ANALYSIS OF FACTORS AFFECTING CONSTRUCTION QUALITY: A CASE STUDY OF ERRA PROJECTS IN RAWALAKOT DISTRICT – AJK

By

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(NUST-2012-61375-MMCE-155-12F)

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science in Construction Engineering and Management

In

Military College of Engineering, Risalpur

National University of Sciences and Technology (NUST) Islamabad, Pakistan

(2014)

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ACKNOWLEDGEMENT

All the praise belongs to Almighty Allah who gave me strength and patience to successfully complete my research. I was really blessed to have Dr. Muhammad Bilal Khurshid as my supervisor whose able guidance, helpful attitude, vision and valuable time that he spared out of his extremely busy schedule kept me going in the right direction throughout the course of my study. It was due to his tireless efforts, prompt guidance, thoughtful criticism and valuable suggestions which served as an ultimate source of encouragement for me to accomplish my thesis in time. I would also like to thank all the committee members and Faculty of Construction Engineering and Management Department as a whole for the unprecedented guidance and support which I received from them in every aspect for the completion of this thesis.

I am really grateful to my course mates and friends who were always there for me providing moral support and encouragement time and again during the entire course of my study. Also not to forget the commendable and important role which my colleagues played in providing their full support and assistance that made my data collection and site visits a success. I owe my special thanks to those representatives of client, consultant and contractors who fully cooperated by participating in the survey and helped in the completion of my thesis.

ABREVIATIONS

ERRA	Earthquake Reconstruction & Rehabilitation Authority
KPK	Khyber Pakhtunkhwa
AJ&K	Azad Jammu & Kashmir
PERRA	Provincial Earthquake Reconstruction & Rehabilitation Authority
SERRA	State Earthquake Reconstruction & Rehabilitation Authority
DRU	District Reconstruction Unit
DRAC	District Reconstruction Advisory Committee
NESPAK	National Engineering Services Pakistan
SPSS	Statistical Package for Social Sciences
TQM	Total Quality Management
ISO	International Standardization Organization
QA	Quality Assurance
BS	British Standard
NSPE	National Society of Professional Engineers
QMTF	Quality Management Task Force
CII	Construction Industry Institute
QPMS	Quality Performance Management System
M&E	Monitoring & Evaluation
CMT	Construction Monitoring Team
BHU	Basic Health Unit

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ABSTRACT

Almost 8 years back, it was the morning of October the 8th – 2005, 8:50 AM (PST), when Mother Nature trembled the north of Pakistan. It was an earthquake of magnitude 7.6 affecting the lives of 3.5 million people in terms of massive loss to precious lives and transforming buildings/infrastructure into dust & debris. To this the Government & people of Pakistan, humanitarian organizations and international community immediately and actively participated in rescue activities and successfully completed the relief and recovery phase.

But then, all these initial efforts had to be followed by further strengthening of rehabilitation & reconstruction process. It was surely not possible to cope with such a huge disaster without the establishment of a professional body at national level, under the umbrella of which a systematic approach could be adopted for coordinating and integrating all the efforts. In view of all these circumstances, Government of Pakistan established "Earthquake Reconstruction & Rehabilitation Authority" (ERRA) on 24th of October 2005 to take up the challenging massive task of rebuilding in affected areas. Meanwhile the need was also felt for the establishment of dedicated units within the provincial governments down to the district levels in order to strengthen the government by managing and overseeing the rehabilitation and reconstruction activities. The establishment of these bodies at district levels was with a view that they being on the front line could more effectively highlight the strengths as well as weaknesses with a basic aim of suggesting improvements for incorporating timely corrections during the ongoing construction process and over project implementation.

The reconstruction and rehabilitation activities were decided to be executed in 9 districts of Khyber Pakhtunkhwa and Azad Jammu & Kashmir, categorized into 11 different sectors, consisting of over 14,000 projects, out of which ERRA currently claims to have completed approximately 66% of the total projects.

There has been a lot of criticism on the outcomes of ERRA and media has also been projecting about its ineffectiveness time and again, yet, no professional research has yet been carried out addressing any possible shortfalls related to construction management with their effects on construction quality and most importantly suggesting any suitable recommendations that could have positively contributed towards the betterment and improvement of ERRA's productivity

Therefore the basic aim for carrying out this study was to identify the factors affecting construction quality and giving recommendations positively contributing towards productivity of ERRA and also for dealing more effectively with such a disaster in future (God forbid) w.r.t construction quality.

The research was carried out in four basic phases i.e. 1st Phase involved in-depth literature review supporting research aims & objectives and preliminary framework development. 2nd Phase involved developing of preliminary questionnaire and carrying out a pilot survey for its further improvement before carrying out a survey. 3rd Phase involved conduct of a full scale survey to get feedback through questionnaire, establishment of facts & figures supported by discussion/interviews and practical examples of quality of construction on physically on ground projects to validate the objectives of the research. And in the 4th Phase, based on final results

achieved from data analysis, conclusions followed by some recommendations were made.

A total of 30 potential factors affecting the construction quality were considered in questionnaire based survey, out of which 10 most significant factors affecting the construction quality highlighted as result of field survey were: shortage of funds and stoppage in its smooth flow, excessive subletting of projects, slow process of land acquisition later making it difficult for the contractors to meet deadlines, initial preparation of technical documents done without ground survey, lack of coordination between stakeholders, lack of power/authority to stop the faulty work, grouping of small projects into large packages, awarding contracts to financially strong but technically weak contractors, contractors undertaking work beyond their capacity and change in policies and rules with change in command.

Chapter 1

INTRODUCTION

1.1 BACKGROUND

The earthquake of 8th October 2005 trembled the North of Pakistan, bringing distress to the lives of more than 3.5 million people. It claimed huge loss of precious lives besides converting buildings and infrastructure into debris and dust. Apart from Government and the people of Pakistan, this catastrophe caught the attention of the International community as well, to which they responded immediately by rendering rescue efforts. After that, relief and recovery phase spanning for a period of six months was completed successfully which was then had to be followed by reconstruction and rehabilitation activities.

The Government of Pakistan then took an unprecedented step by establishing Earthquake Reconstruction and Rehabilitation Authority (ERRA) on October 24th 2005 for accomplishing the massive task of rebuilding in the earthquake hit areas, spreading over 30,000 Sq. Km. The overall reconstruction and rehabilitation projects were divided into 12 different sectors, consisting of over 13,000 projects at a cost of over US $ 5 billion.

ERRA started working with a mission to "Convert this Adversity into an Opportunity" complying with highest standards of reconstruction and rehabilitation with the obligation to "Build Back Better". Its main role was defined as: macro planning, project approval, financing, developing sectorial strategies and monitoring and evaluation. Before conceiving any policy as well as during the course of policies

formulation, ERRA never neglected the importance of comprehensive consultative process with not only all the major donor organizations but also with the respective governments of KPK and AJ&K prior submitting it before ERRA Board/Council for final decision.

At province and state level, the governments have established Provincial Earthquake Reconstruction and Rehabilitation Agency (PERRA) and State Earthquake Reconstruction and Rehabilitation Agency (SERRA), which act as secretariats for the provincial and state steering committees, headed by their respective chief secretaries. These forums have been granted the financial powers to approve any reconstruction project costing up to Rs.250 million.

The provincial and state governments have further created District Reconstruction Units (DRUs) at district levels, which act as secretariat to the District Reconstruction Advisory Committee (DRAC). Each DRAC has been granted the financial power to approve any reconstruction project up to Rs.100 million and can also prioritize reconstruction activities as per their needs.

1.2 PROFILE OF THE STUDY AREA

a. Map:

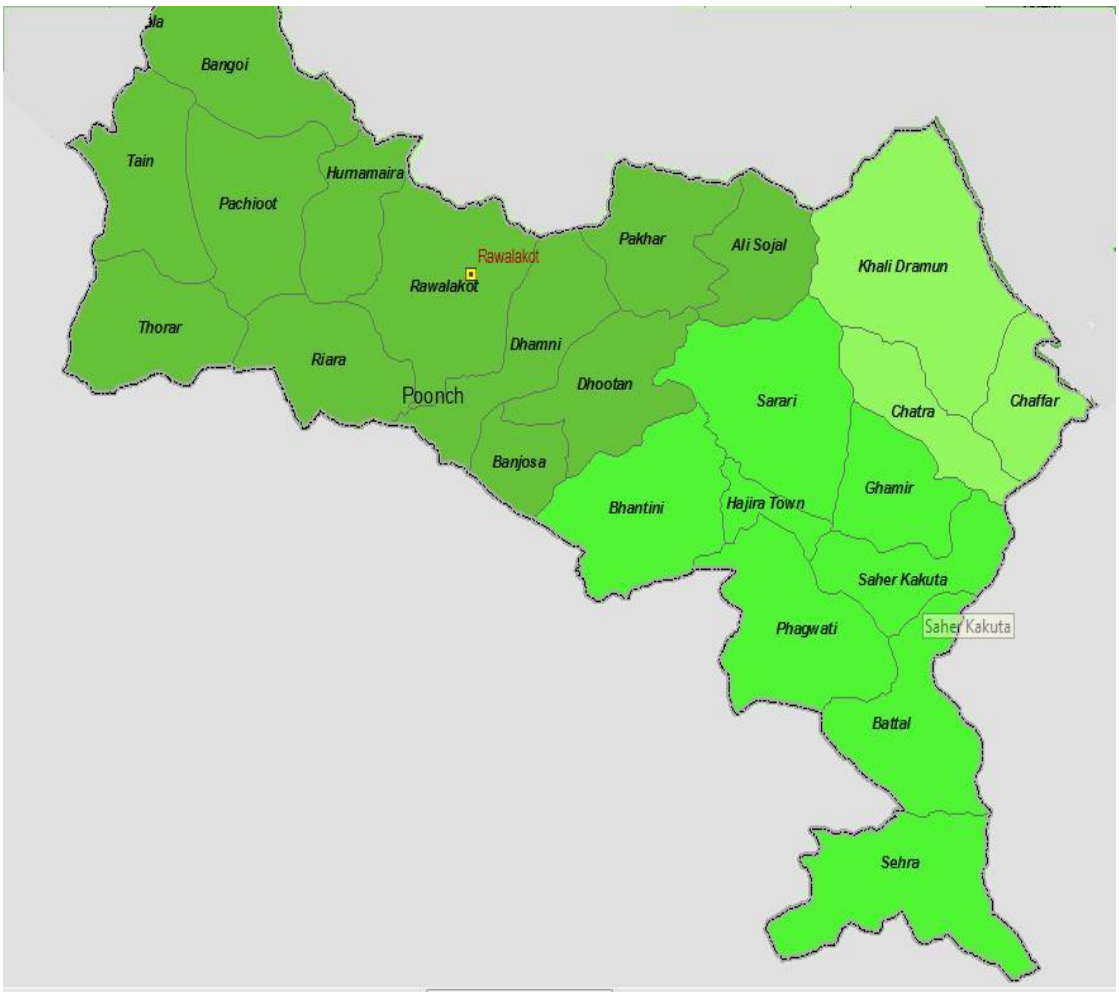


Figure 1.1: Map of the Study Area

b. Introduction:

Rawalakot is situated in a beautiful valley surrounded by hills in Azad Jammu & Kashmir. It is the district headquarters of Poonch Division. It has a population of over 500,000. It has a downtown area, where shops selling everything from groceries to electronic goods are present. Banjosa and Toli Pir

are two popular tourism destination in Rawalakot. Rawalakot Airport has also great attraction for tourists. Other attractions include: mountaineering, trekking, summer camping, hiking and paragliding. Sustenance level farming for corn and wheat is carried out in and around the area. Harvesting of poplar trees is the largest industry for Rawalakot, which are transported to Pakistan and used in manufacture of sporting goods. Major area for employment is Government sector, however, large section of population depends upon remittances from abroad, where workers working send money to their relative in Azad Kashmir (Wikipedia, 2013).

c. Location:

Rawalakot is located at 33°51'32.18" N (latitude), 73° 45'34.93" E (longitude) and an elevation of 5374 ft. Rawalakot is approximately 120 Km from Rawalpindi. Construction of Ghazi-i-Millat road/Guoien Nulla road has considerably reduced travel times and it is main road which connects Islamabad and Rawalpindi with Rawalakot (Wikipedia, 2013).

d. Geography:

Islamabad, Rawalpindi and Murre are in a southward direction from Rawalakot. The road passing through Pak Gali Parati - Paniola Jalooth - Jandathi - Arja connects to Muzaffarabad and Bagh. The other shortest possible road that links Rawalakot city with Bagh passes through Mohri Farman Shah and Shuja Abad. Rawalakot Airport is non-operational since 1998, as there has been no demand for air service provided by Pakistan International Airlines (PIA) (Wikipedia, 2013).

e. Climate:

The temperature of Rawalakot is mild to warm during spring and autumn, humid during summer while cold to snowy during the winters. The temperature can rise up to 100 °F (38 °C) during midsummer and can drop below 27 °F (−3 °C) during winters. Snowfall can occur in the months of December and January, however, most rainfall occurs during the monsoon season i.e. from July to September (Wikipedia, 2013).

f. Losses in 2005 Earthquake:

Rawalakot significantly suffered damage from the 2005 earthquake, although most of the buildings were left standing but many of them were declared un-inhabitable, leaving some of the population homeless (Wikipedia, 2013).

1.2.1 Projects Portfolio In The Study Area

A total of 1211 projects are identified for reconstruction and rehabilitation in various sectors. Number of projects allocation in different sectors is shown in the table:

Table 1.1: Projects Portfolio in the Study Area (ERRA, 2013)

Sr. #	Sector	Project Type	No. of Projects
1	Education	Schools/Colleges/University	581
2	Environment	Forest Offices/Rest Houses	7
3	Governance	Government Offices/Buildings	34
4	Health	BHUs/RHCs/THQ/DHQ	37
5	Livelihood	Office Buildings/CVDs/Poultry Farms/Water Storage Tanks/Link Roads	305
6	Power	Power House Building	2
7	Social Protection	Development Centre Buildings	2
8	Transport	Roads	5
9	WatSan	Water Supply and Sanitation Schemes/Office Buildings	238
		Total	**1211**

1.2.2 Institutional Arrangements in Study Area

The massive scope of work demanded formation and proper functioning of an implementation and monitoring & evaluation mechanism for the successful execution and completion of projects. Therefore, a setup consisting of State Earthquake Reconstruction and Rehabilitation Agency (SERRA), District Reconstruction Unit (DRU), NESPAK at district level and ERRA monitoring and evaluation (M&E) office at district level were formed for the purpose of looking into the activities at district level.

a. State Earthquake Reconstruction and Rehabilitation Agency (SERRA)

At the state level, the government created its respective agency i.e. State Earthquake Reconstruction and Rehabilitation Agency (SERRA), to act as secretariats for the state steering committees, headed by their respective chief secretaries. At District level its organizational setup comprised of a Deputy Director (Reconstruction) as its executive who to be further assisted by two Assistant Directors along with other support staff. Some of the main duties assigned to SERRA are: project execution through contractors, preparation of district annual work plans and budgets, generating quarterly and annual progress reports.

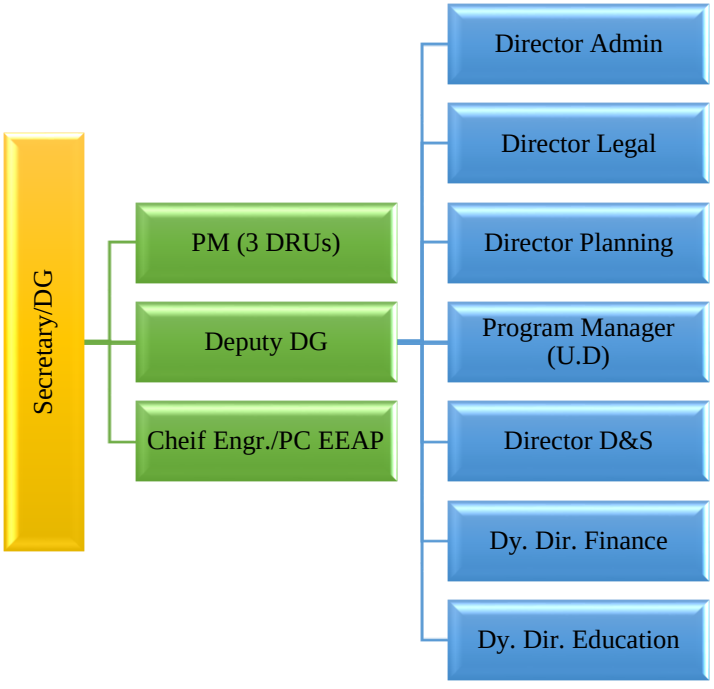


Figure 1.2: Organogram of SERRA (SERRA, 2013)

b. District Reconstruction Unit (DRU):

The state government further created District Reconstruction Unit (DRU) at district level with the basic aim to strengthen the coordination between all stakeholders at district level involved in reconstruction/rehabilitation activities. Answerable to both ERRA and SERRA, some of the major responsibilities delegated to DRU are: updating of projects current progress on software i.e. ERRA Reconstruction Monitor (ERRM) and receiving payments from SERRA for its further distribution among contractors.

