

**School of Civil and Environmental Engineering
Addis Ababa Institute of Technology
Addis Ababa University**



**Assessment of Quality Management Practices of Ethiopian Contractors
Focused on Building Construction Projects**

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School of Civil and Environmental Engineering
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Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university. All sources of materials used for this thesis have been duly acknowledged.

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Abstract

Quality Management has increasingly been adopted by construction companies as an initiative to solve quality problems and to meet the needs of the final customer. This research deals with the assessment of quality Management practices of Ethiopian contractors focusing on building construction projects and with emphasis on grade one contractors registered in Addis Ababa and renew their licenses. The objectives of the research were to investigate how the concept of quality and quality management is adopted in the construction process, to identify the major factors that are mostly affecting the quality of building construction during the construction phase and to propose measures for effective quality management practice.

Different literatures were assessed to show the concept of quality and quality management in the construction industry and the factors that affect quality management practices. Those issues were also assessed in Ethiopia situation by using interview and questionnaire. The interview was conducted with different professionals in order to help the questionnaire design. The questionnaire survey was performed on different selected Ethiopian contractors to assess their practices.

The research finding indicated that most respondents were familiar with the concepts of quality and quality management but its application was relatively low. Several authors also pointed out that most of the hindrances to the application of quality management practices are lack of information in the area. Further to this, different success factors are identified for the success of quality management practices.

Keywords: Construction industry, Execution stage, Practices, Quality management, Success factors.

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Abbreviations

ISO	International Organization for Standardization
PM	Project management
QA	Quality Assurance
QC	Quality Control
QIP	Quality Improvement program
QMP	Quality Management Practice
QMS	Quality Management System
QS	Quality System
RII	Relative Important Index
TQM	Total Quality Management

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Research background

Quality is one of the critical factors in the success of construction projects. Quality of construction projects, as well as project success, can be regarded as the fulfillment of expectations (i.e. the satisfaction) of the project participants (i.e. client, multi-disciplinary construction consultants and building contractor). The construction industry in Ethiopia has been struggling with quality issues for many years. A significant amount of the budget is spent each year on infrastructure and other development projects. Since the quality outcomes of the projects are not according to the required standards this leads to faulty construction. Consequently additional investments are required for removal of defects and maintenance work. A construction project in its life span goes through different phases. The main phases of a project can be described as: conceptual planning, feasibility study, design, procurement, construction, acceptance, operation and maintenance.

The concept of quality management is to ensure efforts to achieve the required level of quality for the product which are well planned and organized. From the perspective of a construction company, quality management in construction projects should mean maintaining the quality of construction works at the required standard so as to obtain customers' satisfaction that would bring long term competitiveness and business survival for the companies.

Quality management is critically required for a construction company to sustain in current construction market which is highly challenging and competitive. Quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a company. The role of quality management for a

construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the company.

1.2 Research problem

The research problem in this thesis is to analyze the construction sector's activities regarding quality by using existing quality management systems. With inefficient or nonexistent quality management procedures, significant expenditures of time, money, and resources are wasted on construction projects. In addition, the lack of quality due to deficient construction quality management is detected through non-conformance to established requirements. In construction, non-conformance occurs when the finished state of a project and its components deviates from the established requirements. Non-conformance also occurs because of time and cost of a project if it's not managed properly. Quality-related problems during construction can be projected on the operating life of the finished project. To a contractor, non-conformance can yield penalties as well as cost time burdens for re-work, which can convert into productivity loss.

According to ISO 9000:2015 Conformity is the "fulfillment of a requirement". To conform means to meet or comply with requirements and a requirement is a need, expectation, or obligation. There are many types of requirements including customer requirements, quality requirements, quality management requirements, management requirements, product requirements, service requirements, contractual requirements, statutory requirements, and regulatory requirements.

During the last some years the construction industry has been heavily criticized for its performance and productivity in relation to other industries. With the turn of the new millennium (2000 E.C), it appears that the construction industry is going through an intense period of looking inward which is exacerbated by increased technological and social change. These changes are altering the tempo of the environment within which construction operates. Now a day building collapse in Ethiopia has become so alarming.

According to Abebe Dinku (2016), the collapses of a five-storey building in Addis Ababa were not new in Ethiopia. There were similar collapses that occurred in Ethiopia like a three-storey

building in Gonder; three –storey building in Hawassa; and a four-storey building in Wolayta in the past couple of years. And he suggested the most important elements for high quality in the construction industry are active participation of all stakeholders like client, contractor, consultant, financiers and so on.

The aforementioned study and reports clearly demonstrates the value of quality on the performance of a building/structure. It is against this background that this study seeks to identify the effect of quality on the performance of a project and offer some recommendations where appropriate.

1.3 Research objectives

The objectives of this paper are to study the quality management practices of Ethiopian contractors particularly in Addis Ababa. In order to achieve the study objectives, some objectives have been established as follow:

- ❖ To investigate how the concept of quality and quality management are adopted in the building construction projects.
- ❖ To identify the main objectives of using quality management system.
- ❖ To identify the factors that are mostly affecting the quality of building construction during the construction phase;
- ❖ To propose measures for effective quality management practices in Ethiopia building construction.

1.4 Research scope

The thesis intends to assess the quality management practices of grade one Ethiopian contractors limited to Addis Ababa city only. The main reasons beyond these limitations are the numbers of contractors in the country are a lot, so it's very important to take representatives sample to assess in short time.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

For more than two decades “quality” and “quality management systems” have been leading buzzwords in the business world. Numerous consultants have built their careers around these topics, and quality issues in business have been responsible for the development of new organizations and even industries, for instance, the American Society for Quality and Six Sigma consulting. The notion of quality in business focuses on the savings and additional revenue that organizations can realize if they eliminate errors throughout their operations and produce products and service at the optimal level of quality desired by their customers. Errors can take almost any form for example, producing the wrong number of parts, sending bank statements to customers who have already closed their accounts or sending an incorrect bill to a client. All of these errors are very common, and the costs incurred seem minimal. But over time when mistakes are repeated the costs add up to a significant amount, so eliminating errors can result in significant increases to the bottom line of a business.

2.2 Characteristics of the construction industry

Construction works are carried out in the form of project. Projects are becoming progressively larger and more complex in terms of physical size and cost. In the modern world, the execution of a project requires the management of scarce resources; manpower, material, money, and machines to be managed throughout the life of the project – from conception to completion.

Construction work requires different trades and knowledge but the management, scheduling, and control of those projects utilize the same tools and techniques, and are subject to constraints of time, cost, and quality. There are also unique characteristics of project, which differ from routine operations. Construction projects have five distinctive objectives to be managed: scope, organization, quality, cost and time as presented by Syed M. Ahmed, as shown in Figure 2.1.

