.915	.895	.993	.949
MR - UN SUITABLE CONTRACTOR	41.1250	136.239	.849	.882	.950
MR - LACK OF PROJECT MANAGEMENT SKILLS/STRATEGY	40.6458	136.021	.897	.983	.949
MR - SCHEDULE SLIPPAGE BY THE CONTRACTOR	40.6875	139.964	.819	.972	.951
MR - IN APPROPRIATE PROCEDURES/POLICIES OF CONTRACTOR	41.6250	153.048	.493	.954	.957
MR - LACK OF PROJECT KNOWLEDGE BY CONTRACTOR	41.5417	151.445	.572	.782	.956
MR - POOR PROJECT SUPERVISION	41.0833	147.993	.841	.926	.952
MR - IN ADEQUATE SITE INSPECTIONS	41.4167	147.397	.630	.963	.955
MR - INAPPROPERIATE CONSTRUCTION METHODOLOGY	40.8125	134.113	.841	.849	.951
MR - LACK OF MONITORING THROUGH REPORTS & RETURNS	41.2292	144.563	.771	.962	.952
MR - POOR FINANCIAL CONTROL ON SITE BY CONTRACTOR	40.9375	139.379	.878	.962	.950

MR - LACK OF COORD B/W PRIME & SUB CONTRACTOR	40.8542	136.851	.829	.899	.951
MR - LACK OF COORD B/W DESIGN TEAM & CONTRACTOR	41.7292	150.712	.535	.941	.956

FACTOR 9

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.939	.943	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
FR - DELAY IN PAYMENTS BY CLIENT	16.9583	31.743	.886	.903	.924
FR - DELAY IN PROCESSING/REQUEST FOR PAYMENTS	16.5833	30.078	.817	.708	.927
FR - POOR DISBURSEMENT PROCEDURE BY THE CLIENT	16.8333	30.950	.838	.890	.926
FR - CASH FLOW ISSUE DUE TO CONTRACTOR NOT SOUND	16.2917	34.424	.408	.342	.965
FR - INADEQUATE CLIENT FINANCING	16.8333	30.142	.923	.956	.919
FR - POOR ACCOUNTING PROCEDURE	16.7500	28.404	.880	.935	.921

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
FR - DELAY IN PAYMENTS BY CLIENT	16.9583	31.743	.886	.903	.924
FR - DELAY IN PROCESSING/REQUEST FOR PAYMENTS	16.5833	30.078	.817	.708	.927
FR - POOR DISBURSEMENT PROCEDURE BY THE CLIENT	16.8333	30.950	.838	.890	.926
FR - CASH FLOW ISSUE DUE TO CONTRACTOR NOT SOUND	16.2917	34.424	.408	.342	.965
FR - INADEQUATE CLIENT FINANCING	16.8333	30.142	.923	.956	.919
FR - POOR ACCOUNTING PROCEDURE	16.7500	28.404	.880	.935	.921
FR - MAL PRACTICES RESULTING IN PILFERAGE & WASTAGE	16.7500	28.489	.941	.969	.915

FACTOR 10

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.963	.965	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CR - COST ESCALATION/INFLATION	10.5833	16.035	.929	.951	.953

CR - HIGHER TRANSPORTATION COST	10.4583	14.509	.939	.944	.947
CR - HIGHER COST OF SKILLED LABOUR	10.5625	16.039	.796	.721	.970
CR - HIGHER MACHINARY HIRING / MAINTENANCE COST	10.6250	14.282	.902	.836	.955
CR - FLUCTUATING PRICES OF RAW MATERIALS/FITTING FIXTURES	10.6042	14.159	.943	.913	.947

FACTOR 11

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.804	.805	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
QR - IN ADEQUATE QUALITY RESULTING IN WORK SUSPENSION/REDOING	2.7083	1.317	.673	.454	.[a]
QR - USE OF SUB STANDARD MATERIAL/FITTINGS FIXTURES	3.0208	1.170	.673	.454	.[a]

FACTOR 12

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.881	.892	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
WR - ADVERSE WEATHER RESULTING DELAY	8.1875	4.156	.837	.779	.831
WR - EARTHQUAKES	8.1458	3.489	.780	.705	.846
WR - FLOODS	8.1250	4.112	.616	.521	.883
WR - UNFORESEEN GROUND CONDITIONS	8.1875	4.241	.790	.798	.841
WR - ACCIDENTS ON SITE	8.4375	4.719	.648	.530	.873

FACTOR 13

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.962	.965	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
GR - IN APPROPERIATE GOVT POLICIES / PROCEDURES	4.3125	4.815	.964	.929	.917

GR - NON CONDUCIVE LAW & ORDER SECURITY SITUATION	4.1667	4.227	.904	.859	.961
GR - LACK OF COORD BETWEEN VARIOUS AGENCIES	4.2292	4.691	.903	.862	.955