Figure 1.3: Organogram of DRU (SERRA, 2013)

c. NESPAK

NESPAK as consultant established its setup at district level for the purpose of providing consultancy on reconstruction/rehabilitation projects. Providing technical assistance, ensuring quality and verification of bill/payments were amongst the basic responsibilities of NESPAK at district level.

d. ERRA Monitoring and Evaluation (M&E)

The M&E office at district level was headed by a Deputy Director, looking after the construction monitoring team (CMT). The CMT consisted of 4 x

Engineers and 4 x Sub Engineers for monitoring of all reconstruction/rehabilitation projects in the district. The office also comprised of other supporting staff.

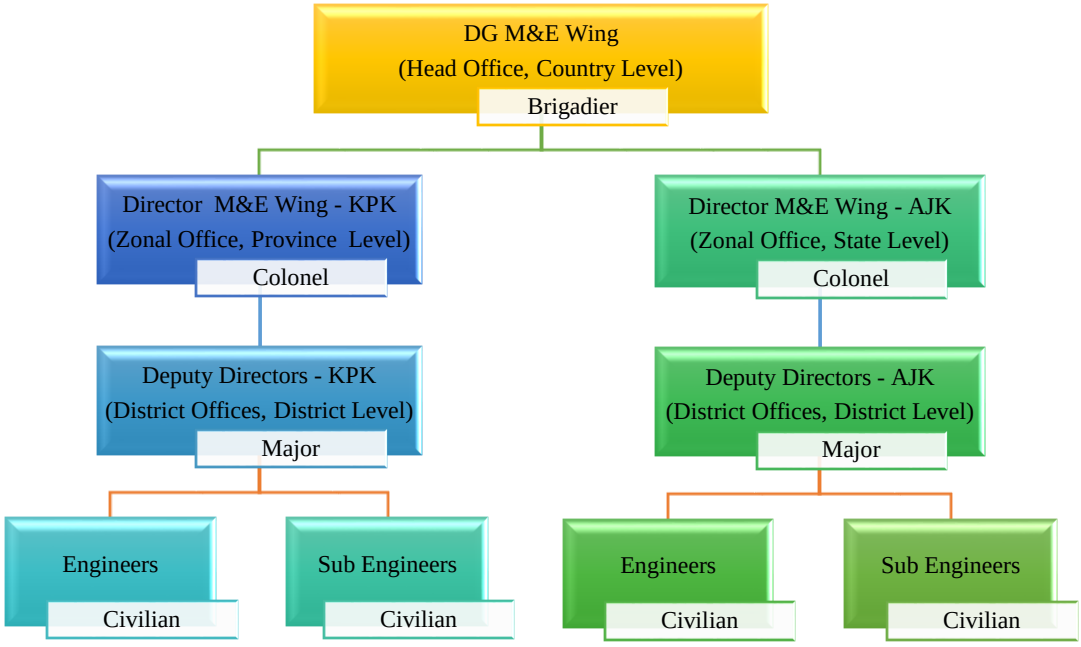


Figure 1.4: Organogram of ERRA (M&E Wing)

1.2.3 Contractors Working in the Study Area

There are total 163 contractors working in Poonch division in different sectors i.e. education, health, transport, environment, governance, livelihood, power, social protection and WatSan.

The detail of number of contractors working in different sectors is shown in the table:

Table 1.2: Sector wise distribution of Contractors (ERRA, 2013)

Sr. #	Sector	Project Type	No. of Contractors
1	Education	Schools/Colleges/University	135
2	Health	BHUs/RHCs/THQ/DHQ	10
3	Transport	Roads	4
4	Livelihood	Office Buildings/CVDs/Poultry Farms/Water Storage Tanks/Link Roads	12
5	Environment	Forest Offices/Rest Houses	1
6	Governance	Government Offices/Buildings	11
7	Power	Power House Building	2
8	Social Protection	Development Centre Buildings	1
9	WatSan	Water Supply and Sanitation Schemes/Office Buildings	4

1.2.4 Current Progress of Construction Work

Out of 1211 projects, 735 projects have been completed, 390 projects are under construction and 86 are under designing.

Sector wise details of projects is shown in the table:

Table 1.3: Current progress of Work in the Study Area (ERRA, 2013)

Sr. #	Sector	Completed	Under Construction	Designing	Total
1	Education	230	286	65	**581**
2	Environment	7	0	0	**7**
3	Governance	16	18	0	**34**
4	Health	31	3	3	**37**
5	Livelihood	231	56	18	**305**
6	Power	2	0	0	**2**
7	Social Protection	0	2	0	**2**
8	Transport	4	1	0	**5**
9	WatSan	214	24	0	**238**
	Total	**735**	**390**	**86**	**1211**

1.3 PROBLEM STATEMENT

In view of massive loss of human lives, buildings, infrastructure and all the devastating circumstances, ERRA came into being with a mission to "Convert this Adversity into an Opportunity" complying with highest standards of reconstruction and rehabilitation with the obligation to "Build Back Better". Huge scope of work, like the one undertaken by ERRA, demands extremely professional management & implementation system to be in place for the effective execution of on ground construction/reconstruction works with minimum flaws/gaps. However, in case of shortfalls/mistakes, which are natural and unavoidable to some extent, timely lessons

must be learnt for necessary side by side improvements, so that the quality of work may not be compromised any way.

After couple of years of its establishment, media started to criticize the performance and efficiency of ERRA from different perspectives e.g. delay in completion of projects, shortage of funds and also the quality of construction. Still, no professional research had yet been carried out addressing any possible shortfalls related to construction management and their effects on, on ground construction quality, followed by suggestions/recommendations that could have positively contributed towards the betterment and improvement of ERRA's productivity. This research will enable us in dealing more effectively with a disaster of such a magnitude in future (God forbid) with construction and construction management perspective. It will also give a chance to enhance personal knowledge and experience to analyze the project execution and monitoring mechanism from construction engineering and management point of view especially on reconstruction/rehabilitation projects.

1.4 OBJECTIVES

Following are the main objectives of this research project:

a. To ascertain the status of construction quality in ERRA projects by finding real/on ground evidence and literature review.
b. To identify the factors affecting the quality of construction/reconstruction in ERRA projects.

c. To confirm the identified factors affecting ERRA's construction/reconstruction quality through case studies.

d. To proffer recommendations, with construction management perspective, for enhancing the quality and efficiency of construction/ reconstruction projects of ERRA in particular and other national projects in general.

1.5 RESEARCH METHODOLOGY

The research was carried out in four basic phases:

1st Phase involved in-depth literature review supporting research aims & objectives and preliminary framework development.

2nd Phase involved developing of preliminary questionnaire and carrying out a pilot survey for its pre-testing in order to get feedback for further refinement before finalizing it.

3rd Phase involved conduct of a full scale survey to get feedback through questionnaire, establishment of facts & figures supported by discussion/interviews and by giving practical examples of quality of construction on physically on ground projects to validate the objectives of research. Additionally, case studies were also conducted in which comparison was made between bad quality projects and good quality project to further figure out the basic causes responsible for both low and good quality of construction on these projects.

And in the 4th Phase, based on final results achieved from data analysis, conclusions followed by some recommendations were made.

1.6 OVERVIEW OF CHAPTERS

This research thesis comprises of five chapters:

1st Chapter: *"Introduction"*, as the name suggests it's about introduction of the thesis, giving us an overview of what the research is about. It covers the basis and background for selecting the mentioned topic for research, the issues to be addressed and the objectives to be achieved. And in achieving the mentioned aims and objectives of this study, methodology is also discussed to establish footings on which this research will be based upon throughout in the due course of attaining the set goals.

2nd Chapter: *"Literature Review"*, besides refreshing some basic knowledge, describes the existing body of knowledge and the level of research being carried out in relevance with the study under consideration. The issues not addressed by other researchers and suggestions on how those gaps can be catered are also part of this chapter.

The 3rd Chapter: *"Research Design and Methodology"*, illustrates the footings on which the study was carried out by dividing the research into four basic phases and techniques applied in the due course of achieving the set aims and objectives.

4th Chapter: *"Data Analysis and Results"*. This chapter covers the data analysis part and the results in detail. The data collected i.e. the perception of each of the three major stakeholders (client, consultant and contractor) involved in the reconstruction activities about the contributing factors affecting the quality of construction is analyzed using widely used software i.e. SPSS (Statistical Package for Social Sciences) by applying different statistical tests.

And the last 5th Chapter: *"Conclusions and Recommendations"*, includes conclusions based on this research study carried out, followed by recommendations and guidelines for future study.

Chapter 2

LITERATURE REVIEW

2.1 PROBLEMS AND CHARACTERISTICS OF CONSTRUCTION INDUSTRY

Construction industry is very often criticized for its poor performance in quality, for which there are many reasons. Firstly, the construction industry involves many parties, with each party having a role to play in ensuring the quality. The performance, good or bad, of one party affects the performance of next party. Total quality management (TQM) is among some of the concepts that can be applied to solve quality problems in the industry to meet the needs of customers (Kanji and Wong, 1998).

The construction industry comprises of a multitude of organizations, professions and occupations and possess lot of problems due to its complicated operational nature (Milakovich, 1995) and (Sommerville, 1994). All the stakeholders i.e. client, consultants and contractors have different objectives in construction projects which keep them apart, but all have a role to play in delivering a quality project and failure of any one party adversely affects the quality of the final project.

Rowlinson & Walker (1995) pointed out that the construction industry is also known for its non-standardization, i.e. production processes deviates to some extent

from each other, because of which no universal standard/specification can be applied, which leads to difficulties in quality assurance of the product.

Due to the growth of multinational companies and overall international trade the construction companies nationwide are forced to divert their attention towards quality improvement. Therefore, there is an extensive need for studies and research for improving the quality of construction in developing countries. And in doing so, an effort is being made through this research study to first identify the factors responsible for construction falling short of required standards and then address the issue of making improvements to achieve the required quality standards. Almost all of the developing countries completely depend on methods and techniques concerning quality which were developed in Far East and West. Moreover, these all have been wrongly practiced without making any changes in order to particularly suit their own country's circumstances. Quality improvement should be made according to one's own specific cultures and in the light of their own technological and economic backgrounds (Razek, 1998). Razek (1996a & 1996b) states that simple and basic methods/techniques suiting one's particular environment will serve as a better basis for more appropriate and successful development of construction quality.

Many researchers are of the view that an important first step towards establishing methods and techniques for the improvement of construction quality in real sense in most of the developing countries is determining construction managers' point of view regarding factors that would positively improve construction quality on their projects.

2.2 QUALITY

Quality and quality systems are such subjects, which are increasingly diverting attention toward it selves' worldwide (Chan, 1996a; Lowe and Seymour, 1990; Yates and Aniftos, 1997; Low, 1992; Docker, 1991; Walters, 1992). In any industry, the final product should be up to the requisite standards, i.e. providing customer satisfaction as well as value for money. However, attaining quality of the final product in construction is not easy and less than any other industry. Moreover, the huge budget of building further reinforce the aim of ensuring quality of the final product (Chan and Tam, 2000). And this very much implies on all ERRA reconstruction projects as contracts are awarded on very high rates with a reason none other than to ensure quality as per their motive to "Build Back Better".

To define quality, different professionals use different definitions. However, quality is simply defined as: meeting customer's satisfaction or expectations. Moreover, for a customer, quality is not more than satisfaction with look, reliability and performance within the budget (Jha and Iyer, 2006). The totality of attributes, features and characteristics of a facility, service, process, product, workmanship or component that bear on its ability for satisfying a given need. It is usually measured by degree of conformance with respect to a predetermined performance standard.

British Standards Institution (1987) and ISO 9001 (1994) defines quality as: the entirety of characteristics and features of a facility or product, that endures on its capacity to conform the stated needs. However, particularly w.r.t construction industry, the quality is defined as: attainment of established objectives between client and the

contractor (Fan, 1995) or client's conformance to requirements (Atkins, 1994). Construction Industry Research & Information Association (1985) defines quality as 'fitness for purpose' and specifically in view of this definition if one looks and goes to the background of ERRA, which is explained earlier in the beginning also, that the crux for its establishment was to rehabilitate the affected people by rebuilding 'safe structures', with the basic objective that such massive and unfortunate casualties can be avoided in future. Now, if building safe structures being the purpose of ERRA is not achieved then it undoubtedly implies that quality is not achieved.

2.2.1 Quality Perception in Construction

The interpretation of quality is likewise unclear. The previous quality descriptions broadly documented in construction industry, try to brand quality limited and realistic, still quality in reality remains very subjective in nature. Quality can be defined, but its insight lacks description. There is considerable disparity which prevails in defining quality, yet there exists much common ground in its various definitions (Razek, 1998).

Construction Industry Institute defines quality as: conformance to established requirements. This definition in fact being simple cannot only be considered and another definition for the term 'requirements' is needed. Therefore, requirements are established characteristics of a product through contract (Ledbetter & Wolter, 1992; Ledbetter, 1994), therefore, for a clear understanding, various aspects must be taken into account. Griffith (1990) states these aspects as: durability, function, economy, depreciation and aesthetics.

Moreover, usually at a workplace, quality is directed towards the skill of a craftsman. Therefore, the interpretation of quality fundamentally depends upon one's viewpoint within a particular construction process.

2.2.2 ISO 9000 and Quality Assurance in Construction

There is a worldwide drift towards strict client/customer expectations towards the quality of construction. ISO 9000 quality system standards were developed as technical specifications. UK issued BS-5750 for quality systems in the year 1979, since then for 34 years, construction has been living with the concept of QA certification. In construction, the adoption of international standard i.e. ISO 9000 started in 1987. Many large construction companies in UK and other European countries have been certified to ISO 9000 standards since the late 1980s. Likewise ERRA is also ISO certified.

2.2.3 Customer Satisfaction and Construction Industry

Before addressing customer satisfaction, subject i.e. 'customer' must be clearly identified first. A customer can be owner of the project, a person needing the constructed facility or buyer of the facility (Karna et al., 2004).

Customers can be internal or external. Internal customers are known as part of company, however external customers are not. The internal customers i.e. customers within the construction organization, get information and products from other individuals/groups within the company. Fulfilling the requirements of external customers by supplying them with a quality product can only be made possible by fulfilling the requirements of internal customers as a vital part of the whole practice (Burati et al., 1992).

Customer satisfaction can be considered as a measurement tool or can be seen as a goal in achieving construction quality. Customer satisfaction is a vital factor in establishment of construction process and customer relation. Due to the increasing competition, construction companies put greater attention on customer relationship and customer satisfaction. The thing which allows construction organizations to segregate themselves from their rivals and also produce workable advantage is 'customer satisfaction'. Various authors debates on the significance of 'customer satisfaction' and its usage for assessing quality from customers' perspective, yet, there does not exists overall identified methods for measuring customer satisfaction (Sami Karna et al., 2004; Barret, 2000; Torbica and Stroh, 2001; Maloney, 2002; Yasamis et al., 2002).

Customer satisfaction can be used as company's quality assessment tool and also as a tool for evaluation of quality improvement program. Studies reveal that TQM implementation is very much linked with customer satisfaction.

2.2.4 Customers' Expectations and Construction Quality

Customers' expectations & product/service quality are functions of customer satisfaction. Majority of researchers have consensus that overriding satisfaction model is confirmation or disconfirmation model. The disconfirmation model suggests that the customers have certain set expectations about a product/service before its actual use or consumption. Such expectations have a whole frame of references with the help of which an individual makes certain comparative judgments in order to gain satisfaction. Customers usually compare the actual product performance with certain performance standards. Customers are satisfied when the apparent performance of a particular

product or service is greater as compared to the standards, known as 'positively disconfirmed'. However, in case of dissatisfaction, which is perceived when performance falls short of standards, it's then known as 'negatively disconfirmed'. In case when quality is unclear and its evaluation is difficult, then customers' expectations play an important role in determining satisfaction (Karna et al., 2004; Andersson and Sullivan, 1993).

Researchers have been arguing on the issue regarding difference between customer satisfaction and service quality. The literature review suggests that though customer satisfaction and service quality are conceptually different but also at the same time are closely related. Moreover, some recent evidences also suggest that satisfaction is a predecessor of service quality. Expected quality heads satisfaction and which is also very much related to behavioral responses of customers' (Bitner et al., 1990; Cronin and Taylor, 1992; Karna et al., 2004). People debate that advantages of higher customer satisfaction in construction field is not as forthright as specified in other production fields, for which the key reason is unique and temporary nature of construction (Karna et al., 2004).

2.3 FACTORS AFFECTING OVERALL PROCESS QUALITY IN CONSTRUCTION

There are three main phases identified and ranked as the factors affecting process quality by degree of importance i.e. design phase, construction phase and operation phase of life cycle of a construction project. Furthermore, the generic factors

affecting process quality are: leadership in promotion of high process quality, commitment to continuous improvement in quality, teamwork at corporate level, all the parties cooperation and training on quality of all the staff. At industry level, the specific factors considered for enhancing the quality of construction process include: selection of designers and contractors on merit, consistent specifications and drawings, quality inspection on construction site, effective communication between parties, planned maintenance and operational budget early in the design phase and a detailed building operation manual (Arditi and Gunaydin, 1998).

Due to the successful application of TQM in the manufacturing industries, significant amount of attention has been given in recent years for improving the quality of construction process. Main objective of TQM is not the management of quality, but, it's the improvement of quality management system (Bates, 1993). TQM is considered very important in the construction industry. National Society of Professional Engineers (NSPE) advocates the implementation of TQM by all stakeholders including engineers, architects, subcontractors, vendors and owners throughout the process of construction (Tribus, 1991).