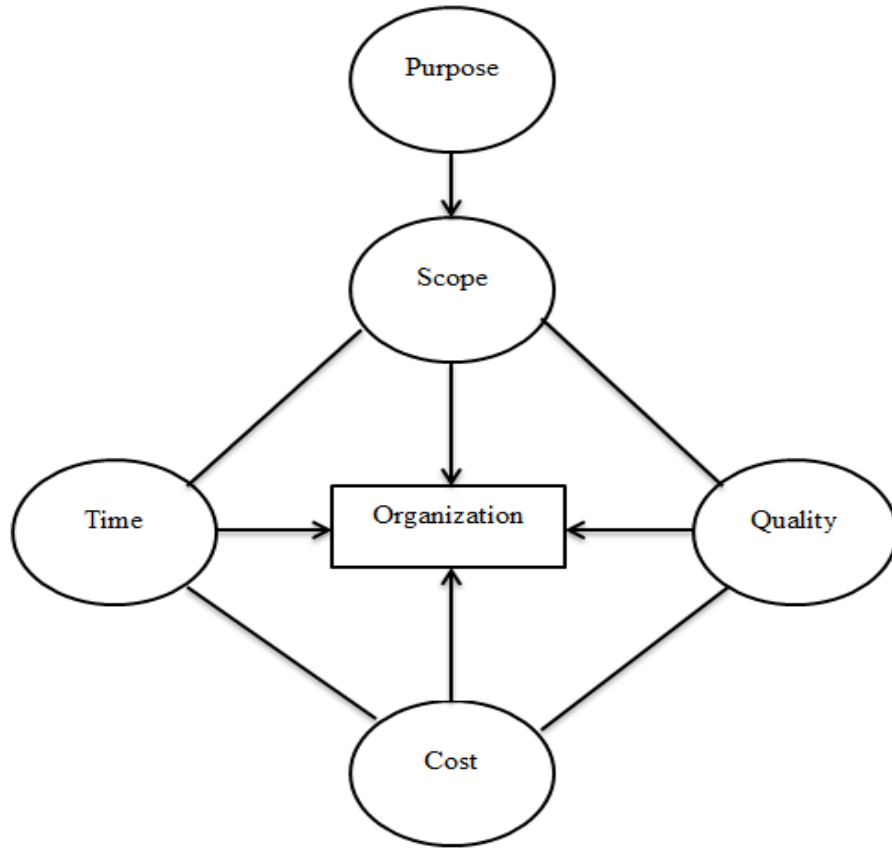


Figure 2. 1 The five objectives of project (Syed M. Ahmed,2016)

2.3 Overview of quality and quality management

2.3.1 Quality definition

Quality may mean different things to different people. Some take it to represent customer satisfaction, others interpret it as compliance with contractual requirements, yet others equate it to attainment of prescribed standards. The International Organization for Standardization (ISO) formally defines quality as the ‘totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs’ (ISO, 1994a). Dr J.M.Juran, an international authority in quality management, perceives quality simply as ‘fitness for purpose’. Indeed, a product befitting its intended purpose would satisfy the user’s needs and expectations. The crucial point lies in making the purpose clear to all parties involved in the design and production (Chung H.W., 1999).

In the context of quality management, quality is not an expression of excellence in a comparative sense. It is just an abbreviation for ‘desired quality’ that should be laid down as explicitly as possible. The supplier (producer), on the one hand, endeavors to attain the desired quality at optimum cost while the customer, on the other hand, requires confidence in the producer’s ability to deliver and consistently maintain that quality (Chung H.W., 1999).

According to Chung H.W. (1999), Quality of construction is even more difficult to define. First of all, the product is usually not a repetitive unit but a unique piece of work with specific characteristics. Taking building construction as an example, the product can be an entire building, a section of a building or just a prefabricated component that ultimately forms part of a building. Secondly, the needs to be satisfied include not only those of the client but also the expectations of the community into which the completed building will integrate. The construction cost and time of delivery are also important characteristics of quality. All these should be properly addressed in designing the building, and the outcome should be expressed unequivocally in drawings and specifications.

According to the American Society for Quality, “quality” can be defined in the following ways:

- ❖ The ability of a product/service to satisfy stated or implied needs.
- ❖ A product or service free of deficiencies.

The definitions of quality now are not different from the previous definition of quality. Those definitions are taken from previous gurus about quality.

The quality of building work is difficult, and often impossible, to quantify since a lot of construction practices cannot be assessed in numerical terms. The framework of reference is commonly the appearance of the final product. In fact, a building is of good quality if it will function as intended for its design life. As the true quality of the building will not be revealed until many years after completion, the notion of quality can be interpreted in terms of the design attribute (i.e. having an attribute like clear and complete information, detail specification, clear construction method, considering safety, and so forth). So far as the builder is concerned, it is fair to judge the quality of his work by the degree of compliance with stipulations in the contract, not only the technical specifications but also the contract sum and the contract period. His client cannot be satisfied if the construction is not executed as specified, within budget and on time.

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Therefore, a quality product of building construction is one that meets all contractual requirements (including statutory regulations) at specified budget and on time. The building process and quality relations are described as shown in Table 2.1.

Table 2.1 Building process and quality (Chung H.W. 1999)

Process	Derives from
1. Quality of design	<ul style="list-style-type: none"> • Reliability of initial brief • Reliability of all information used as basis of the design, and selection of products. • Reliability of design solution and detailed specification • Reliability of estimates of quantities of materials and labours required and their costs, of management and site overheads, and predictions of possible contingencies. • Reliability of calculations relating costs to benefits, including tangibles like economies in energy consumption • Experience of designer in judging whether estimate of total cost of project is realistic, and will meet requirements of client
2. Quality of construction	<ul style="list-style-type: none"> • Reliability of organization, procedures and skills of builder to interpret the design, marshal required resources and provide the end product in accordance with design and specification, and at contracted price. • A workforce of appropriate skills • Products of specified quality
3. Quality of products	<ul style="list-style-type: none"> • Reliability of all the materials, products, components and equipment supplied to the site, and their handling, storage and protection on site.
4. Quality of building in use	<ul style="list-style-type: none"> • Reliability of commissioning of installations and inspection of work on handing over, and making any corrections required. • Reliability of the maintenance program • Reliability of management of building in use, including assurance that any alteration to building or modification to installations will not impair performance or quality achieved.

According to Barbara J. Jackson (2010), the quality of the project is defined by the standards set forth in the specifications. Quality clearly impacts project cost. The specifications stipulate what materials to use and equipment to install. There are grades of performance, durability, and aesthetics associated with every construction product. A project that specifies minimum

standards for the products and equipment to be installed will cost less than a project that includes several high-end materials and installations.