TQM is becoming more and more popular in construction industry but problems arising in the implementation process continue to be serious. Deming & Oberlender (1993) highlighted that majority of the problems in manufacturing industry are with the process and statistics can be effectively used to control those process. Juran (1988) suggested a managerial approach for quality control and emphasized on achieving customer satisfaction with a project team approach i.e. project by project improvement and highlighted the importance of staff training at all levels i.e. from

workers to top management level. Staff training is one of the major areas where ERRA lacks and need to give special attention in addition to different other efforts for enhancing quality on its projects.

2.4 GENERAL FACTORS AFFECTING PROJECT QUALITY IN CONSTRUCTION

Chan and Tam (2000) debates that project management by the team is highly effective indicator of client's satisfaction towards quality besides other important factors such as construction team leader's effectiveness and client's emphasis upon quality & time. Moreover, literature review of previous research done suggests different probable lists of variables apparently influencing the quality in construction, out of which there are few common variables, but, no general agreement exists on certain fixed variables. Chan and Tam (2000) further group the general perceived factors influencing the quality performance as: client characteristics, project characteristics, project procedures, project team, project environment and project management actions:

a. Client Characteristics:

Specialized and experienced clients had high and better chance of success on their projects as compared to beginners (Masterman and Gameson, 1995). Other aspects such as nature of client i.e. from public or private sector, clarity about project aims and objectives, competency i.e. communication, decision making, and

defining roles have been considered influencing the quality of project (Nahapiet, 1983; Bresnen et al., 1990; Naoum, 1991; Naoum and Mustapha, 1995).

b. Project Characteristics:

According to Walker (1994), project characteristics can be most appropriately defined in terms of:

- Project's name i.e. whether it's a new project or a renovation work
- Complexity of project i.e. scope, site accessibility, site conditions, design build-ability, design coordination and quality management
- Scope of project i.e. project type, number of storeys and project sophistication

c. Project Procedures:

Serpell and Alarcon (1998) refers quality performance as a function of procedures adopted during construction process. Davenport (1995) argues that uneven nature of construction industry, the fact of no two projects being identical and the resulting temporary nature of project organization have a great influence on the project team in setting up the building process and successful completion of the project. Moreover, early and particular attention is required in selecting a suitable and competent organization for design and construction of the project to ensure success.

d. Project Team:

The project team comprises of many diverse groups of professionals and personnel from one or more organizations i.e. client, designers, suppliers, sub-contractors and consultants who collectively work to accomplish different

necessary functions of the construction project. The performance of the teams mainly depends upon the competency, skills and experience of team leaders (Beale and Freeman, 1991). The performance of other project team members can be evaluated by their working relationship, attitude, management & technical abilities, and support from their respective organizations.

e. Project Environment:

All the external influences on construction process can be considered as environment. These influences may broadly be grouped as physical, socio-political, economic and industrial relations having their effects at local level, in different ways (Walker, 1994).

f. Project Management Actions:

The basic function of management is decision making for the purpose of planning & controlling different organizational endeavors, relating the organization to the environment, setting goals and developing comprehensive, strategic & operational plans (Kast and Rosenzweig, 1985). Some of the most important functions involved in project management are setting objectives, decision making, designing processes, formulating strategies, assessing results, initiating changes, selecting people and delegating responsibilities (Chan and Tam, 2000).

2.5 CRITICAL SUCCESS & FAILURE FACTORS AFFECTING CONSTRUCTION QUALITY

In the field of project management, the three aspects i.e. cost, schedule and quality are referred as ‘iron triangle’. Out of them, cost and schedule usually gets the

maximum attention and as a result quality gets neglected. Also, many studies have documented that quality at projects is usually sacrificed in the run of achieving short term objectives. Similarly, if we look particularly in case of ERRA, then at many projects, initially time gets wasted in tendering/re-tendering, delayed land acquisition and mobilization of contractor on site. The contractor then gets in a hustle situation to meet the deadlines and in doing so mostly the quality is compromised.

Quality is mainly influenced by project characteristics & participants, interactive processes and contractual arrangements (Chua et al., 1999). Arditi and Gunaydin (1998) found that the factors affecting process quality management are: leadership for promoting high process quality, commitment to continuous improvement in quality, teamwork, all parties cooperation and quality training of all the staff.

Bubshait and Atiq (1999) states that a proper contractor's quality assurance system for ensuring consistent quality is necessary for minimizing and preventing problems. He also points out the lack of documentation about quality system at majority of contractors' level.

Jha and Iyer (2006) tried to help the construction companies by identifying the critical factors affecting quality i.e. success as well as failure factors.

2.5.1 Success Factors:

Rockart (1982) first used this term 'critical success factors' in context of projects and projects management. Success on a project means meeting certain expectations of given participants, i.e. owner, engineer, contractor, operator or planner (Sanvido et al., 1992). Ashley (1987) defines success as: achieving results far better

than normally observed or expected in terms of quality, cost, safety, schedule and participant satisfaction. Success is getting everything as hoped or anticipating all requirements of the project and in presence of sufficient resources timely meeting the needs (Tuman, 1986). The project is considered to be an overall success, if it meets technical specifications and if the satisfaction level is high among the project participants (Wit 1986). Morris (1983) and Wit (1986) argues that success and failure in projects must be before long decided that what actually is meant by success? Using what criteria? Over what time period? And for whom? It is this area where most studies present a very limited view about the project success. And if at all success was defined, then it was often not clear that from whose perspective and at what point it was measured in the project life cycle.

Jha and Iyer (2006) mentioned the critical success factors as: owners' competence, top management's support, project manager's competence, feedback & monitoring by project partakers and communication between project members:

a. Owners' Competence:

In achieving quality, the owners' competence is involved in terms of preparation of clear and correct specifications as well as monitoring of the actual work at site. Barnes (1987) further recognizes the fact that the clients' inspectors should better work with the contractor side by side in order to ensure good quality prior the work is completed, rather than walking around afterwards. This problem is seen in ERRA projects due to large number of projects to monitor and limited number of technical staff to properly monitor every site and identify shortfalls/gaps for timely rectification.

b. Top Management Support:

It's the top management's mandate to figure out all policy matters containing trainings of their staff linked with project and also select the project manager.

c. Project Manager's Competence:

The qualities of a project manager i.e. technical capability, positive attitude, coordinating ability, delegating authority, trust imposed in the team and leadership are required for the purpose of achieving quality.

d. Feedback and Monitoring by Project Participants:

Timely feedback and monitoring help in keeping a check on workmanship, which enhance the project quality. Commitment of project participants to quality plan and following the established and recognized technical practices ensures quality.

e. Interaction among Project Participants:

Sometimes besides other factors, the quality of project also suffers from absence of interaction between project participants, therefore, proper coordination and positive attitude are important assets contributing in project quality. Close interaction/coordination lacked between stakeholders at field level in ERRA projects. There were hardly any meetings especially with the contractor at field level, to discuss and solve problems quickly on ground affecting quality.

2.5.2 Failure Factors:

Jha and Iyer (2006) mentioned the factors adversely affecting quality performances on projects as: ignorance & lack of knowledge, clash among project partakers, aggressive climatic conditions, faulty project conceptualization, project precise aspects and hostile competition during tendering:

a. Ignorance & Lack of Knowledge:

Lack of job knowledge, ignorance of planning tools & established quality norms among participants of the project results in poor quality. Top management have the responsibility of providing training to their staff at regular intervals and formulate means to convey knowledge to all project participants.

b. Clash among Project Partakers:

The management should ensure a suitable working environment by eliminating all negative aspects causing and giving rise to confrontational relationship among their team members. All the workers should work in harmony with each other otherwise it will adversely affect the quality of work at site.

c. Aggressive Climatic Condition:

Bad working atmosphere not only lowers efficiency but also affects the quality. Moreover, aggressive climatic conditions results in fatigued workforce and thus leading to poor quality.

d. Faulty Project Conceptualization:

Faulty project conceptualization also leads to poor quality, e.g. if the completion date of project has been fixed without catering for realistic inputs, it will result in a haphazard work, thus affecting the project's quality e.g. in ERRA projects, there were situations when work orders were issued to contractors without ensuring land acquisition from the concerned line departments and as a result of which, contractors were hard pressed to meet the deadlines. This haste then generally results in compromise on the deviations in agreed technical specification from the owner's side. Moreover, the contractor also adopts bad technical practices to save time.

e. Project Precise Aspects:

If a project is unique or it involves certain unique activities, which project people have not previously performed on any project, then it will adversely affect the quality achievement process. The project people will be requiring some learning time before properly accomplishing such activities. NESPAK a renowned consultancy firm was the main consultant of ERRA, although it was the best choice at national level but NESPAK itself also lacked the experience of providing consultancy on projects with such a huge scope of work as of ERRA. Moreover, if the scope of the project is too large, then limited staff may not be able to fully deliver and do justice in all areas of the project, which may adversely affect quality of the project and this was the problem with all the three main stakeholders i.e. client, consultant and contractor on ERRA projects.

f. Hostile Competition during Tendering:

In aggressive competition sometimes bidders are forced to quote low, and then afterwards, when the project is awarded, the contractors are hesitant to do quality work. Further, in the run to make some profit they try to use low quality materials and bad technical practices, which results in poor quality of work. In addition, the lowest bidder sometimes go for subcontracting the whole project to any unqualified contractor, thus leading to poor quality. One of the top major issues faced by ERRA having an effect on quality of work is subletting. Excessive subletting made the projects land into the hands of weak contractors in all respects and thus ultimately affecting the quality of work.

2.6 CAUSES AND COST OF POOR CONSTRUCTION QUALITY

Many reports and studies from United Kingdom and United States recognize that problems responsible for poor quality of construction are a major issue which require rapid improvement (Burati and Farrington, 1987; Matthews and Burati, 1989; Davis and Ledbetter, 1987; Griffith, 1990). Studies further highlights aspects such as: lack of site supervision, poor communications, poor workmanship and inadequate information responsible for poor construction quality. When we look at quality of work at ERRA projects, then poor workmanship is a cause that always comes in our mind besides other causes adversely affecting the construction quality.

Quality Management Task Force (QMTF) of Construction Industry Institute (CII) carried out research for identification and quantification of rework costs, which revealed that the average rework cost exceeded 12% on industrial projects. Approximately 80% of the increased costs were due to the design nonconformities, while 20% for construction nonconformities.

2.7 TOTAL QUALITY MANAGEMENT IN CONSTRUCTION

Total quality management makes quality a strategic objective and permeates in every aspect of a company. TQM demands an overall integrated effort at all levels among personnel in order to increase the customer satisfaction and achieve cost effectiveness and defect free work by continuously improving performance. TQM involves continuous process improvement, involvement of customer & supplier, teamwork and training in an effort for achieving customer satisfaction (Burati et al., 1992).

2.7.1 Principles of TQM:

Continuous improvement and customer satisfaction are the vital goals of TQM and thereby are the basic principles on which it is based upon, i.e. all the efforts are made for the satisfaction of customer by continuous improvement of methods and procedures that govern the project (Burati et al., 1992).

2.7.2 Application of TQM in the Construction Industry:

Total quality management emphasizes on continuously meeting the customers' needs. TQM is adopted by more and more construction companies for their performance improvement (Fung and Wong, 1995; Jido, 1996; Sommerville, 1994).

The major benefits obtained by adopting TQM are better quality products with higher customer satisfaction and ultimately higher market share by the construction companies. The application of principles of quality management and quantitative methods requires the leadership and commitment of top management to utilize the human and material resources of an organization in the most effective way for changing and continuously improving the quality culture.

2.7.3 Elements of Total Quality Management:

G. W. Chase (1993) presents ten common elements found in TQM processes that are being used by different design and construction companies. These 10 elements include:

a. Upper management leadership, involvement and commitment
b. Mission, vision and guiding principles developed in concert with organization employees
c. Striving for continuous improvement
d. Training about teamwork, quality awareness, leadership, job-related skills, communication and process improvement
e. Focus on customer satisfaction
f. Teamwork

g. Focus on improvement in work environment, improvement of employees and also involving them in organizational improvement efforts
h. Providing help to suppliers and subcontractors for improvement
i. Use of formalized process improvement techniques and
j. Improved communications

2.7.4 Implementation of TQM in Construction:

Low & Peh (1996) states that in the due course of developing total quality culture in the construction industry, one important step is the development of a construction team comprising of main contractor and subcontractors who would commit to develop a true quality attitude and quality process. Moreover, the main contractor should only select such subcontractors who have a proven quality attitude and work performance on their previous jobs and this is where ERRA's main contractors lacked.

Low & Peh (1996) mentioned few basic steps in implementing TQM in construction projects, which are as follows:

a. Get commitment of client to quality
b. Prepare quality plans for all levels of work in project
c. Create awareness, change the attitudes and educate staff
d. Develop a process approach towards the TQM
e. Promote participation of staff and their contribution by using motivation programs and quality control circles
f. Review measure performance and quality plans
g. Ensure continuous improvement

2.8 SUMMARY

Quality in construction project depends upon performances of many parties involved in that particular project and performance of one party directly affects performance of the other party. Although all the three main stakeholders i.e. client, consultant and contractor have different objectives but they have one common goal i.e. delivery of a quality project. As no universal standard can be established to achieve quality on projects, for the reason that production processes deviates from one another, therefore quality assurance becomes a difficult task.

There is an extensive need for studies and research on quality improvement in developing countries. And in doing so, an effort is being made through this research study by first identifying the factors responsible for construction falling short of required standards and then addressing the issue of making improvements to achieve the required quality standards.

Quality improvement efforts in developing countries should be made according to their own specific cultures and in the light of their own technological and economic backgrounds rather than just relying and applying methods, techniques and philosophies concerning quality developed in Far East and West. And in doing so, focus should be more on problem oriented approach than on method oriented approach, which will serve as better basis for more appropriate and successful development of construction quality.

Attaining quality of final product in construction is not less important than in any other industry. Also, the huge budget of building further reinforce the aim of

ensuring quality of the final product, and this very much implies on all ERRA reconstruction projects as contracts are awarded on very high rates with a reason none other than to ensure quality as per their motive to “Build Back Better”.

The interpretation of quality fundamentally depends upon one's viewpoint within a particular construction process. Among numerous definitions, quality is also defined as ‘fitness for purpose’ and specifically in view of this definition if one looks and goes to the background of ERRA, which is explained earlier in the beginning also, that the crux for its establishment was to rehabilitate the affected people by rebuilding ‘safe structures’, with the basic objective that such massive and unfortunate casualties can be avoided in future. Now, if building safe structures being the purpose of ERRA is not achieved then it undoubtedly implies that quality is not achieved.

Other very common definition defines quality as ‘conformance to customer satisfaction’. Customer satisfaction can be considered as a measurement tool or can be seen as a goal in the development of construction quality. Customer satisfaction is a vital factor in development of construction process and customer relationship. Due to the increasing competition, construction companies put greater attention on customer relationship and customer satisfaction. The thing which allows construction organizations to distinguish themselves from rivals and also create viable advantage is ‘customer satisfaction’.

Many studies have documented that quality at projects is usually sacrificed in the run of achieving short term objectives. Similarly, if we look particularly in case of ERRA, then at many projects, initially time gets wasted in tendering/re-tendering, delayed land acquisition and mobilization of contractor on site. The contractor then

gets in a hustle situation to meet the deadlines and in doing so mostly the quality is compromised.

There are three main phases identified and ranked as the factors affecting construction process quality by degree of importance i.e. design phase, construction phase and operation phase of life cycle of a construction project. Furthermore, the generic factors affecting process quality are: leadership in promotion of high process quality, commitment to continuous improvement in quality, teamwork, all parties cooperation and training on quality of all the staff. Staff training is one of the major areas where ERRA lacks and need to give special attention in addition to different other efforts for enhancing quality on its projects.

Critical success factors affecting construction quality can be widely categorized as: owners' competence, top management's support, project manager's competence, feedback & monitoring by project partakers and communication among project partakers. However, Critical failure factors affecting construction quality can be widely categorized as: ignorance & lack of knowledge, clash among project partakers, aggressive climatic conditions, faulty project conceptualization, project precise aspects and hostile competition during tendering. Aspects such as: lack of site supervision, poor communications, poor workmanship and inadequate information responsible for poor construction quality. When we look at quality of work at ERRA projects, then poor workmanship is a cause that always comes in our mind besides other causes adversely affecting the construction quality.

Total quality management (TQM) is among some of the concepts that can be applied to solve quality problems in the industry to meet the needs of customers. TQM

involves continuous process improvement, involvement of customer & supplier, teamwork and training in an effort for achieving customer satisfaction.

Chapter 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter aims in defining the research methodology used for the collection of data, which carries immense importance in achieving the research objectives. The chapter includes the research methodology flow chart, questionnaire design, pilot survey, finalization of questionnaire followed by a full scale survey and software & technique used for data analysis.

3.2 RESEARCH DESIGN

Keeping in view the research aim & objectives, a questionnaire was designed and used as a main source for collection of data from the individuals in the organizations. Questionnaire was preferred due to following reasons:

- It is a cheap method for collection of data and saves cost as well as time.
- It can be sent through e-mail which has a good response rate.
- It can be sent to wide geographical area.
- The respondents get ample time to respond, therefore they can consult with others in their organization on any issue.

The research methodology adopted for this study follows the phases as shown in the flow chart in Figure 3.1:

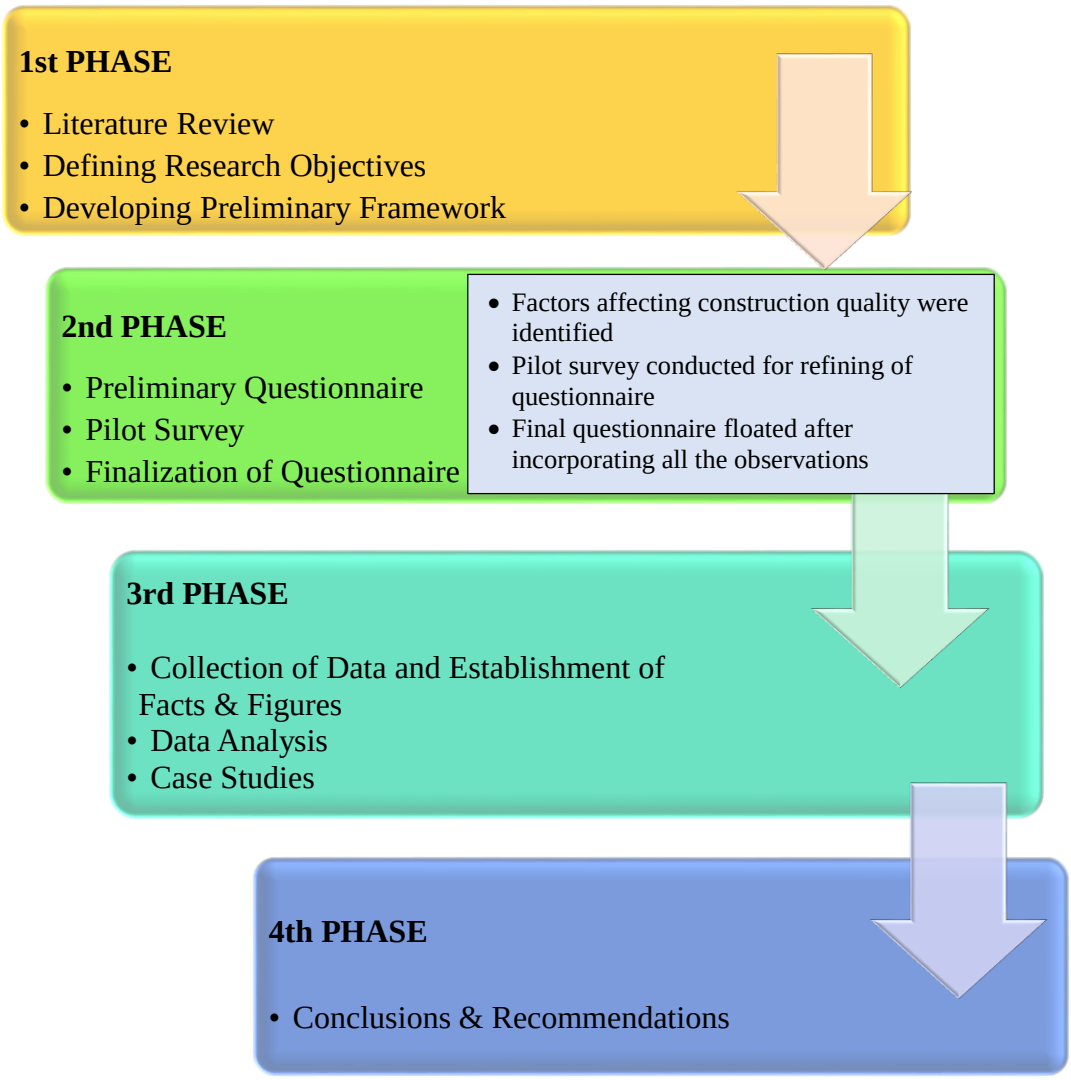


Figure 3.1: Research Methodology Flow Chart

The research was carried out in four basic phases:

In first phase, research objectives were clearly identified establishing a defined path on which further research will be carried out. Literature reviewed, supporting the

research aims & objectives, was related to construction quality in general, practices for its management and management failures resulting in substandard construction quality. The main sources of literature review were textbooks, journals, conference proceedings/ research papers and technical reports. The use of internet also proved fruitful in getting information. The related work done was searched and studied on the internet to know about the level of research already done in this regard and on what aspects. A preliminary framework was developed, establishing: managerial failures and their seriousness, consequences of these failures and reasons for poor management.

In second phase, a preliminary questionnaire was developed. It was selected as a main source of data collection i.e. from different stakeholders. It was intended to make a simple, easy and unambiguous questionnaire by keeping in view the research aims and objectives. A five point scale was adopted for survey questionnaire to get feedback on management gaps at different levels affecting quality of construction.

Before carrying out of the actual survey i.e. before distribution of the questionnaire, it was pre-tested. A sample of 6 respondents was taken 2 each from client, consultant and contractor category. The purpose of this pre-testing was to get feedback and inputs to validate and refine the preliminary questionnaire in order to make necessary changes for the improvement of questionnaire if required.

In third phase a full scale survey was conducted to get feedback through questionnaire from the main three stakeholders i.e. Client, Consultant and Contractor. Facts & figures were established by having discussions with the concerned higher ups of organizations, employees/engineers currently working with them, personal working

experience with ERRA and practical examples of quality of construction on physically on ground projects validating the objectives of research. All the survey findings/data collected was assessed through software i.e. Statistical Package for Social Sciences (SPSS). Different statistical tests were conducted for overall ranking of factors affecting the construction quality.

And in the fourth and final phase, based on final results achieved from data analysis, conclusions were made highlighting managerial gaps/flaws affecting the quality of construction, followed by some recommendations, which were made for better organizational management system that will positively contribute towards the efficiency of not only ERRA but other disaster management organizations as well.

3.3 DEVELOPING PRELIMINARY QUESTIONNAIRE

For this study, a questionnaire with a very simple format was developed and was designed in such a way that it could be easily understood by everyone. The questionnaire was divided into two sections, the first section pertained to general information about the respondent i.e. name, working with, experience and qualification. The second part comprised of factors grouped into four categories i.e. client related, consultant related, contractor related and miscellaneous. After going through literature review, personal experience and interviews conducted with current and ex-employees, a total of 25 factors were identified and included in the questionnaire considering them of having effect on the construction quality.

A five point scales was adopted for the survey questionnaire to get feedback on each factor and defined the scales as 1 for Strongly Disagree, 2 for Disagree, 3 for Neither agree Nor Disagree or Neutral, 4 for Agree and 5 for Strongly Agree to show their attitude towards each factor affecting the construction quality in ERRA projects.

Questionnaire developed before the pilot survey is attached at the end as "Appendix – I".

3.4 PILOT STUDY

A sample of fifteen respondents, five each from client, consultant and contractor was taken to carry out a pilot survey for the refinement of preliminary questionnaire prepared. The responses provided by the respondents were very useful in validating and improving the questionnaire for the successful conduction of a full scale survey.

As a result of this pilot study and owing to the observations/suggestions put forward by the respondents, firstly, in section-II, twenty five identified factors were categorized under four separate groups were eliminated and all the factors were mixed together as it was rightly pointed out in the pilot survey that the respondents may not give their true opinion if the factors were grouped under separate categories of client, consultant, contractor and miscellaneous. Moreover, five more important factors were also added, making up thirty factors in total. Secondly, it was also suggested that for the purpose that respondents may not be hesitant in providing their personal

information in section-I, a note was added that the personal information provided will be kept confidential and will only be used for research purposes.

Questionnaire developed after the pilot survey is attached at the end as "Appendix – II".

3.5 DATA COLLECTION

Data was supposed to be collected from district Rawalakot and its surrounding areas, so it was relatively easier to reach people/respondents personally yet alone through e-mail or courier services. Since I had been working in the mentioned area, so coordination and making people understand about the conduction of survey for research purpose was also not really a hurdle and a high rate of response was always expected.

3.6 DATA ANALYSIS

As discussed, the survey questionnaire was designed using a Lickert Scale, therefore to check the reliability of collected data, Cronbach's Alpha coeffiecient method was used. To rank these contributing factors, formula of Relative Importance Index (RII) was used. And then an overall ranking of all the thirty contributing factors was obtained.

Chapter 4

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

This chapter covers the overview of the construction quality at ERRA projects, data analysis part and the results in detail. The perception of each of the three major stakeholders (client, consultant and contractor) involved in the reconstruction activities about the contributing factors affecting the quality of construction was the main data which was collected through questionnaire and analyzed using widely used software i.e. SPSS (Statistical Package for Social Sciences). Different statistical tests such as: reliability & descriptive statistics (mean & frequency), calculation of relative importance index (RII) to rank each of the contributing factor and percentage agreement between the three parties is done in order to come up with the overall ranking of all the contributing factors.

4.2 OVERVIEW OF CONSTRUCTION QUALITY ON ERRA PROJECTS

Issues related to following on different construction sites have been focused upon:

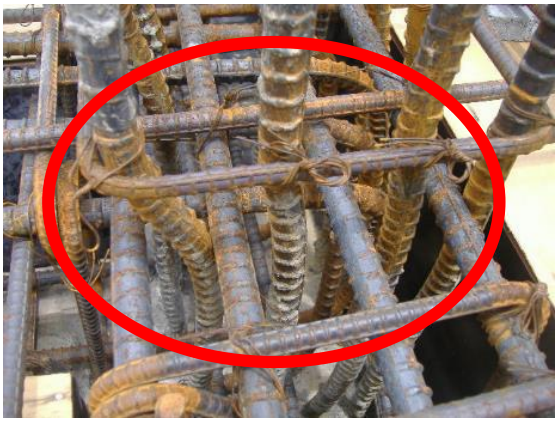
a. Reinforcement
b. Retaining/Breast walls

c. Brick Masonry

d. Form work &

e. Concreting

a. Reinforcement



Due to unskilled labor and careless workmanship, contractors used to bend the steel bars to cater for misalignment, resulting in reduction of column strength.

However,

Ref: ACI 318-02

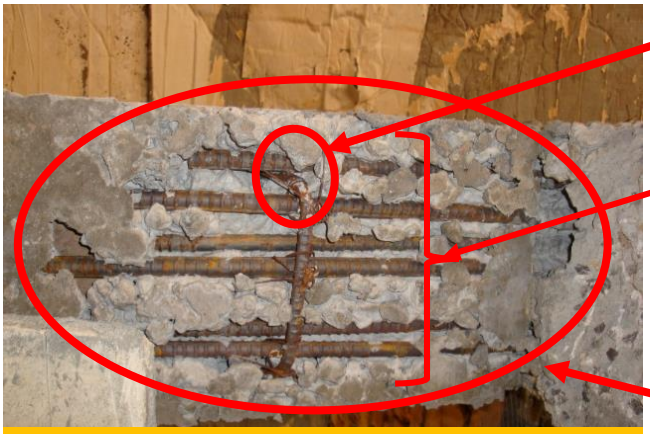
7.8.1.1: Slope of inclined portion of an offset bar with axis of column shall not exceed 1 in 6

Column Reinforcement

Column Steel Bars

Ref: ACI 318-02 21.1: Seismic Hook
A hook on a stirrup, hoop or crossties having a bend ***not less than 135 degrees*** *except that circular hoops shall have a bend not less than 90 degrees. Hooks shall have a six-diameter (but* ***not less than 3 in.****) extension that engages the longitudinal reinforcement and projects into the interior of the stirrup or hoop.*

Non uniform c/c spacing between the bars



Roof Beam

Improper placement of stirrup

Non uniform c/c spacing between the bars

Absence of concrete cover

Ref: ACI 318-02

6.2.1: Concrete exposed by form removal shall have sufficient strength not to be damaged by removal operation.

b. Retaining/Breast Walls

Back/Outside View	Front/Inside View
	

Sites prone to land sliding were also selected for construction with no retaining/breast walls proposed or included in the design. The structures were not only damaged during the construction, but were also left vulnerable to damage due to land sliding after completion

Due to unskilled labor and careless workmanship the retaining/breast walls were not built as per the required standards. Dry stone masonry was practiced without applying the required cement mortar for proper bond between stones, required slope not being maintained and required curing not being done

c. Brick Masonry

- Joints not staggered
- Cement mortar not properly applied between bricks for strong bond
- Improper bond/arrangement of bricks

- Cross walls not interlocked with each other at corners, resulting in reduction of its strength to safely withstand even minor jolts of earthquake

d. Form Work

Form work fixed for roof beam concreting

- In place of using proper wooden/ply or steel formwork, technically weak contractors using ‘stones’ for concreting of column footings.

- Due to non-availability of form work contractor using blocks, stones and small wooden planks to concrete plinth beam in pieces with no continuity.

e. Concreting

Roof Beam

Column

Plinth Beam

Unskilled labor and careless workmanship resulted in out alignment of beams and columns

Ref: ACI 318-02

6.1.3: Forms shall be properly braced or tied together to maintain position and shape

4.3 PROJECT IMPLEMENTATION AND MONITORING SETUP IN THE STUDY AREA

4.3.1 General Observations

Based on personal experience and interviews conducted with the current and ex-employees of client and consultants, some of the following general observations regarding weaknesses of implementation and monitoring system were established:

a. Inexperienced & Insufficient Staff at Field Level:

Fresh/inexperienced staff was appointed at field level for monitoring of projects. Initially there was only one engineer, and four sub engineers in technical monitoring team. After a period of time the number of engineers were increased to four, but that was still insufficient for monitoring 120 project sites a month. Later due to shortage of funds the number of engineers and sub engineers was again reduced to almost half with same number of projects to monitor.

b. Improper and Ineffective Monitoring System:

Due to large number of projects and limited number of staff to monitor them, the project which got monitored during the current month may get monitored again after a lapse of at least a month or two and sometimes even more than that. This really affected the quality of work as it got unchecked for a long period of time.

Moreover the staff responsible for monitoring was bound to submit the technical monitoring report the same day after returning from sites and usually

they had to sit till night without any incentive or overtime allowance, which affected the quality of monitoring report.

c. Grouping of Small Projects into Single Large Packages:

Small projects were grouped into single large packages with the idea of better management and implementation but it didn't prove so as it attracted financially strong but technically weak contractors to offer and win bids. This practice thus adversely affected the quality of work on ground.

d. Lack of Capacity to Ensure Participation of Outsider Experienced Contractors:

The local contractors and their union/leaders didn't allow the non-local contractors to participate in bidding by threatening and even beating them forcing them to withdraw from bidding. This discouraged the participation of outsider experienced contractors to come and deliver quality work.

e. Lack of Skilled Labor:

One of the main reasons for contractors to be technically weak was lack of use of professional tools and skilled labor. It was also due to the remote area that skilled labor was hard to find, but any how it greatly damaged the quality of work on sites.

f. Uncontrollable Excessive Subletting:

Excessive subletting was very common on all projects. At times it became difficult to even trace that who subletted to whom. It was seen that more the project was subletted, more the quality was compromised due to incapable and weak contactors down the order to whom projects were subletted.

g. Lack of Experience in Providing Consultancy on Projects with such a Large Scope of Work:

Although NESPAK was one of the best option available to engage as a consultancy firm, but NESPAK itself lacked the experience to handle project with such a massive scope of work. Thus, due to gaps and flaws the work suffered in terms of quality.

h. Shortage of Funds:

Due to shortage of funds ERRA already once fired almost 50% of their staff which as explained above affected the monitoring of projects, similarly, news about shortage of funds and closure of organization keep on roaming which greatly influence the moral of employees by making them worry about their job security and thus directly affects the quality of work under their supervision.

4.4 ANALYSIS OF FACTORS AFFECTING CONSTRUCTION QUALITY

A questionnaire based survey was carried out in the Rawalakot district and its surrounding areas. The questionnaire was based on Lickert Scale, therefore to check the reliability of collected data, Cronbach's Alpha coeffiecient method was used. And for ranking of these contributing factors, Relative Importance Index (RII) formula was used.

4.4.1 Defining Variables

To analyze the data in SPSS, the variables needed to be defined. Therefore, all the contributing factors affecting the construction quality were taken as variables and coded.

4.4.2 Reliability Analysis

Cronbach's Alpha is the widely used method for assessing reliability of continuous data in SPSS (Likert scale). The Cronbach's Alpha value range from 0 (un-reliable) to 1 (Reliable) with 0.75 being considered the sensible value (Hinton et al., 2004) and (Leech et al., 2005).

Guideline to assess the reliability of any data is shown in the table below:

Table 4.1: Reliability w.r.t Cronbach's Alpha value

Sr. #	Cronbach's Alpha value	Reliability
1	0.9 and above	Excellent
2	0.7 to 0.9	High
3	0.5 to 0.7	Moderate
4	0.5 and below	Low

4.4.2.1 Overall Alpha Value for the Questionnaire

Table 4.2: Overall Cronbach's Alpha Value

Reliability Statistics	
Cronbach's Alpha	**No. of Items**
0.865	30

4.5 DESCRIPTIVE ANALYSIS

4.5.1 Sample Size

Population size on Projects in Rawalakot district and its surrounding areas is estimated to be 2000 (i.e. 100 persons from client, 100 persons from consultant and 1800 persons are assumed to be working from contractor side).