2.3.2 Quality planning

Planning quality management is the process of identifying quality requirements and/or standards for the project and its deliverables, and documenting how the project will demonstrate compliance with relevant quality requirements. The key benefit of this process is that it provides guidance and direction on how quality will be managed and validated throughout the project.

Quality planning should be performed in parallel with the other planning processes. For example, proposed changes in the deliverables to meet identified quality standards may require cost or schedule adjustments and a detailed risk analysis of the impact to plans (PMBOK Guide, 2013).

The Project Management Book of Knowledge also addressed quality planning from a different position to enhance the thoughts earlier expressed. It said that quality planning has a process input generated by predecessor processes referred to as the project scope statement and project management plan. These processes are introduced by external units like enterprise environmental factors and organizational process assets. Further defined quality planning as the process for "identifying which quality standards are relevant to a project and determining how to satisfy them": In other words, it means planning how to fulfill process and product (deliverable) quality requirements: "Quality is the degree to which a set of inherent characteristics fulfill requirements". By planning the quality one has to respect some principles, and these are:

- ❖ **Customer's (i.e. client or its representative) satisfaction comes first:** Quality is defined by the requirements of the client (i.e. Client or his representative who have enough knowledge about the requirements).
- ❖ **Prevention over inspection:** It's better to avoid mistakes than to inspect the result and repair the defects.
- ❖ **Management responsibility:** Costs of quality must be approved by the management.
- ❖ **Continuous improvement:** Becoming better is an iteratively structured process.

2.3.3 Quality assurance

Despite the wealth of site experience accumulated throughout the decades, one in ten building contracts still leads to client dissatisfaction and complaint against the contractor. A survey conducted by the Building Research Establishment in the United Kingdom indicates that 40% of building defects occur during the construction phase (BRE, 1982) as cited in Chung H.W., (1999). In most cases, the defects are found to be the result of:

- ❖ misinterpretation of drawings and specifications;
- ❖ use of superseded drawings and specifications;
- ❖ poor communication with the architect/engineer, subcontractors and material suppliers;
- ❖ poor coordination of subcontracted work;
- ❖ ambiguous instructions or unqualified operators;
- ❖ Inadequate supervision and verification on site.

It is obvious that defects arising in construction are mostly caused by poor management and communication. It is not right to assume that mistakes appearing on site are actually made on site. These mistakes may be traced back to the purchase of incorrect or incompatible materials and the failure to retrieve the out-dated drawings (Kettlewell, 1990). In other words, site problems can be the consequence of negligence or malpractice in the head office.

Consistent quality can only be achieved when such avoidable mistakes are avoided in the first instance. Preventive measures must be taken to minimize the risk of managerial and communication problems. This is the basic concept of quality assurance, (Chung H.W., 1999).

The performance of an individual in an organization could directly or indirectly affect the quality of the finished product. Responsibility for quality therefore stretches from the chief executive right down to the person-on-the-job. If consistent quality is to be assured, all staff in the organization, both in the head office and on site, must:

To practice quality assurance, an organization has to establish and maintain a quality management system (usually abbreviated to quality system) in its day-to-day operation. A quality system contains, among other things, a set of documented procedures for the various processes carried out by the organization. Implementing a quality management system does not replace the existing quality control functions, nor does it result in more inspection and testing; it just ensures that the appropriate type and amount of verification is performed when and where it is planned to be done. In other word quality management system does not add or replace the existing QA/QC in the company just it ensures the works are done according to the planned. In fact, a quality system embraces quality control as its technical arm. This is why a quality management system is sometimes referred to as a QA/QC program.

In short, quality assurance is oriented towards prevention of quality deficiencies. It aims at minimizing the risk of making mistakes in the first place, thereby avoiding the necessity for rework, repair or reject (Teklebrhan Kidanu, 2014).

Evaluating overall project perform on a regular basis to provide confidence that the project will satisfy the relevant quality standards. (Lakshmi R., 2016).

1. INPUTS

Quality management plan, result of quality control measurements, operational definitions

2. TOOLS AND TECH.

Quality planning tools and techniques, quality audits

3. OUTPUTS

Quality improvement

2.3.4 Quality assurance for construction

In the construction industry, quality assurance was first adopted in nuclear installation and offshore works mainly for safety and reliability reasons. Spread of the concepts to conventional types of construction has been gradual but slow. This is because the product of construction is in a sense always unique, unlike consumer goods which are repetitive in nature. The processes of construction involve a variety of professionals and tradesmen with a wide range of skills and level of education. The environment where these processes are carried out is often exposed to

aggressive elements. Under such conditions, it is arguable whether the procedures can be standardized at all. Some contractors even think that trying to do so merely implants another layer of bureaucracy in the organization.

Despite the diversity of work handled by a construction company, the corporate procedures apply to all projects in varying degrees. Typical examples are tendering, procurement, document control and record keeping. A quality system may be set up to standardize these corporate procedures, with provision for preparation of a quality plan to cover the characteristics and specific requirements of a particular project.

It is unfortunate that adoption of quality assurance in the construction industry has been mainly client-led. Realizing that enforcement of the contract in law cannot undo any damage already done, a progressive client, when awarding a contract, tends to take into account the contractor's capability to 'do it right first time, every time' the underlying philosophy of quality assurance. There is a general movement towards making the implementation of a quality system a contractual requirement. Many government bodies responsible for public works and housing have begun to insist on an effective (or even certified) quality system as prerequisite for tendering. Public utilities companies are doing the same thing. Private developers with major projects in planning will follow suit. The basis of competition for business will shift from 'price only' to a combination of price and quality. If a contractor does not want to be excluded from bidding for available work, he should wait no more in establishing a quality system in his organization. Even if such external pressure is not on at the moment, he will be fighting a losing battle against his competitors who have enhanced their productivity through better quality management (Chung H.W., 1999). An analysis of seven building projects of various sizes in Australia has demonstrated that 'quality does not cost it pays' (Roberts, 1991). Figure 2.2 shows the results of the analysis; the quality related costs are expressed as percentages of the total construction cost.