To find the desired sample size following factors were considered:

a. Sampling error

b. Population size

c. Confidence interval

Dillman (2000) gives the equation for finding the true sample size for the selected population:

$$\text{Ns} = \frac{Np\ x\ P\ x\ (1-P)}{(Np-1)\left(\frac{B}{C}\right)^2 + P\ x\ (1-P)}$$

Where,

Ns: sample size

Np: population size (here, it's taken 2000 approximately)

P: proportion of the population that is expected to choose one of the response categories. (here, it's taken 0.2)

B: acceptable sampling error i.e. (±10% or ±0.10)

C: Z statistic associated with the confidence level. (1.645 corresponds to 90% confidence level)

Putting the values in the formula

$$Ns = \frac{2000\ x\ 0.2\ x\ (1-0.2)}{(2000-1)\left(\frac{0.1}{1.96}\right)^2 + 0.2\ x\ (1-0.2)}$$

Ns = 59.66

Therefore, the above value of "Ns" suggests that 60 responses should be collected. A total of 63 valid responses were received i.e. 24 from client, 26 from consultant and 13 from contractor which is shown in the table 4.3 below.

4.5.2 Response Rate

In this survey there is a sample of 63 valid responses out of 100 targeted population showing response rate of 63% as mentioned in table below:

Table 4.3: Sample Characteristics

Sr. No.	Category	Population	Sample
1	Client	30	24
2	Consultant	30	26
3	Contractor	40	13
	Total	**100**	**63**

4.5.3 Respondents' Information

a. Respondents' Profile:

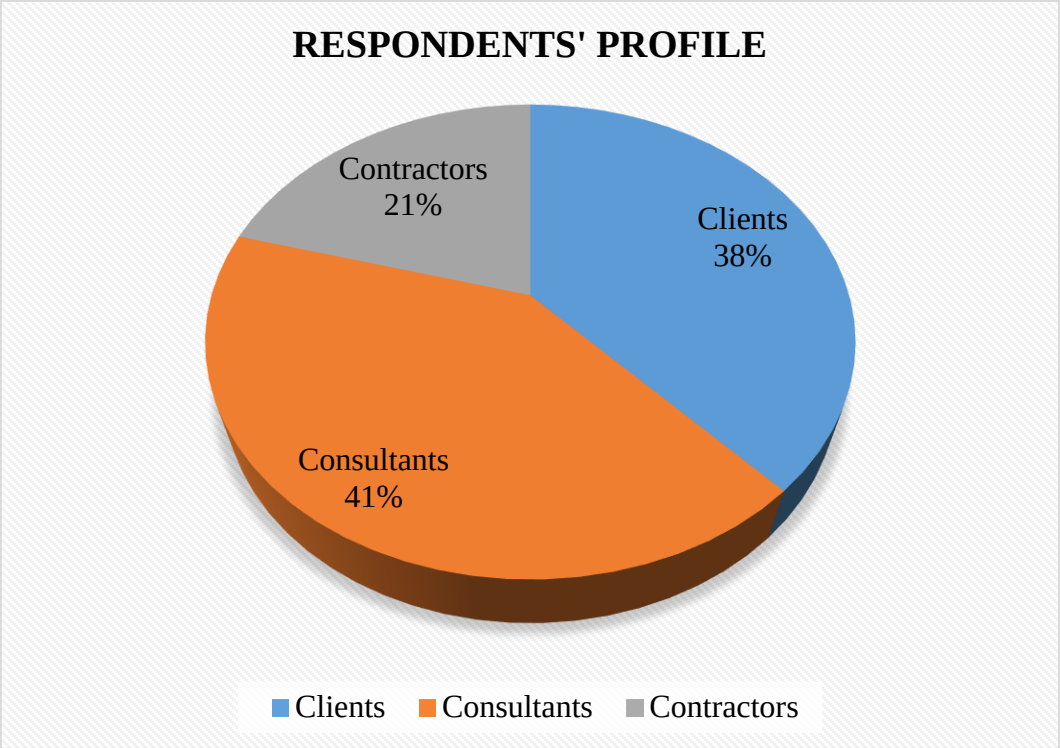
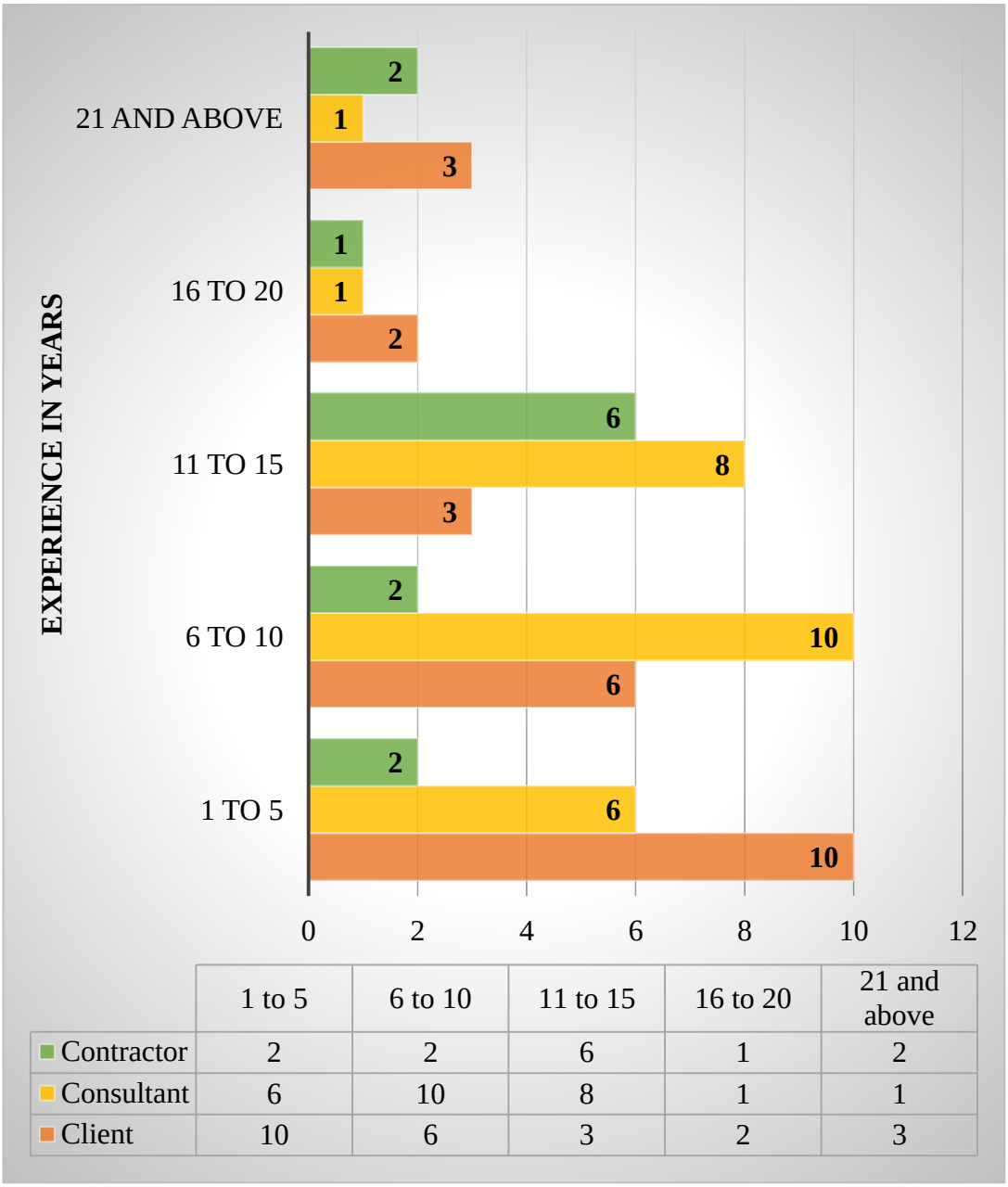


Figure 4.1: Respondents' Profile

b. Respondents' Experience:

Respondent's experience is shown below:



	1 to 5	6 to 10	11 to 15	16 to 20	21 and above
Contractor	2	2	6	1	2
Consultant	6	10	8	1	1
Client	10	6	3	2	3

Figure 4.2: Respondents' Experience

c. Respondents' Education:

Respondent's education is shown below:

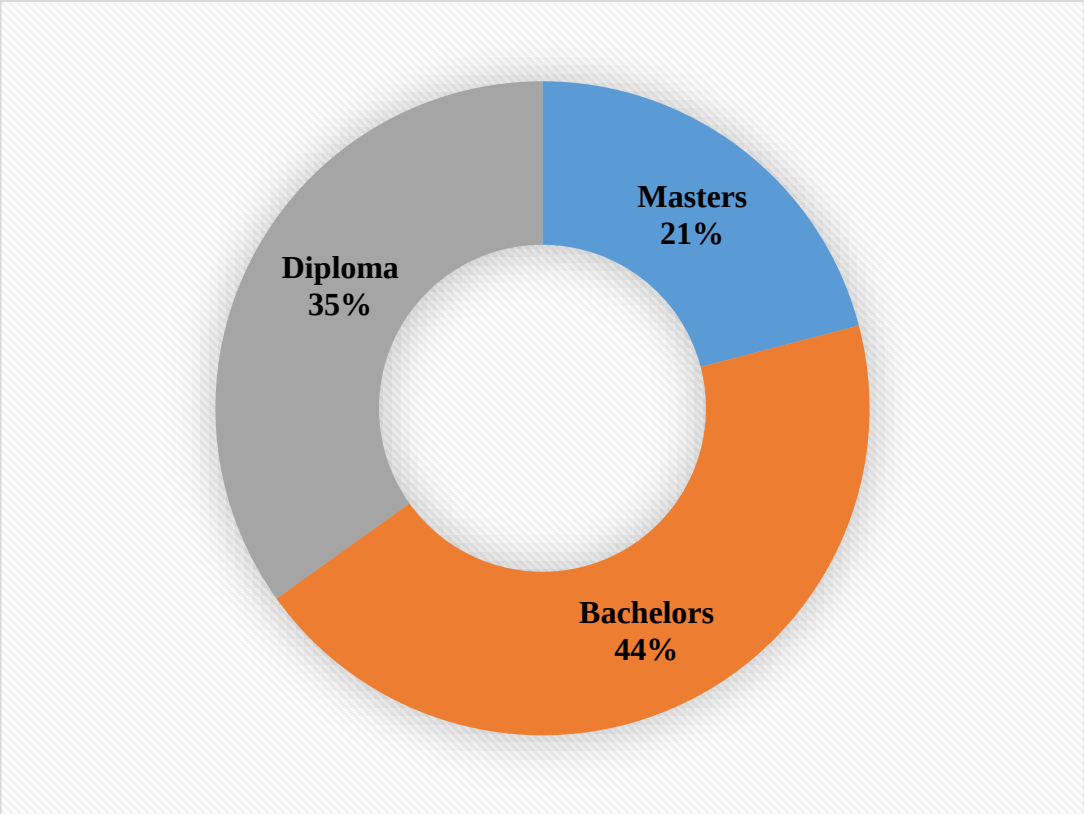


Figure 4.3: Respondents' Education

4.5.4 Ranking of Contributing Factors

In order to find out most significant factors affecting construction quality, ranking of these factors was done w.r.t Client's, Consultant's and Contractor's perceptions individually as well as on their overall response. For the said purpose, descriptive statistics was applied using SPSS to rank these contributing factors and finding Relative Importance Index (RII) as per formula:

$$RII = \frac{\Sigma w}{A \times N}$$

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 i.e. 5

N = total number in the sample

(In this case it is number of respondents belonging to Client, Consultant and Contractor category).

RII and Ranking corresponding to all the key stake holders' i.e. client, consultant and contractor for each contributing factor affecting construction quality is tabulated in table below:

Table 4.4: Ranking of Contributing Factors

Contributing Factors	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Improper/ineffective monitoring system	0.51	29	0.62	28	0.58	15	0.16	29
Insufficient workforce at field level	0.67	16	0.71	18	0.50	22	0.18	23
Inexperienced and nontechnical staff also appointed at field level	0.62	23	0.78	5	0.43	26	0.18	24
Lack of power/authority to stop the faulty work	0.78	3	0.73	16	0.50	23	0.20	6
Grouping of small projects into large packages	0.67	17	0.79	4	0.60	13	0.20	7
Issuance of work order prior land acquisition from the Government	0.62	24	0.74	13	0.75	4	0.19	11
Lack of capacity to review the technical documents	0.58	27	0.76	8	0.73	6	0.19	18

Contributing Factors	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Awarding contracts to financially strong but technically weak contractors	0.72	10	0.82	1	0.43	27	0.20	8
Slow process of land acquisition, later making it difficult for the contractors to meet deadlines	0.75	6	0.76	9	0.78	3	0.21	3
Awarding contracts on very high rates, discouraging financially weak but technically strong contractors	0.51	30	0.61	29	0.55	17	0.16	30
Initial preparation of technical documents done without ground survey	0.76	4	0.73	17	0.75	5	0.21	4
Mistakes/discrepancies in design documents	0.64	22	0.68	24	0.73	7	0.19	20
Gaps/flaws in inspection, testing and approval of works	0.61	25	0.66	26	0.60	14	0.17	27
Lack of experts at field level for technical guidance	0.61	26	0.70	19	0.70	8	0.18	21
Lack of consultant's experience in handling such a huge scope of work	0.56	28	0.67	25	0.63	10	0.17	28
Inadequate planning and scheduling of projects	0.65	19	0.76	10	0.63	11	0.19	14
Non availability of skilled labor	0.71	11	0.78	6	0.43	28	0.19	15
Inadequate site supervision and management	0.75	7	0.74	14	0.40	30	0.19	16
Lack of experienced contractors	0.68	13	0.80	2	0.43	29	0.19	17
Insufficient workforce for execution of projects	0.68	14	0.70	20	0.55	18	0.18	22
Excessive subletting of projects	0.86	2	0.77	7	0.58	16	0.21	2

Contributing Factors	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Discouraging/not allowing outsider/experienced contractors by local contractors	0.76	5	0.70	21	0.53	19	0.19	12
Contractors hesitant in using quality construction materials due to heavy costs of transportation involved	0.65	20	0.70	22	0.45	25	0.18	26
Contractors undertaking work beyond their capacity	0.75	8	0.74	15	0.53	20	0.20	9
Lack of professional construction skills and tools	0.73	9	0.60	30	0.48	24	0.19	19
Bad weather conditions	0.65	21	0.63	27	0.63	12	0.18	25
Shortage of technical and skilled labor to manage such a large scope of work	0.71	12	0.76	11	0.53	21	0.19	13
Lack of coordination between stakeholders	0.68	15	0.70	23	0.80	2	0.20	5
Shortage of funds and stoppage in its smooth flow	0.91	1	0.80	3	0.90	1	0.24	1
Change in policies and rules with change in command	0.67	18	0.76	12	0.65	9	0.20	10

4.5.5 Clients' Top 5 Ranking of Contributing Factors

As per clients' ratings, following factors were rated top 5 in affecting the construction quality:

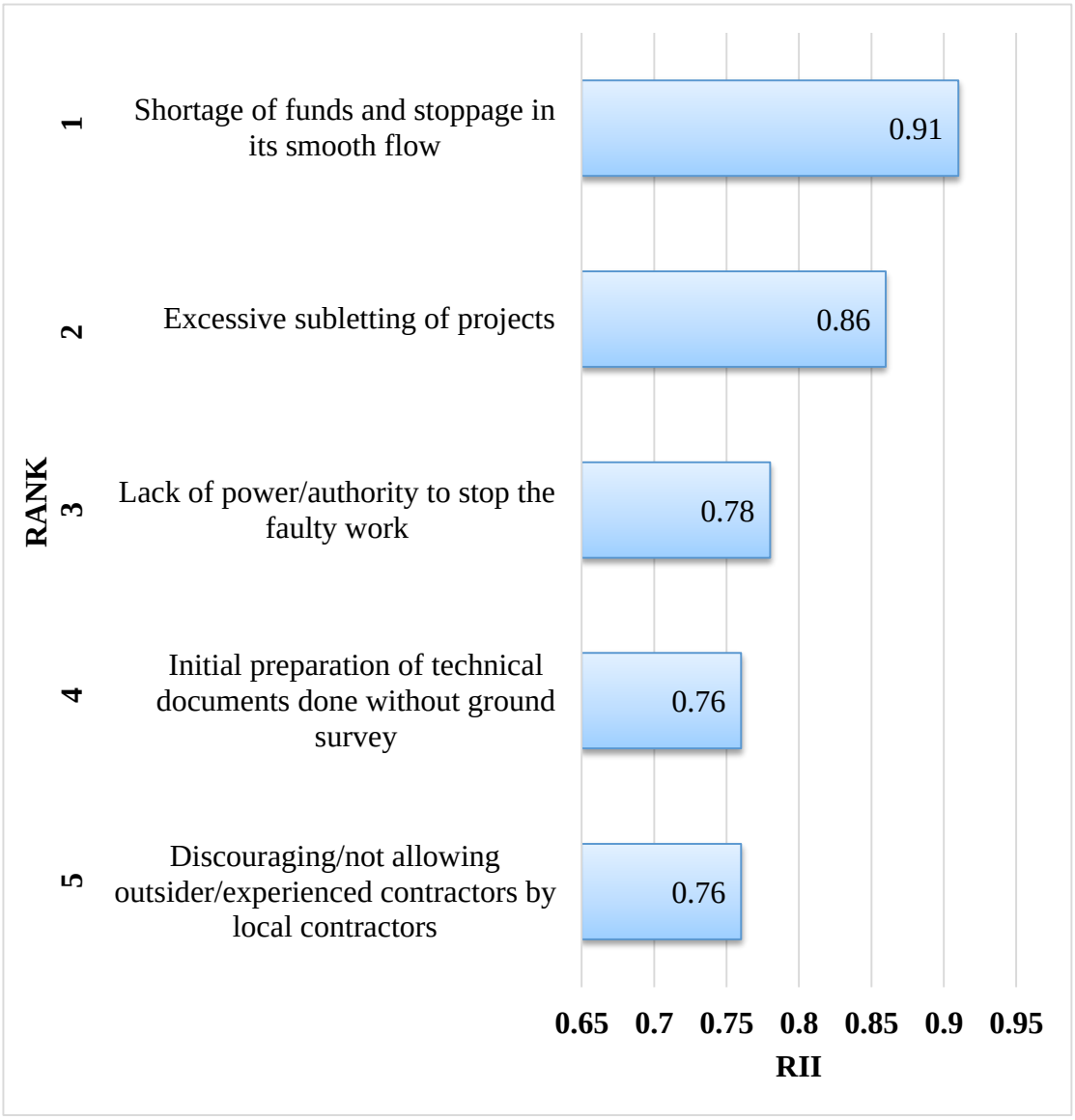


Figure 4.4: Clients' Top 5 Ranking of Contributing Factors

4.5.6 Consultants' Top 5 Ranking of Contributing Factors

As per consultants' ratings, following factors were rated top 5 in affecting the construction quality:

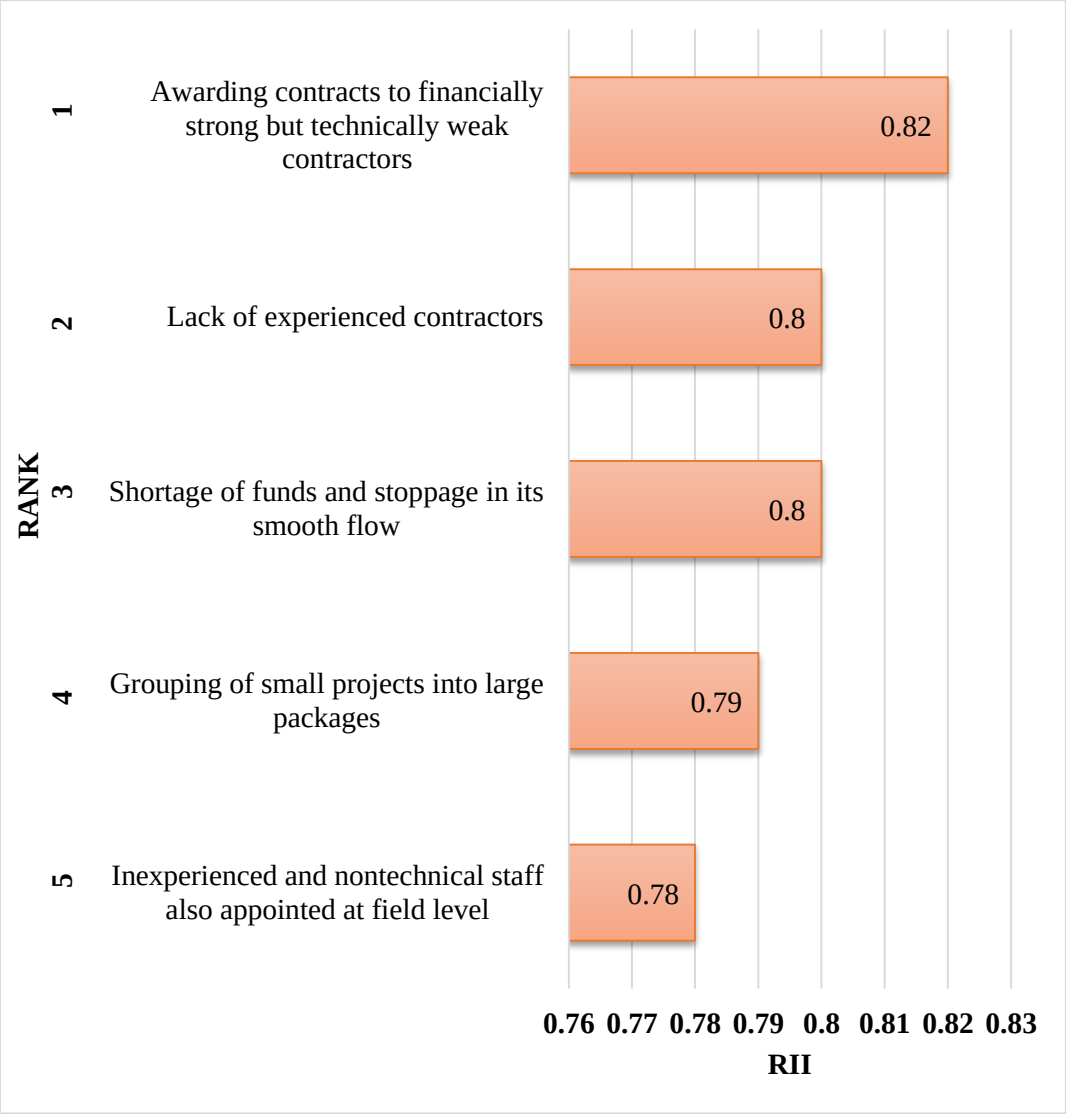


Figure 4.5: Consultants' Top 5 Ranking of Contributing Factors

4.5.7 Contractors' Top 5 Ranking of Contributing Factors

As per contractors' ratings, following factors were rated top 5 in affecting the construction quality:

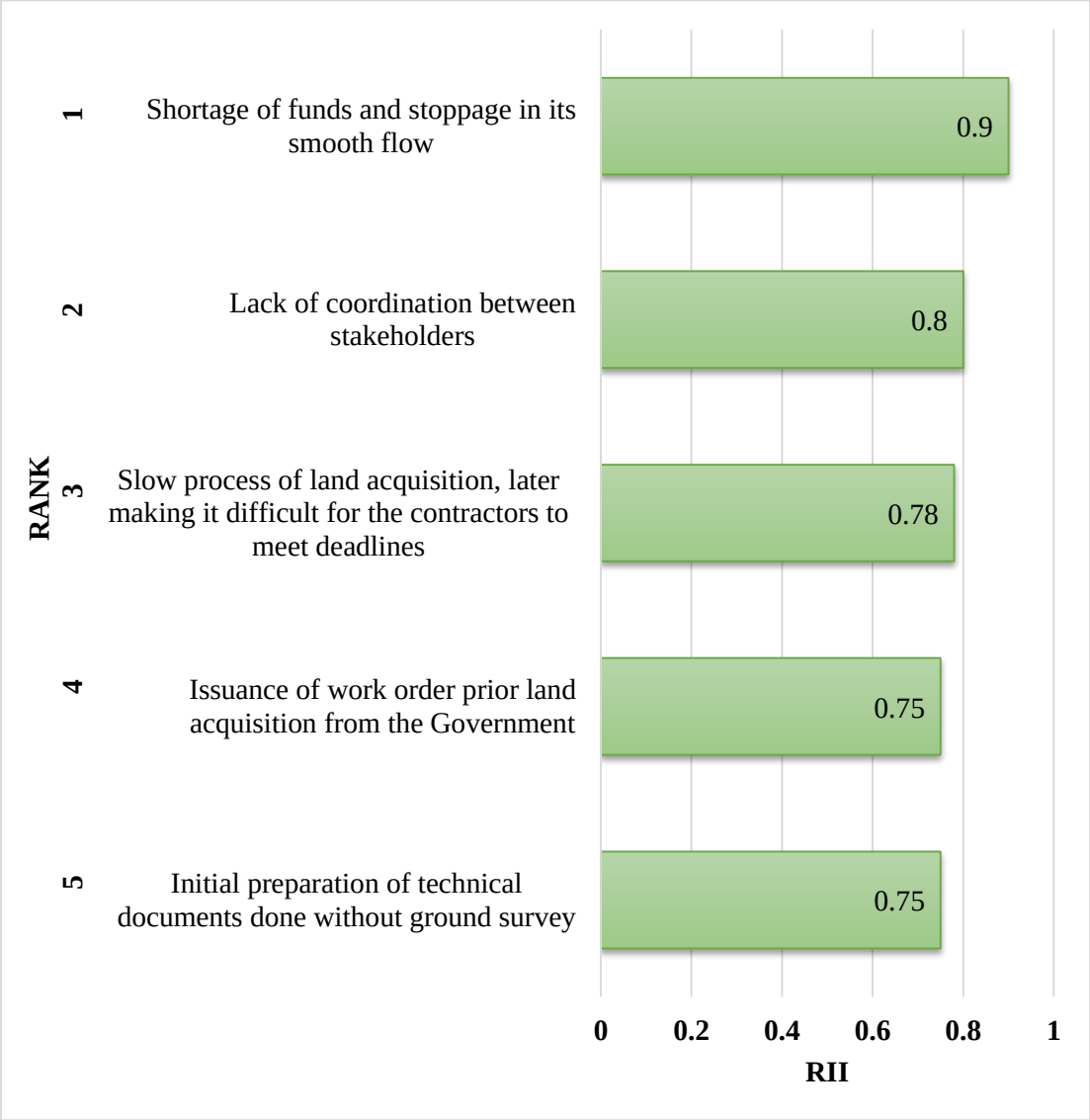


Figure 4.6: Contractors' Top 5 Ranking of Contributing Factors

4.5.8 Top 15 Most Significant Factors

15 most significant contributing factors affecting construction quality in ERRA projects are listed in the table:

Table 4.5: Top 15 Most Significant Factors

Ranking	Contributing Factor
1	Shortage of funds and stoppage in its smooth flow
2	Excessive subletting of projects
3	Slow process of land acquisition, later making it difficult for the contractors to meet deadlines
4	Initial preparation of technical documents done without ground survey
5	Lack of coordination between stakeholders
6	Lack of power/authority to stop the faulty work
7	Grouping of small projects into large packages
8	Awarding contracts to financially strong but technically weak contractors
9	Contractors undertaking work beyond their capacity
10	Change in policies and rules with change in command
11	Issuance of work order prior land acquisition from the Government
12	Discouraging/not allowing outsider/experienced contractors by local contractors
13	Shortage of technical and skilled labor to manage such a large scope of work
14	Inadequate planning and scheduling of projects
15	Non availability of skilled labor

4.5.9 Rank Given to Top 5 Contributing Factors by each Stakeholder

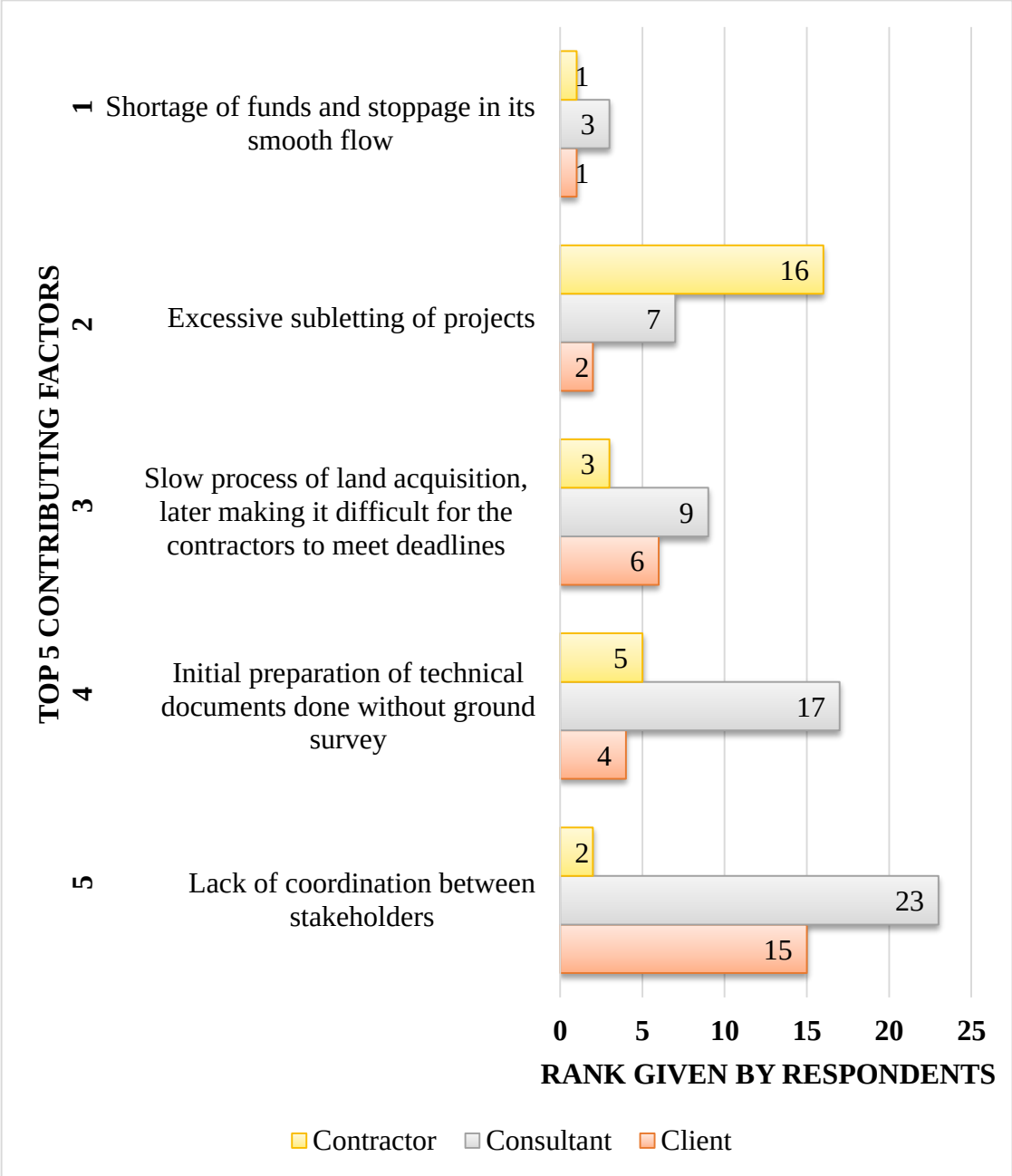


Figure 4.7: Rank Given to Top 5 Contributing Factors by each Stakeholder

The Figure 4.7 above shows overall top 5 ranked contributing factors and also rank given to these factors individually by each stakeholder i.e. client, consultant and contractor. e.g. "shortage of funds and stoppage in its smooth flow" was overall ranked as the top contributing factor with client and contractor both ranking it 1st, however consultant ranked it 3rd. Similarly, "lack of coordination between stakeholders" was overall ranked as 5th contributing factor, however, client ranked it 15th, consultant ranked it 23rd and contractor ranked it 2nd.

4.6 CASE STUDIES

One good project and two bad quality projects were selected for case studies. i.e.

a	BHU Thorar	Bad Quality Project
b	BHU Sehra	Bad Quality Project
c	CMH Rawalakot	Good Quality Project

a. BHU Thorar:

Basic Health Unit Thorar was the project funded by Asian Development Bank (ADB) and client was ERRA. Project implementation authority was given to SERRA and a consultant was also involved. The construction quality of the project was not up to the standard which is clear from the pictures shown below:

b. BHU Sehra:

Basic Health Unit Sehra was the project funded by Asian Development Bank (ADB) and client was ERRA. Project implementation authority was given to SERRA and a consultant was also involved. The construction quality of the project was not up to the standard which is clear from the pictures shown below:

c. CMH Rawalakot:

CMH Rawalakot was the project funded by UAE, client and implementing authority was ERRA. The construction quality of the project was very good and up to the standard which can be seen in the pictures shown below:

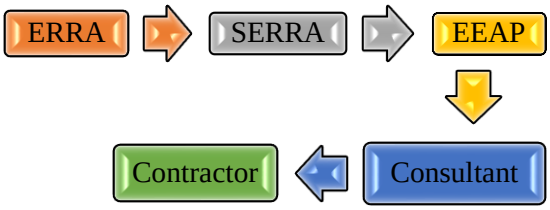



Findings from Case Studies:

Personal experience, review of project documents, discussions/interviews conducted and on-ground survey of projects revealed the reasons for bad and good quality of construction.

Factors responsible for bad quality of construction on BHU Thorar and BHU Sehra projects were identified as:

i. Long chain of stakeholders in project execution phase



ii. Inefficiency of contractors, lack of professional skills and tools for proper project management and lack of skilled labor to produce quality work on sites

iii. Moreover, whenever coordinating with consultant highlighting quality issues, they used to negate the facts and seemed party to the contractor rather than representing client

However, factors responsible for good quality of construction on CMH Rawalakot project were identified as:

i. More professional, experienced and technically sound consultants

ii. Internationally renowned contractor with commendable construction profile

iii. Short chain of stakeholders in project execution phase

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

5.1.1 Top 15 Contributing Factors Affecting Construction Quality w.r.t Responsibility

Most significant factors highlighted as a result of survey w.r.t responsibility i.e. client related factors, consultant related factors, contractor related factors and miscellaneous factors are listed as under:

a. Client Related Factors:

1. Slow process of land acquisition, later making it difficult for the contractors to meet deadlines
2. Grouping of small projects into large packages
3. Awarding contracts to financially strong but technically weak contractors
4. Issuance of work order prior land acquisition from the Government
5. Lack of power/authority to stop the faulty work

b. Consultant Related Factors:

1. Initial preparation of technical documents done without ground survey

c. Contractor Related Factors:

1. Excessive subletting of projects
2. Contractors undertaking work beyond their capacity

3. Shortage of technical and skilled labor to manage such a large scope of work
4. Discouraging/not allowing outsider/experienced contractors by local contractors
5. Inadequate planning and scheduling of projects
6. Non availability of skilled labor

d. Miscellaneous Factors:

1. Shortage of funds and stoppage in its smooth flow
2. Lack of coordination between stakeholders
3. Change in policies and rules with change in command

5.1.2 Analysis of Project Implementation and Monitoring Setup in the Study Area

On the basis of personal experience, on-ground visits to project sites, documentary review, discussions/interviews conducted and survey results, following conclusion are made with regard to project implementation and monitoring setup in the study area:

1. ERRA was established with a mission to "Convert this Adversity into an Opportunity" by reconstruction of destroyed facilities, following highest standards of reconstruction & rehabilitation with the commitment to "Build Back Better" and earned a good name too. But, after literature review, questionnaire survey, interviews/discussions and on ground visits, the construction quality of projects didn't seem to fully comply by the goals and objectives to which ERRA committed to at the time of its establishment.

2. Involvement of all stakeholders i.e. client, consultant, contractor and especially end user in reconstruction activities was a positive step towards efforts in achieving quality but due to poor coordination it didn't really prove fruitful.
3. ERRA did a great job by developing a software i.e. ERRA Reconstruction Monitor (ERM) for tracking progress of such a huge number of projects online, which is really helpful for project managers and other officials to monitor progress, but, it does not address the issue of monitoring and depicting actual on ground quality of projects.

5.1.3 Most Significant Contributing Factors Affecting the Construction Quality

After conducting questionnaire based field survey, most significant contributing factors affecting the construction quality are discussed as under:

a. Management Issues:

i. *"Shortage of funds and stoppage in its smooth flow":* It was the foremost significant factor and was unanimously declared as major contributor in affecting the quality of construction. One of the main reason for this issue is overall financial problems being faced by the government and at present also there is shortage of funds with the government to properly run the projects. Initial high/wrong estimates also contributed towards leakage and then scarcity of funds. Price escalation also played significant role in increasing cost of projects thereby causing shortage of funds to complete them. Non-payments to the contractors affects their morale for working up to the standards and

just to get rid of the work within the limited budget they fell short of specifications thus adversely affecting the quality of construction.

ii. *"Slow process of land acquisition, later making it difficult for the contractors to meet deadlines" & "Issuance of work order prior land acquisition from the Government":* There were projects which were awarded to the contractors prior proper land acquisition, which after initially wasting a lot of time of the contractor made it difficult for the contractor to meet short deadlines which he usually cater at the cost of quality.

iii. *"Lack of coordination between stakeholders":* All the three stakeholders i.e. client, consultant and contractor have a very weak coordination to promptly solve quality issues at field level.

iv. *"Grouping of small projects into large packages" & "Awarding contracts to financially strong but technically weak contractors":* Small projects were grouped into large packages with an aim for better control and management but it greatly affected the quality of construction as it attracted financially strong but technically weak contractors.

v. *"Change in policies and rules with change in command":* It is the issue in almost every organization that our policies are governed and molded as per the desires of people in command. When staff get used to the rules, regulations and procedures, they usually get changed with change

in command. So, by the time people again learn and adopt new policies and procedures, the quality of work gets suffered.

b. Other Issues:

i. *"Excessive subletting of projects":* Another one of the major issues' responsible for ruining the quality of construction in ERRA projects is excessive subletting. Most of the enlisted contractors just acquired work by using their PEC registration and then further sold/passed on the projects to local small and inexperienced contractors. These weak and inexperienced contractors not being able to perform work as per the required standards greatly affected the quality of work.

ii. *"Initial preparation of technical documents done without ground survey":* There are many sites which are very hard to access. Many buildings prone to land sliding are not provided with retaining structures and they were damaged due to land sliding during their construction phase yet alone after completion.

iii. *"Contractors undertaking work beyond their capacity":* Contractors in lust took work beyond their capacity without foreseeing the scope of work, sites accessibility and availability of resources thus ending up with bad quality of work.

iv. *"Discouraging/not allowing outsider/experienced contractors by local contractors":* It is usually observed during bidding that local contractors make lobby against outsider strong and experienced

contractors and discourage by bullying them through different means so that they might not win the bid against them.

v. *"Shortage of technical and skilled labor to manage such a large scope of work" & "Non-availability of skilled labor":* Contractors in lust took work beyond their capacity without foreseeing the availability of resources with them to properly accomplish the job and later fell short of technically skilled labor to ensure quality on projects.

vi. *"Inadequate planning and scheduling of projects":* Contractors being weak specially in case of subletting are totally unaware of proper planning and scheduling of their projects and carry out their work without it thus compromising quality.

5.1.4 Conclusions from Case Studies

1. In bad quality projects, long chain of stakeholders in execution adversely affected the quality, as more the responsibility shared, more it was denied. In such circumstances the contractor was always confused that to whom he is answerable and whom instructions he has to follow. Moreover, if at all unavoidable, long chain of stakeholders required very strong coordination but its absence added to the substandard construction.
2. In good quality project, funding was directly and smoothly managed from the donor to the contractor with no hindrance, which added to the efficiency of the contractor. However, in case of bad quality projects, payments were usually delayed as it had to pass through different channels i.e. client, implementing authorities and consultants. Thus not ensuring timely payments to the

contractor affected their morale which ultimately affected the quality of work they produced.

5.1.5 Conclusions from Respondents' Perspective Analysis and their Comparison with Overall Ranking

1. **Clients' Perspective Analysis:**

   The contributing factors which client rated as top 5, they all appeared in overall top 15 contributing factors. Moreover, both according to overall ranking and client's perspective, *"shortage of funds and stoppage in its smooth flow"* was the 1st and *"excessive subletting of the projects"* was the 2nd major cause adversely affecting the construction quality.

2. **Consultants' Perspective Analysis:**

   Three contributing factors out of consultants' top 5 rated factors appeared in overall top 15 contributing factors. Moreover, client ranked overall 1st contributing factor *"shortage of funds and stoppage in its smooth flow"* as 3rd and overall 8th contributing factor *"awarding contracts to financially strong but technically weak contractors"* as 1st.

3. **Contractors' Perspective Analysis:**

   The top 5 contributing factors rated by contractor also appeared in overall top 15 contributing factors. Moreover, according to contractors' perspective and overall ranking, *"shortage of funds and stoppage in its smooth flow"* was 1st major contributing factor and *"slow process of land acquisition, later making it difficult for the contractors to meet deadlines"* as 3rd major contributing factor.

5.2 RECOMMENDATIONS

1. **Induction of More Number of Staff:**

By visiting stakeholders, it was observed that all of them were running short of staff/employees/labor as compared to the scope of work and they all agreed to this fact. e.g. to monitor 1000 plus projects in every district, client and consultant both have hardly 2 to 3 Engineers and 3 to 4 sub. Engineers. Similarly contractors are also short of manpower as compared to scope of work/projects they had acquired. Therefore, more staff should be inducted at all stakeholders' levels for proper control of projects and their successful accomplishment.

2. **Hiring of Experienced and Technical Staff:**

Working experience with ERRA narrates that initially ERRA hired nontechnical staff as deputy directors i.e. senior most personnel representing ERRA at district levels. In addition to it, maximum number of technical staff hired at field level was inexperienced including fresh graduates with zero experience. However, on the basis of current interviews conducted, it was revealed that ERRA had replaced some nontechnical staff with the technical ones at field level but the experience issue is still there. Therefore nontechnical staff should be completely replaced with technical ones and more of experienced staff should be appointed so that organization could benefit from their experience, mature approach and overall technical guidance on projects.

3. **Replacing Existing Monitoring and Reporting System with a More Swifter and Quick Response System:**

Interviews conducted and personal past experience reveals that according to past and current monitoring system of ERRA, after the sites visits, technical monitoring report (TMR) is prepared on a particular format supported with pictures for each site. This report then follows a long chain i.e. from district office to zonal office, from zonal office to head office and from head office it is then forwarded to the concerned consultant who then have to communicate it to the contractor. Due to this long time wasting communication chain, usually the shortfall/fault gets out of the stage and difficult or impossible in which it could be rectified. Therefore, existing monitoring and reporting system should be made swifter i.e. immediate action should be demanded within specified viable working hours.

4. **Empowerment of Client to Stop Faulty Work:**

Survey results showed that client gave 3rd rank to this factor that there is lack of power to stop any ongoing faulty work i.e. ERRA technical staff are not authorized to cease or stop any faulty construction work they find against the specified engineering practices on any site. The only thing they can do is to take pictures and report. Therefore, client should practice its authority to timely stop the faulty work for further ensuring it to be done as per the specified engineering practices.

5. **Avoiding Long Chain of Stakeholders in Project Execution:**

Case studies conducted revealed that in order to avoid confusion created between all stakeholders due to responsibility sharing and overall weak

coordination and control over the project, it's always better to keep the chain of stakeholders as short as possible to ensure quality in construction.

6. Revision of Very High Rates:

After conducting interviews/discussions with client and consultant it was figured out that both had consensus on the fact that initially ERRA offered contracts on very high rates which later caused scarcity of funds to properly fuel the ongoing projects. In future for any new projects, ERRA should revise its very high rates, so that unnecessary leakage of funds could be avoided. Moreover, high rates gave advantage to financially strong but technically weak contractors over financially weak but technically strong contractors.

7. Prohibiting Sub-Letting of Projects:

After field visits, personal experience, questionnaire survey and interviews/discussions carried out it was established that subletting greatly ruined the quality of projects as ERRA didn't properly put some mechanism in place to address this issue. As excessive subletting went unchecked, the projects landed in the hands of extremely weak contractors both financially and technically. Therefore, special clause should be included in work agreements clearly stating subletting to be prohibited unless and until done with the consensus of client or else contractor should be imposed with heavy penalties.

8. Following Pre-Qualification Criteria for Contractors:

After experiencing serious problems with award of contracts to incapable/weak contractors, client, consultant and government line departments all suggested that a set and defined criteria for prequalification of contractors should be strictly

followed before bidding phase, so that only prequalified contractors both financially and technically strong enough with a decent past construction profile could be allowed to bid and then later one of them could be awarded contract based on successful bid offered on merit.

9. Ensuring Strong Coordination Between All Stakeholders:

Results of survey questionnaire revealed that weak coordination between stakeholders at field level also played an important role in adversely affecting the projects by not addressing the quality related issues and thus timely questions raised on quality went unanswered. Strong and frequent coordination should be developed at field level in terms of meetings by timely raising and solving the quality related issues. Moreover, ideally, client and consultant should plan joint visits to the sites so that shortfalls/gaps could be directly communicated and solved in minimum time period rather than forwarding routine technical monitoring reports (TMRs) on which response could be expected from weeks and probably by that time the defect/shortfall could have gone beyond rectification.

10. Allocation of Separate Budget for ERRA:

One of the sore issue and highly ranked contributing factor after survey turned out to be shortage of funds with ERRA, due to which ERRA already once fired almost 50% of their staff. News about shortage of funds and closure of organization keep on roaming which greatly influence the moral of employees by making them worry more about their job security than any other issue and thus directly affects the quality of work under their supervision. Considering such a huge scope of work to be accomplished by such a large organization, Government

of Pakistan should allocate a separate budget to fuel these projects, so that all the construction/reconstruction projects could be successfully completed in a manner to which ERRA committed to at the time of its establishment.

5.3 FUTURE DIRECTIONS

1. Similar study may be carried out in one of the districts' of Khyber Pakhtunkhwa to find out strengths and weaknesses of overall reconstruction activities along with factors affecting the construction quality.
2. A comparative study of ERRA projects with similar nature of projects run by other NGOs/INGOs and humanitarian organizations may be carried out with a view to incorporate positive things like quality index especially for reconstruction & rehabilitation projects.
3. More case studies based forensic research can be carried out by comparing good quality projects and bad quality projects to figure out the issues adversely affecting the construction quality and also to find out governing factors responsible for quality construction on good projects with its further implication on upcoming as well as ongoing projects.

REFERENCES

Abdulaziz A. Bubshait and Tawfiq H. Al-Atiq, (1999), *"ISO 9000 Quality Standards In Construction"*, Journal of Management in Engineering, Vol. 15, No. 6, Nov/Dec, 1999. Paper No. 16624 © ASCE

Albert P.C. Chan and C.M. Tam, *"Factors Affecting The Quality Of Building Projects In Hong Kong"*, International Journal of Quality & Reliability Management, Vol. 17 Numbers 4/5, 2000, pp. 423-441, © Emerald

Alexander Laufer and Dora Cohenca, (1990), *"Factors Affecting Construction Planning Outcomes"*, Journal of Construction Engineering and Management, Vol. 116, No. 1, March, 1990. Paper No. 24454 © ASCE

Andrew Brown, John Adams, (2000), *"Measuring the Effect of Project Management on Construction Outputs: A New Approach"*, International Journal of Project Management 18 (2000) 327-335, © Elsevier Science Ltd and IPMA

C.W. Kam and S.L. Tang, (1997), *"Development And Implementation Of Quality Assurance In Public Construction Works In Singapore And Hong Kong"*, International Journal of Quality & Reliability Management, Vol. 14, No. 9, 1997, pp. 909-928, © Emerald

David Arditi and H Murat Gunaydin, (1997), "*Total Quality Management In The Construction Process"*, International Journal of Project Management Vol. 15, No. 4, pp. 235-243, © 1997 Elsevier Science Ltd and IPMA

David Arditi and H. Murat Gunaydin, (1998), *"Factors That Affect Process Quality In The Life Cycle Of Building Projects"*, Journal of Construction Engineering and Management, Vol. 124, No.3, May/June, 1998. Paper No. 16504 © ASCE

Ellen van Bueren and Jitske de Jong, (2007), *"Establishing Sustainability: Policy Successes and Failures"*, Building Research & Information ISSN 0961-3218 print/ISSN 1466-4321, 2007, © Taylor & Francis

ERRA *"Earthquake Reconstruction & Rehabilitation Authority"*, (2013), www.erra.pk, accessed on 15th November 2013)

Gopal K. Kanji & Alfred Wong, (1998), *"Quality Culture in the Construction Industry"*, Total Quality Management, 9:4-5, 133-140, DOI: 10.1080/0954412988758, 1998, © Taylor & Francis

G. W. Chase, (1993), *"Effective Total Quality Management (TQM) Process For Construction"*, Journal of Management in Engineering, Vol. 9, No. 4, October, 1993, Paper No. 5655, © ASCE

Hong Xiao and David Proverbs, (2003), *"Factors Influencing Contractor Performance: An International Investigation"*, Engineering, Construction and Architectural Management, Volume 10, Number 5, 2003, pp. 322-332, © Emerald

James L. Burati Jr., Michael F. Matthews and Satyanarayana N. Kalidindi, (1991), *"Quality Management in Construction Industry"*, Journal of Construction Engineering and Management, Vol. 117, No. 2, June, 1991. Paper No. 25908, © ASCE

James L. Burati Jr., Michael F. Matthews and Satyanarayana N. Kalidindi, (1992), *"Quality Management Organizations and Techniques"*, Journal of Construction Engineering and Management, Vol. 118, No. 1, March, 1992. Paper No. 26576, © ASCE

Janet K. Yates and Edward E. Lockley, *"Documenting And Analyzing Construction Failures"*, Journal of Construction Engineering and Management, Vol. 128, No. 1, February 1, 2002, © ASCE

Kent Davis, W. B. Ledbetter and James L. Burati Jr., (1989), *"Measuring Design and Construction Quality Costs"*, Journal of Construction Engineering and Management, Vol. 115, No. 3, Sep, 1989. Paper No. 23847 © ASCE

K. N. Jha and K. C. Iyer, (2006), *"Critical Factors Affecting Quality Performance in Construction Projects"*, Total Quality Management, Vol. 17, No. 9, 1155–1170, November 2006, © Taylor & Francis

Low Sui Pheng and Jasmine Ann Teo, (2004), *"Implementing Total Quality Management in Construction Firms"*, Journal of Management in Engineering, Vol. 20, No. 1, January 1, 2004. © ASCE

Lung-Chuang Wang, (2008), *"Enhancing Construction Quality Inspection and Management Using RFID Technology"*, Automation in Construction 17 (2008) 467–479, © Elsevier

Mireille G. Battikha, (2002), *"Qualicon: Computer Based System for Construction Quality Management"*, Journal of Construction Engineering and Management, Vol. 128, No. 2, April 1, 2002. © ASCE

Nguyen Duy Long, Stephen Ogunlana, Truong Quang and Ka Chi Lam, (2004), *"Large Construction Projects In Developing Countries: A Case Study from Vietnam"*, International Journal of Project Management 22 (2004) 553–561, © Elsevier Ltd and IPMA

Peter Barrett, (2000), *"Systems and Relationships for Construction Quality"*, International Journal of Quality & Reliability Management, Vol. 17 No. 4/5, 2000, pp. 377-392, © Emerald

Peter E.D. Love and Zahir Irani, (2003), *"A Project Management Quality Cost Information System for the Construction Industry"*, Information & Management 40 (2003) 649–661, © Elsevier

Refaat H. Abdel-Razek, (1998), *"Quality Improvement in Egypt: Methodology and Implementation"*, Journal of Construction Engineering and Management, Vol. 124, No.5, Sep/Oct, 1998. Paper No. 12663, © ASCE

Ronald L. Deffenbaugh, (1993), "*Total Quality Management At Construction Jobsites"*, Journal of Management in Engineering, Vol. 9, No. 4, October, 1993, Paper No. 5032, © ASCE

SERRA, *"State Earthquake Reconstruction & Rehabilitation Authority"*, (2013), www.serra.gov.pk, accessed on 15th November 2013

Victor Sanvido, Francois Grobler, Kevin Parfitt, Moris Guvenis and Michael Coyle, (1992), *"Critical Success Factors For Construction Projects"*, Journal of Construction Engineering and Management, Vol. 118, No. 1, March, 1992. Paper No. 873 © ASCE

Wikipedia, (2013), www.wikipedia.org, accessed on 30th November 2013

Abdel-Razek, R. H., (1996a), *"Improving construction quality in Egypt: A consensus view"*, Proc., 5th Int. Symp.: Engrg. Mgmt. for the 21st Century, Vol. 2, Session 18.1, International Project Management Association and Management Engineering Society, Cairo, Egypt, 1-10.