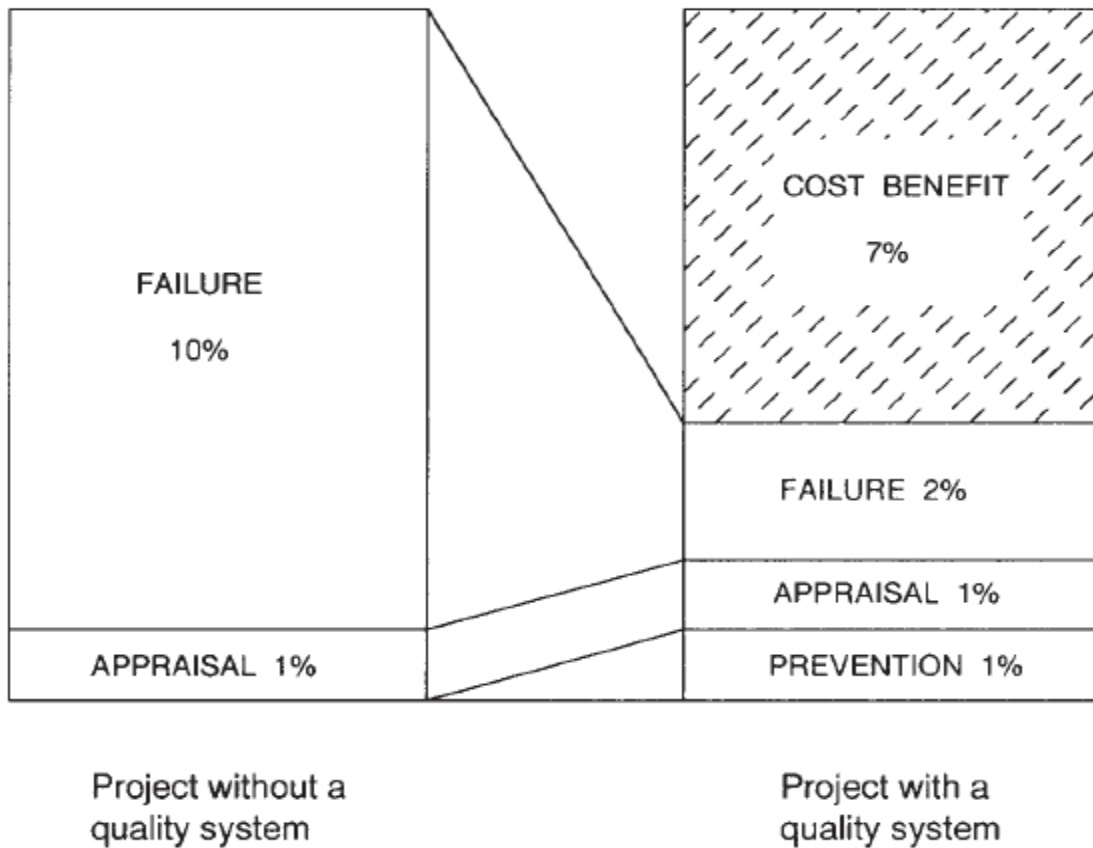


Figure 2. 2 Implementation of quality management (Roberts, 1991) cited at Chung H.W., (1999)

Through the implementation of a proactive quality system that costs about 1% of the project value (the prevention cost), the expenditure as a result of repair etc. (the failure cost) drops from 10% to 2%, representing a saving of 7%. The economic benefit of preventive measures is obvious (Chung H.W., 1999). Although there is cost to apply quality system, this results in less rework toward the end of the project. So, the impact of improved quality on project cost results in less reworks and also saves failure cost.

2.3.5 Quality control

Monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfied performance. Contract documents comprise a clear, complete, and accurate description of the facility to be constructed, correctly conveying the intent of the owner regarding the characteristics of the facility needed to serve his or her purposes. The contract documents define a constructed facility considered acceptable under the applicable regulatory codes and standards of professional practice, in terms of its reliability, the

ease with which maintenance and repairs can be performed, the durability of its materials and operating systems, and the life safety provided to its users. The facility is constructed in accordance with those documents (Lakshmi R., 2016).

1. INPUTS

Work results, quality management plan, operational definitions, checklists

2- TOOLS AND TECH.

Inspection, control charts, pareto diagrams, statistical sampling, flow charting, trend analysis

3- OUTPUTS

Quality improvement, acceptance decisions, rework, completed checklist process adjustment

Quality control refers to the activities that are carried out on the production line to prevent or eliminate causes of unsatisfactory performance. In the manufacturing industry, including production of ready-mixed concrete and fabrication of precast units, the major functions of quality control are control of incoming materials, monitoring of production processes and testing of the finished product. Before production is commenced, an assessment is made of the minimum quality needed to satisfy the stated requirements and how that quality can be consistently achieved. An example is establishing the target mean strength of concrete on the basis of the specified characteristic strength and the estimated variability. During production, the strength of the concrete is continuously monitored via routine testing and statistical analysis of the test results, so as to detect at the earliest possible moment when either the mean strength or the variability of strength shows a significant change.

The control mechanism then goes on to rectify the detected change, thereby preventing a potential problem from developing into a real one. Very rigid rules for production control may be combined with lenient criteria of acceptance and trivial consequences of noncompliance. Alternatively the producer may be given greater freedom in production, but stringent acceptance criteria are set and severe penalties for noncompliance are imposed. Within the spectrum of possible combinations of production control and acceptance control, there will be an optimum that is the most economical to operate.

In the building industry, it is traditional practice to have separate contracts for design and construction, with the designer also taking up the role of supervision of construction. The quality of the finished works is controlled by way of inspection and testing as construction proceeds. For example, the quality of concrete and other materials on site is judged by random sampling and testing, and a thorough inspection of the finished works is performed without exception before final acceptance. The major drawback of this ‘inspectorial system’ of quality control is that it identifies the mistakes after the event. Even high strength concrete can be defective if it is not properly compacted and cured, and the potential hazard of steel corrosion will not surface until some years later. Many building defects are covered up during subsequent construction and consequently the quality of the finished works cannot be assessed by final inspection. Unlike consumer goods, defective building work is very difficult, if not impossible, to replace. The client is often left with the patched-up original which will be a source of recurrent trouble and huge expenditure in the years to come. Regular supervision by the contractor’s staff themselves is undoubtedly the key to quality.

There are, however, commercial and organizational pressures that often favour speed at the expense of quality. Sometimes poor workmanship is condoned to keep up with expected productivity or just labour. To show commitment to quality, senior management of the company must therefore provide adequate resources on site to avoid anybody cutting corners. Furthermore, a comprehensive record of in process inspection is essential to ensure that the intended verification is actually done. The extra efforts are managerial in nature and complementary to the operational techniques of quality control in assuring the quality of the product (Chung H.W., 1999).