Abdel-Razek, R. H., (1996b), *"Quality improvement in contracting companies: A project managers' view"*, Proc., Cairo 1st Int. Conf. on Concrete Struct., Vol. I, Cairo University, Cairo, Egypt, 5-24, 5-35.

"Achieving quality on building sites", (1987), Building Economic Development Council, National Economic Development Office, U.K.

Anderson, E.W., Sullivan, M.W., (1993), *"The Antecedents and Consequences of Customer Satisfaction for Firms"*, Marketing Science. Vol. 12 No. 2, pp. 125-143.

"An investigation into faults and their avoidance", (1982), Quality in traditional housing, Vol. I, Building Research Establishment, Her Majesty's Stationery Office, London, U.K.

Arditi, D. & Gunaydin, H. M., (1998), *"Factors that affect process quality in the life cycle of building projects"*, ASCE Journal of Construction Engineering and Management, 124(3), pp. 194–203.

Ashley, D. B., Lurie, C. S., and Jaselskis, E. J., (1987), *"Determinants of construction project success"*, Proj. Mgmt. J., 18(2), 69-79.

Barnes, M., (1987), *"Construction Project Management"*, Seminar on "Construction Project Management", 21–22 October, London, UK.

Barrett, P. (2000), *"Systems and relationships for construction quality"*, International Journal of Quality & Reliability Management. Vol. 17 Nos. 4/5, pp. 377-392.

Bates, G. D., ed., (1993), *"An organizational development process to prepare for total quality management"*, J. Mgmt. Engrg., ASCE, 9(4), 291-294.

Beale, P. and Freeman, M., (1991), *"Successful project execution: a model"*, Project Management Journal, Vol. XXII No. 4, December, pp. 23-30.

Bitner, J.B., Booms B.H., and Tetreault M.S., (1990), "*The Service Encounter: diagnosing favorable and unfavorable incidents"*, Journal of Marketing. Vol. 54 No.1, pp. 71-84.

Bresnen, M.J., Haslam, C.O., Beardsworth, A.D., Bryman, A.E. and Keil, E.T., (1990), *"Performance on site and the building client"*, Occasional Paper No. 42, Chartered Institute of Building, Ascot.

"British Standards Institution", (1987), BS 4778 Part 1: Quality Vocabulary, BSI, London.

Burati, J. L., and Farrington, J. J., (1987), *"Costs of quality deviations in design and construction"*, Cll Source Document No. 29, Construction Industry Institute, Austin, Tex.

Bubshait, A. A. & Al-Atiq, T. H., (1999), *"ISO 9000 quality standards in construction"*, ASCE Journal of Management in Engineering, 15(6), pp. 41–46.

Burcu Akinci, Frank Boukamp, Chris Gordon, Daniel Huber, Catherine Lyons and Kuhn Park, (2006), *"A Formalism for Utilization of Sensor Systems and*

Integrated Project Models For Active Construction Quality Control", Carnegie Mellon University, 2006, Pittsburgh

Chan, A.P.C., (1996a), *"Quality assurance in the construction industry"*, Architecture Science Review, Vol. 39 No.2, June, pp. 107-12.

Chua, D. K. H. et al., (1999), *"Critical success factors for different project objectives"*, ASCE Journal of Construction Engineering and Management, 125(3), pp. 142–150.

Collins, Jr., F. C., (1996), *"Quality: The Ball in your Court"*, (New Delhi, India: Tata McGraw-Hill).

"Cost of quality deviations in design and construction", (1989), Publ. 10-1, Construction Industry Institute, Austin, Tex.

Cronin, J.J and Taylor S.A., (1992), *"Measuring Service Quality: a re-examination and extension"*, Journal of Marketing. Vol. 56, pp. 55-68.

Davis, K., and Ledbetter, W. B., (1987), *"Measuring design and construction quality cost"*, Cll Source Document No. 30, Construction Industry Institute, Austin, Tex.

Deming, W. E., (1993), "*The new economics for industry, government, education"*, MIT Press, Cambridge, Mass.

de Wit, A., (1986), *"Measuring project success: an illusion"*, Proc, Project Management Institute, Montreal, Canada, 13-21.

Docker, P.B., (1991), *"Quality assurance standard: for the building and construction industry"*, South Australian Builder, March, pp. 15-17.

Fung, P. & Wong, A., (1995), *"TQM in construction industry Hong Kong"*, context in: Proceedings of the First International Conference on ISO 9000 and TQM (Leicester, De Montfort University).

Griffith, A., (1990), "*Quality assurance in buildings",* Macmillian Education Ltd., Basingstoke, U.K.

Homburg C. and Rudolph B. (2000), *"Customer Satisfaction in Industrial Markets: dimensional and multiple role issues"*, Journal of Business Research. Vol. 52, pp. 15-33.

International Standardization Organization, (1994), ISO 9001: *"Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation and Servicing"*, ISO, Geneva.

Jido, J., (1996), *"Quality management with TQM in Takenaka Corporation"*, in: Proceedings of International Conference on Quality (Yokohama).

Ledbetter, W. B., (1994), *"Quality performance on successful projects"*, J. Constr. Engrg. And Mgmt., ASCE, 120(1), 34-46.

Ledbetter, W. B., and Wolter, W. E (1992). "Quality performance management system." *Cll Product No. EM4*, 1st Ed., Construction Industry Institute, University of Texas at Austin, Tex.

Low, S.P. and Seymour, D., (1990), *"The quality debate"*, Construction Management and Economics, Vol. 8 No. 1, pp. 13-29.

Low, S.P., (1992), *"Quality assurance: technical provisions and implementation for the Singapore construction industry"*, Building, Singapore Institute of Builders Journal, February, pp. 22-32.

Low, S. P. and Peh, K. W., (1996), *"A framework for implementing total quality management in construction"*, The TQM Magazine, 8-51, 39–46.

Maloney, W.F. (2002). *"Construction product/service and customer satisfaction"*, Journal of Construction Engineering and Management, November/December, pp. 522-529.

Masterman, J.W.E. and Gameson, R.N., (1995), *"Client characteristics and needs in relation to their selection of building procurement systems"*, Proceedings of CIB W92 Symposium "East meets West", pp. 79-87.

Matthews, M. E, and Burati, J. L. (1989). *"Quality management organizations and techniques"*, Cll Source Document No. 51, Construction Industry Institute, Austin, Tex.

"Measuring the cost of quality in design and construction", (1989), Publ. 10-2, Construction Industry Institute, Austin, Tex.

Michail Kagioglou, Rachel Cooper & Ghassan Aouad, (2001*), "Performance Management in Construction: A Conceptual Framework"*, University of Salford, UK, 2001

Milakovich, M.E., (1995), "*Improving Services Quality: Achieving High Performance in the Public and Private Sector"* (St Lucie Press).

Morris, P. W. G., (1983), *"Managing project interfaces – key points for project success"*, Project management handbook, D. I. Cleland and W. R. King, eds., Van Nostrand Reinhold Co., New York, N.Y., 3-36.

Naoum, S.G., (1991), *"Procurement and project performance"*, Occasional paper no. 45, The Chartered Institute of Building, Ascot.

Naoum, S.G. and Mustapha, F.H., (1995), *"Influences of the client designer and procurement method on project performance"*, Proceedings of CIB W92 Symposium "East meets West", pp. 221-8.

Nahapiet, J., (1983), *"The management of construction projects – case studies from the USA and UK"*, CIOB, Ascot.

Oberlender, G. D. (1993). *Project management for engineering and construction.* McGraw-Hili, Inc., New York, N.Y.

Ojasalo, J. (1999)., *"Quality dynamics in professional services"*, Publications of the Swedish School of Economics and Business Administration, Nr 76. Helsinki.

"*Quality in the constructed project"*, (1988), ASCE, New York, N.

"Quality performance management system: A blueprint for implementation", (1990), Cll Publ. 19-3, Construction Industry Institute, University of Texas at Austin, Tex.

Rockart, J. F., (1982), *"The changing role of the information systems executive: A critical success factors perspective"*, Sloan Mgmt. Review, 24(1), 3-1

Rowlinson, S.M & Walker, A., (1995), "*The Construction Industry in Hong Kong",* (Hong Kong, Longman).

R. Thomas, Marton Marosszeky, Khalid Karim, S. Davis and D. McGeorge, (2002), *"The Importance of Project Culture in Achieving Quality Outcomes in Construction",* Proceedings IGLC-10, Aug. 2002, Gramado, Brazil

Sami Kärnä, Juha Matti Junnonen and Jouko Kankainen, *"Customer Satisfaction in Construction"*, Construction Economics and Management, Helsinki University of Technology, 2004, Finland

Sami Kärnä, (2004), *"Analyzing Customer Satisfaction and Quality in Construction – The Case of Public and Private Customers"*, Nordic Journal of Surveying and Real Estate Research, Special Series, Vol. 2 (2004)

Sommerville, J., (1994), *"Multivariate barriers to total quality management within the construction industry"*, Total Quality Management, 5, pp. 289 ± 98.

Torbica Z.M. and Stroh R.C., (2001), *"Customer Satisfaction in Home Building"*, Journal of Construction Engineering and Management, Jan/Feb, pp. 82-86.

Tribus, M., (1991), *"Deming's Way"*, DCQ Forum, 1(1), 11-17.

Tuman, J., Jr. (1986). "Success modeling: A technique for building a winning project team." 1986 *Proc*, Project Management Institute, Montreal, Canada, 29-34.

Walker, D.H.T., (1994), *"An investigation into factors that determine building construction time performance"*, PhD thesis, Royal Melbourne Institute of Technology, Melbourne.

Walters, W. (1992), *"The road to quality ± getting started"*, Chartered Builder, Chartered Institute of Building, May, pp. 16-17.

Yasamis, F., Arditi, D. and Mohammadi, J., (2002), *"Assessing contractor quality performance"*, Construction Management and Economics. 20, pp. 211-223.

Yates, J.K. and Aniftos, S., (1997), *"International standards and construction"*, Journal of Construction Engineering and Management, Vol. 123 No. 2, June.

Appendix – I

SURVEY QUESTIONNAIRE *(Before Pilot Survey)*

FACTORS AFFECTING CONSTRUCTION QUALITY

In order to analyze the factors affecting construction quality in ERRA projects, a survey is being conducted. Your valuable contribution will go long way in establishing bench mark for good engineering practices in construction industry.

Section – I: Personal Information

Name		Designation		
Working with	Client ☐ Name *(optional)*: _ _ _ _ _ _ _	Consultant ☐ Name *(optional)*: _ _ _ _ _ _ _ _ _	Contractor ☐ Name *(optional)*: _ _ _ _ _ _ _ _ _ _ _ _ _ _	
Experience in Construction Industry (years)	1 – 5 ☐	6 – 10 ☐	11 – 15 ☐	16 – 20 ☐	21 and Above ☐
Qualification	Masters ☐	Bachelors ☐	Diploma ☐	Others ☐ Specify:_ _ _ _ _ _ _ _

Section – II: Contributing Factors

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
Client's Related Contributing Factors:						
1	Improper/ineffective monitoring system					
2	Insufficient workforce at field level					
3	Inexperienced and					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	nontechnical staff also appointed at field level					
4	Lack of power/authority to stop the faulty work					
5	Issuance of work order prior land acquisition from the Government					
6	Lack of capacity to review the technical documents					
7	Awarding contracts to financially strong but technically weak contractors					
8	Slow process of land acquisition, later making it difficult for the contractors to meet deadlines					
9	Awarding contracts on very high rates, discouraging financially weak but technically strong contractors					
Consultant's Related Contributing Factors:						
10	Mistakes/discrepancies in design documents					
11	Gaps/flaws in inspection, testing and approval of works					
12	Lack of experts at field level for technical guidance					
13	Lack of consultant's experience in handling					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	such a huge scope of work					
Contractor's Related Contributing Factors:						
14	Inadequate planning and scheduling of projects					
15	Non availability of skilled labor					
16	Inadequate site supervision and management					
17	Lack of experienced contractors					
18	Insufficient workforce for execution of projects					
19	Discouraging/not allowing outsider/experienced contractors by local contractors					
20	Contractors hesitant in using quality construction materials due to heavy costs of transportation involved					
21	Contractors undertaking work beyond their capacity					
Miscellaneous Factors:						
22	Lack of professional construction skills and tools					
23	Shortage of technical and skilled labor to manage such a large scope of work					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
24	Shortage of funds and stoppage in its smooth flow					
25	Change in policies and rules with change in command					

Appendix – II

SURVEY QUESTIONNAIRE *(After Pilot Survey)*

FACTORS AFFECTING CONSTRUCTION QUALITY

In order to analyze the factors affecting construction quality in ERRA projects, a survey is being conducted. Your valuable contribution will go long way in establishing bench mark for good engineering practices in construction industry.

Section – I: Personal Information

Name		Designation		
Working with	Client ☐ Name *(optional)*: _ _ _ _ _ _ _	Consultant ☐ Name *(optional)*: _ _ _ _ _ _ _ _ _	Contractor ☐ Name *(optional)*: _ _ _ _ _ _ _ _ _ _ _ _ _ _	
Experience in Construction Industry (years)	1 – 5 ☐	6 – 10 ☐	11 – 15 ☐	16 – 20 ☐	21 and Above ☐
Qualification	Masters ☐	Bachelors ☐	Diploma ☐	Others ☐ Specify:_ _ _ _ _ _ _ _

Section – II: Contributing Factors

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low ⟶ High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
1	Improper/ineffective monitoring system in place to properly address quality issues					
2	Insufficient workforce at field level w.r.t project					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	scope					
3	Inexperienced and nontechnical staff also appointed at field level for projects execution					
4	Lack of power/authority to stop the faulty work on site by the concerned stakeholders					
5	Grouping of small projects into large packages adversely affecting the projects quality					
6	Issuance of work order prior land acquisition from the Government putting contractor in a difficult situation for timely delivery of a quality project					
7	Lack of capacity to review the technical documents by client					
8	Awarding contracts to financially strong but technically weak contractors					
9	Slow process of land acquisition, later making it difficult for the contractors to meet deadlines and also maintaining quality					
10	Awarding contracts on very high rates,					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	discouraging financially weak but technically strong contractors					
11	Initial preparation of technical documents done without ground survey later causing difficulties in execution stage					
12	Mistakes/discrepancies in design documents by the concerned stakeholder					
13	Gaps/flaws in inspection, testing and approval of works by concerned stakeholders					
14	Lack of experts at field level for technical guidance at respective stakeholders' level					
15	Lack of consultant's experience in handling such a huge scope of work					
16	Inadequate planning and scheduling of projects by contractors					
17	Non availability of skilled labor for ensuring quality					
18	Inadequate site supervision and management by contractors					
19	Lack of experienced					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	contractors to deliver quality work					
20	Insufficient workforce for successful and proper execution of projects					
21	Excessive subletting of projects to weak contractors					
22	Discouraging/not allowing outsider/experienced contractors by local contractors for their own benefit					
23	Contractors hesitant in using quality construction materials due to heavy costs of transportation involved					
24	Contractors undertaking work beyond their capacity without foreseeing the actual scope of work and resources required					
25	Lack of professional construction skills and tools at contractors' level					
26	Bad weather conditions in the working area					
27	Shortage of technical and skilled labor to professionally and successfully manage					

Sr. #	Factors	Importance Level *Please tick the appropriate box as per your opinion from:* (Low → High)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
	such a large scope of work					
28	Lack of coordination between stakeholders at field level					
29	Shortage of funds and stoppage in its smooth flow					
30	Change in policies and rules with change in command					