The required documentation of a quality system ties in closely with the basic functions as aforesaid. The top management’s commitment to quality is expressed in a quality policy statement. The quality policy is incorporated and expanded in a quality manual which sets out what management requires its staff to do to assure quality. How it is to be done is detailed in a number of quality procedures and work instructions. What is actually done is evidenced in the various written records. The hierarchies of quality system documents are portrayed as a pyramid as shown in Figure 2.3 below:

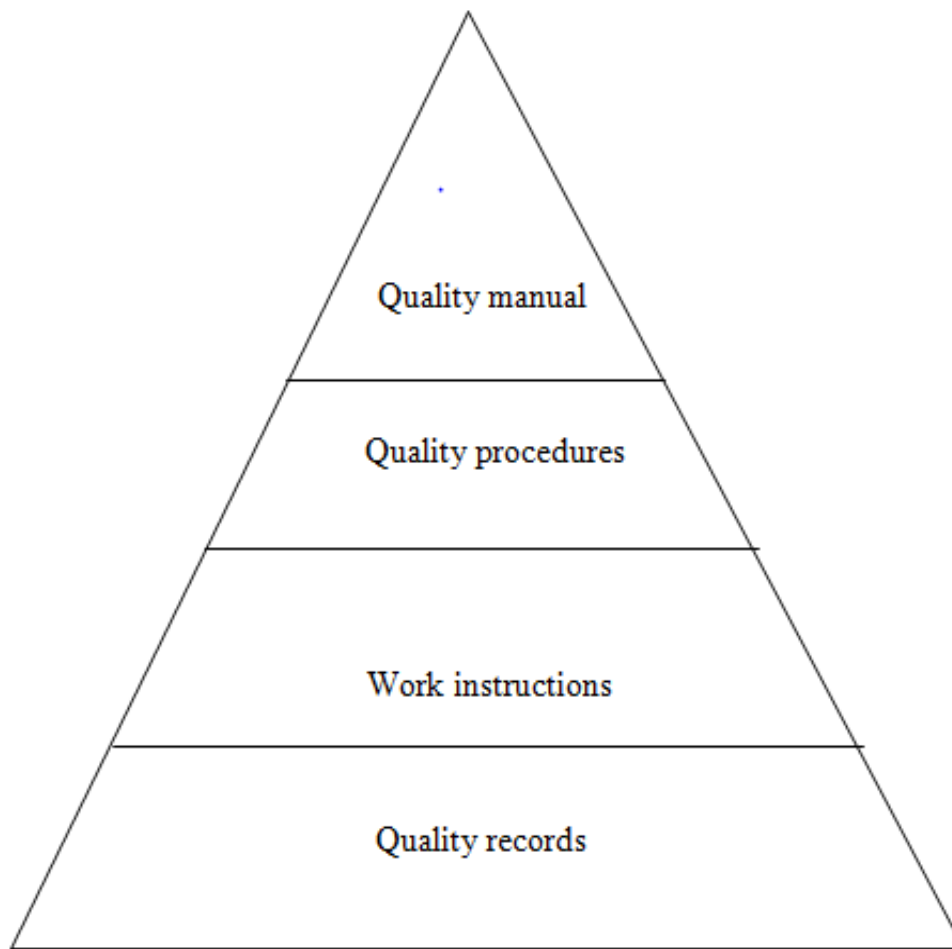


Figure 2. 3 Pyramid of quality system documents (Chung H.W., 1999)

2.4 Quality management systems

According to department of trade and industry A QMS can be defined as: *“A set of co-ordinated activities to direct and control an organization in order to continually improve the effectiveness and efficiency of its performance.”* These activities interact and are affected by being in the system, so the isolation and study of each one in detail will not necessarily lead to an understanding of the system as a whole. The main thrust of a QMS is in defining the processes, which will result in the production of quality products and services, rather than in detecting defective products or services after they have been produced.

Quality Management systems are needed in all areas of activity. A good QMS will Set direction and meet customers' expectations, Improve process control, Reduce wastage, Lower costs, Increase market share, Facilitate training, Involve staff, Raise morale etc.

According to department of trade and industry in UK a fully documented QMS will ensure that two important requirements are met:-

- ❖ The customers' requirements – confidence in the ability of the organization to deliver the desired product and service consistently meeting their needs and expectations.
- ❖ The organization's requirements – both internally and externally, and at an optimum cost with efficient use of the available resources – materials, human, technology and information.

2.5 Total quality management in construction industry

The development of the TQM concept originally took place in the manufacturing industry. Thus, most literature addresses that industry and this gives the misleading impression that the TQM concept cannot be applied to any industry other than manufacturing. One of the main principles of the TQM concept is to achieve customer satisfaction and this is an important objective for any organization, including construction firms. However, the implementation of TQM might differ from one industry to another. The construction industry differs from the manufacturing in such a way that makes introducing TQM more challenging. While the manufacturing industry is characterized by steady-state processes, the construction industry is usually a onetime process (uniqueness). Construction industry is also unique in the following ways: (1) the mobility of staff; (2) diversity in the types, forms, and shapes of construction projects; (3) geographical dispersion; (4) the contractual relationships; (5) frequent prototyping of projects; and (6) the subtle forms of waste that often go unnoticed.

The construction industry has tended to confuse TQM with quality control (QC) and quality assurance (QA), believing that compliance with QA standards such as ISO 9001 and 9002 is all that there is to the application of TQM on construction projects (Jaafari, 2001). This confusion has led to the use of these expressions interchangeably. QA and QC may be considered as

separate and related sub-elements of total quality (TQ). However, QA and QC do not represent the only elements of TQM, as it is a much more comprehensive and broader concept.

Quality assurance and quality control are two aspects of quality management. While some quality assurance and quality control activities are interrelated, the two are defined differently.

According to ISO 9000:2015: Quality management systems—Fundamentals and vocabulary:-

- ❖ **Quality assurance** consists of that “part of quality management focused on providing confidence that quality requirements will be fulfilled.” The confidence provided by quality assurance is twofold—internally to management and externally to customers, government agencies, regulators, certifiers, and third parties.
- ❖ **Quality control** is that “part of quality management focused on fulfilling quality requirements.” While quality assurance relates to how a process is performed or how a product is made, quality control is more the inspection aspect of quality management. Inspection is the process of measuring, examining, and testing to gauge one or more characteristics of a product or service and the comparison of these with specified requirements to determine conformity. Products, processes, and various other results can be inspected to make sure that the object coming off a production line, or the service being provided, is correct and meets specifications.

Differences between QC, QA and TQM are summarized as quality assurance is process oriented and focuses on defect prevention, while quality control is product oriented and focuses on defect identification. Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinements in response to continuous feedback.

QA and QC are applied during project implementation while TQM is a strategic philosophy adopted by an organization and implemented on a continuous basis, even if the organization is waiting to perform a new project. The TQ culture varies from one company to another and from one industry to another. However, the TQ culture, regardless of its differences, aims to achieve common objectives: namely, removal of waste, reduction of costs, improvement of reputation, and increased market share. As can be observed, TQ objectives are dynamic in their nature and

this dictates continued updating and upgrading (H. James Harrington, Frank Voehl, Hal Wiggin, 2012).

2.5.1 Critical success factors in TQM

TQM has gained widespread global acceptance. However, some have achieved remarkable success while others have suffered dismal failures. Many of the failures can be attributed to a misunderstanding of TQM or the way the organization had implemented TQM (Syed M. Ahmed, 2016).

2.5.1.1 Customer Focus

In the TQM philosophy, total customer satisfaction is the goal of entire system, and a pervasive customer focus is what gets us there. The function of the construction industry is to provide customers with facilities that meet their needs. For a company to remain in business this service must be provided at a competitive cost. TQM is a management philosophy that effectively determines the needs of the customer and provides the framework, environment, and culture for meeting those needs at the lowest possible cost. By ensuring quality at each stage in the construction process, and thereby minimizing costly rework, as well as other costs, the quality of the final products should satisfy the final customer.

By definition, customers may be either internal or external. The external customer is the consumer or client, in other words the end user of the products or services being offered. An internal customer is a second process or department within the organization, which depends on the product of the first. For example, for designers the products are plans and specifications, and the customers are the owner and the contractor responsible for the construction. For the contractor, the product is the completed facility, and the customer is the final user of the facility. There are also customers within the construction organization. These internal customers receive products and information from other groups of individuals within their organization. Thus, satisfying the needs of these internal customers is an essential part of the process of supplying the final external customer with a quality product.

Every party in a process has three roles: supplier, processor, and customer. Juran defined this as the triple role concept. These three roles are carried out at every level of the construction process. The designer is a customer of owner. The designer produces the design and supplies plans and

specifications to the contractor. Thus, the contractor is the designer's customer, who uses the designer's plan and specifications to carry out the construction process and supplies the completed facility to the owner. The owner supplies the requirements to the designer, receives the facility from the contractor, and is responsible for the facilities operation. This clearly illustrates that construction is a process, and that TQM principles that have been applied to other processes are potentially adaptable to the construction industry.

2.5.1.2 Process Improvement

A process is a way of getting things done. A process consists of the tasks, procedures and policies necessary to carry out an internal or external customer need. According to the TQM philosophy if the process is correct, so will be the end result (product). Thus the organization should work to improve the process so as to improve the end product or service. Three different approaches have emerged for improving the efficiency or effectiveness of a process. Continuous improvement is an approach used on an ongoing basis for incremental gains. Benchmarking should be used periodically, and reengineering can be launched occasionally to achieve dramatic breakthrough.

By focusing on process by measurement and analysis, a process can possibly be improved by changing five M's of the process namely man, machine, material, method and measurement. A strong emphasis in process improvement centers on measurement of variation, the control of variation, and the knowledge of variation to seek improvement. This analysis is referred to as statistical process control or statistical analysis. This is at the center of process improvement. The objective of measuring the variation in a process is to learn how to control the variation and also how to improve the process by viewing variation as a tool for improvement. The analysis of the positive side (good performance or quality) of the variation of process is referred as a "breakthrough improvement" or "breakthrough management" which is another key component of TQM. Arditi and Gunaydin (1997) cited at Syed M. Ahmed, (2016)

2.5.1.3 Continuous Improvements

The goal of continuous improvement is common to many managerial theories, however, what differentiates TQM is that it specifies a specific step-by-step process to achieve this. This process consists of nine steps as below: Identify the process, organize a multi-disciplinary team to study the process and recommend improvements, define areas where data is needed, collect data on the

process, analyze the collected data and brainstorm for improvement, determine recommendations and methods of implementation, implement the recommendations outlined in step six, collect new data on the process after the proposed changes have been implemented to verify their effectiveness, and circle back to step five and again analyze the data and brainstorm for further improvement.

The nine-step cycle emphasizes on: focusing on the progress, measuring the process, brainstorming for improvement and verification and re-measurement. These four elements are further illustrated in Deming's Plan-Do-Check-Action (PDCA) diagram as shown in Fig. 2.4. The PDCA diagram stresses removing the root cause of problems and continually establishing and revising new standards or goals (Deming 1990).

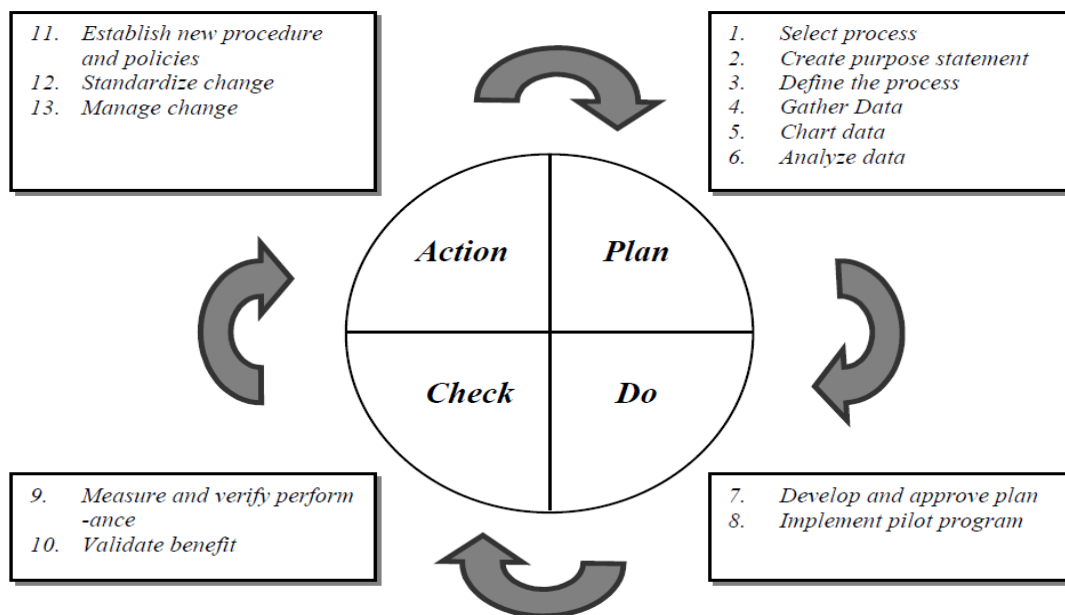


Figure 2. 4 The PDCA Diagram (Deming, 1990)

Under TQM, management in the construction industry has two functions: (1) To maintain and improve current methods and procedures through process control and (2) To direct efforts to achieve, through innovation, major technological advances in construction processes.

The incremental improvements of the process are achieved through process improvement and control. In every construction organization there are major processes by which all the work are accomplished. However, there are innumerable parts in the construction process. Through the use of flow diagrams, every process can be broken down into stages. Within each stage, input changes to output, and the methods and procedures directing the change of state (i.e. the

construction procedures) can be constantly improved to better satisfy the customer at the next stage. During each stage the employees should communicate closely with their supplier and customer to optimize the work process for that stage. This requires each employee to recognize their place in the process and their respective supplier and customer.

PDCA-cycle

An important mindset of quality management is the PDCA-cycle. This cycle including the four components as Plan, Do, Check and Act (PDCA), was originally conceived by Walter Shewhart in the 1930`s, and later adopted by W. Edward Deming. The model provides in general a framework for the improvement of a process or system and is an iterative four-step quality strategy cf. Deming, (1990) cited at Kaufmann, T., Wiltschko, T. (2006).

- ❖ **Plan:** Establish objectives and processes necessary to deliver results in accordance to specification
- ❖ **Do:** implementation of processes

- ❖ **Check:** Monitor and evaluate processes and results against objectives and specifications

- ❖ **Act:** Take actions to the outcome for necessary improvement (e.g. improve, standardize)

Total quality management mainly demands a process of continued improvement aimed at reducing variability. An organization wishing to support and develop such a process needs to use quality management tools and techniques. It is prudent to start with the more simple tools and techniques. These are check-sheet, check list, histogram, pareto diagram, cause-and-effect diagram (Fishbone Diagram), scatter chart and flowchart (Syed M. Ahmed, (2016).

- **Check-sheet:** - is used to record events, or non-events (non-conformances). They can also include information such as the position where the event occurred and any known causes. They are usually prepared in advance and are completed by those who are

carrying out the operations or monitoring their progress. The value of check-sheet can be retrospective analysis, so they help with problem identification and problem solving.

- **Checklist:** - is used to tell the user if there is a certain thing, which must be checked. As such, it can be used in the auditing of quality assurance and to follow the steps in a particular process.
- **Histogram:** - provides a graphical representation of the individual measured values in a data set according to the frequency of occurrence. It helps to visualize the distribution of data and there are several forms, which should be recognized, and in this way they reveal the amount of variation within a process. It should be well designed so that people who carry out the operation can easily use them.
- **Pareto Analysis:** - is a technique employed to prioritize the problems so that attention is initially focused on those, having the greatest effect. It was discovered by an Italian economist, named Vilfredo Pareto, who observed how the vast majority of wealth (80%) was owned by relatively few of the population (20%). As a generalized rule for considering solutions to problems, pareto analysis aims to identify the critical 20% of causes and to solve them as a priority.
- **Cause and Effect Diagram (Fishbone Diagram):**- was developed by Karo Ishikawa, is useful in breaking down the major causes of a particular problem. The shape of the diagram looks like the skeleton of a fish. This is because a process often has a multitude of tasks footing into it, any one of which may be a cause. If a problem occurs, it will have an effect on the process, so it will be necessary to consider the whole multitude of tasks when searching for a solution.

2.6 ISO 9001 standard

Quality control systems were originally developed from United Kingdom (UK) nuclear and military standards, and then rolled out as BS5750:1979 in the manufacturing industry. It was much later (in the 1980s and early 1990s) that the systems were adopted by UK construction companies to meet local and national government requirements for the construction industry, when companies were required to have certified quality systems in order to take up offered bidding opportunities (Thorpe and Sumner 2004).

The first series of ISO 9000 developed by the International Organization for Standardization-Technical Committees (ISO-TC 176) in 1987, was updated in 1994 and 2000, with the latest version of this standard being ISO 9001:2008. The 2008 version did not introduce any major changes relative to the 2000 version, and therefore does not require the re-writing of quality documents to suit the most recent version. The ISO 9001 standard is actually a generic one, which can be used successfully in construction companies and on their projects, even though every project is unique and involves different sub-contractors and suppliers.

The QMS, ISO 9001 standard is made up of five main clauses and 23 sub-clauses, each of which contains requirements that should be fully implemented to gain the potential benefits from the adoption of the system. There are 20 elements of ISO 9001 which are used as the basis of ISO 9001:1994. These elements have been replaced by five clauses for undertaking quality processing. However, the twenty elements are clearly identifiable within the process-based approach for implementing ISO 9001:2008. The twenty elements have been adapted for construction procedures to cover a wide scope of quality related activities of construction-related firms as QMS elements to meet construction organization and project conformity needs.

ISO 9001 is a standard that sets out the requirements for a quality management system. It helps businesses and organizations to be more efficient and improve customer satisfaction. A new version of the standard, ISO 9001:2015, has just been launched, replacing the previous version (ISO 9001:2008).

ISO standards are reviewed every five years and revised if needed. This helps ensure they remain useful tools for the marketplace. The challenges faced by business and organizations today are very different from a few decades ago and ISO 9001 has been updated to take this new environment into account. For example, increased globalization has changed the way we do business and organizations often operate more complex supply chains than they did in the past. In addition, there are increased expectations from customers and other interested parties and, with more access to information; today's wider society has a stronger voice than ever before. ISO 9001 needs to reflect these changes in order to remain relevant (moving from ISO 9001:2008 to ISO 9001:2015).

2.6.1 ISO QMS in Ethiopia construction industry

Now a day's ISO QMS expanded in Ethiopia because of different reasons according to Teklebrhan K., (2014) study on nine ISO certified contractors the main driving for to implement ISO are :-

- 1) **For marketing purposes and to enhance the reputation of the company**
- 2) **To ensure higher productivity**
- 3) **Because GTZ IS trained ISO 9001 for construction companies:** The respondents said that the training provided by GTZ IS has motivated them to implement QMS
- 4) **Customer requirements:** the respondents mentioned that it was mainly the University Capacity Building Program and ministry of education, as part of the capacity building program, were demanding certification or being on process to get certification as a requirement to participate in new university construction projects under the ministry of education. But other customers were not explicitly demanding ISO 9001 certification as a requirement.

According to Yimam Abadir, (2011) on the study of project management maturity in the construction industry of Ethiopia in the part of ISO certified contractors vs. non ISO certified contractors state ISO certified contractors have better PM and quality achievement than non ISO contractors. In his study of maturity of project quality management of Ethiopian grade 1 contractors identified that about 43% of the contractors perform little or no quality management; the other 24% perform only 2 out of 3 quality management processes that are expected to be performed to achieve the goal of project quality management. The rest 33% of the contractors perform quality management formally or at higher process maturity level.

Summary of the differences between ISO 9001 and TQM:-

1. ISO is Standardizations of activities and it needs audits to ensure compliance.
2. TQM is continuous improvement and it need Self-assessment to find opportunities for improvements
3. ISO is responsibility of quality (assurance) manager
4. TQM is responsibility & role of top management
5. ISO is Bureaucratic because of written down procedures & quality manual
6. TQM is culture orientation & high involvement of people

2.7 Cost of quality

Traditionally, the reporting of quality related costs had been limited to inspection and testing; other costs were accumulated in the overhead accounts. As the full range of quality-related costs began to be defined, a number of facts emerged:

1. Quality related costs are much larger than had been traditionally reported, generally in the range of 20 to 40% of revenues.
2. Quality related costs are not only related to manufacturing operations, but to ancillary services such as purchasing and customer service departments as well.
3. Most of the costs are result of poor quality and are avoidable.

The cost of quality was pioneered by Juran and he state that “quality issues need to convey in financial terms for executives to really understand and take notice”. Juran argued that traditionally firms did not focus sufficiently on investing in prevention and that quality costs can be significantly reduced by focusing more on this aspect (prevention costs).

The American Society for Quality Control (ASQC) divides the cost of quality into four separate categories (Evans and Lindsay, 1992):-

1. Prevention costs: costs incurred to prevent the occurrence of nonconformance in future.
2. Appraisal costs: costs incurred in measuring and controlling current production to assure conformance to requirements.
3. Internal failure costs: costs generated before a product is shipped as a result of nonconformance to requirements.
4. External failure costs: costs generated after a product is shipped as a result of nonconformance to requirements.

These cost categories allow the use of quality cost data for a variety of purposes. Quality costs can be used for measuring progress, analyzing problems, or budgeting. By analyzing the relative size of the cost categories, the company can determine if its resources are properly allocated. Quality costs are an important means for directing management action. They also can help management track the success of its quality improvement efforts. Ideally, the total cost of quality

will decline over time. Crosby recommends a 10 percent per year goal for reducing total cost of quality (Pyzdek and Berger, 1996).

The key to improving quality and profitability is prevention. A fundamental approach of total quality assurance is that an increase in prevention expenditures will generate larger savings in all other cost categories. Better prevention of poor quality will clearly reduce internal failure costs, since fewer defective items will be made. External failure costs will also be reduced. In addition, fewer appraisals will be required, since the products will be made correctly the first time. Table 2.2 shows a guide to some of the more commonly encountered quality cost elements (Pyzdek and Berger, 1996).

Table 2.2 Quality Cost Elements (Pyzdek and Berger, 1996)

No.	Category	Elements
1.	Prevention Costs	<ul style="list-style-type: none"> ❖ Quality planning ❖ Process control planning ❖ Design review ❖ Quality training ❖ Gage design
2.	Appraisal Costs	<ul style="list-style-type: none"> ❖ Receiving inspection ❖ Laboratory acceptance testing ❖ In-process inspection ❖ Quality audits ❖ Calibration
3.	Internal Failure Costs	<ul style="list-style-type: none"> ❖ Rework ❖ Scrap ❖ Process troubleshooting ❖ Material review and activity ❖ Re-inspection or retest
4.	External Failure Costs	<ul style="list-style-type: none"> ❖ Processing of customer complaints ❖ Unplanned field repair ❖ Recalls ❖ Processing of returned material ❖ Warranty

2.8 Principles of quality management

The quality management principles can be used by senior management as a framework to guide their organizations towards improved performance. These principles are not elements against which the organization can be directly assessed but their influence can be seen throughout the standard. They should be considered by any organization wishing to comply with the spirit. The eight quality management principles are organized as shown in Table 2.3 below:

Table 2.3 The eight quality management principles cited at (Teklebrhan, 2014)

Concept of the Quality management Principles	Key benefits of the quality management principle	Applying the quality management principle typically leads to:
<p>Principle 1: Customer focus Organizations depend on their customers & therefore should understand current & future customer needs, meet customer requirements & strive to exceed customer expectations.</p>	<ul style="list-style-type: none"> ❖ Increased revenue & market share obtained through flexible & fast responses to market opportunities. ❖ Increased effectiveness in the use of the organization's resources to enhance customer satisfaction. ❖ Improved customer loyalty leading to repeat business. 	<ul style="list-style-type: none"> ❖ Researching & understanding customer needs & expectations ❖ Ensuring that the objectives of the organization are linked to customer needs & expectations ❖ Communicating customer needs & expectations throughout the organization ❖ Measuring customer satisfaction & acting on the results etc.
<p>Principle 2: Leadership Leaders establish unity of purpose & direction of the organization. They should create & maintain the internal environment in which people can become fully involved in achieving the organization's objectives.</p>	<ul style="list-style-type: none"> ❖ People will understand & be motivated towards the organization's goals & objectives. ❖ Activities are evaluated, aligned and implemented in a unified way. ❖ Miscommunication between levels of an organization will be minimized. 	<ul style="list-style-type: none"> ❖ Considering the needs of all interested parties including customers, owners, employees, suppliers, financiers, local communities & society as a whole. ❖ Establishing a clear vision of the organization's future ❖ Creating and sustaining shared values, fairness and ethical role models at all levels of the organization ❖ Providing people with the required resources, training and freedom to act with responsibility & accountability ❖ Inspiring, encouraging & recognizing people's contributions.

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Concept of the Quality management Principles	Key benefits of the quality management principle	Applying the quality management principle typically leads to:
<p>Principle 3: Involvement of people People at all levels are the essence of an organization & their full involvement enables their abilities to be used for the organization's benefit.</p>	<ul style="list-style-type: none"> ❖ Motivated, committed and involved people within the organization. ❖ Innovation & creativity in furthering the organization's objectives. ❖ People being accountable for their own performance. ❖ People eager to participate in and contribute to continual improvement. 	<ul style="list-style-type: none"> ❖ People understanding the importance of their contribution & role in the organization. ❖ People identify constraints to their performance ❖ People accept ownership of problems & their responsibility for solving them ❖ People evaluating their performance against their personal goals & objectives ❖ People actively seeking opportunities to enhance their competence, knowledge and experience ❖ People freely sharing knowledge & experience, openly discuss problems & issues
<p>Principle 4: Process approach A desired result is achieved more efficiently when activities & related resources are managed as a process.</p>	<ul style="list-style-type: none"> ❖ Lower costs & shorter cycle times through effective use of resources. ❖ Improved, consistent & predictable results. ❖ Focused & prioritized improvement opportunities. 	<ul style="list-style-type: none"> ❖ Systematically defining the activities necessary to obtain a desired result ❖ Establishing clear responsibility & accountability for managing key activities ❖ Analyzing & measuring of the capability of key activities ❖ Focusing on the factors such as resources, methods & materials that will improve key activities of the organization ❖ Evaluating risks, consequences & impacts of activities on customers, suppliers & other interested parties

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Concept of the Quality management Principles	Key benefits of the quality management principle	Applying the quality management principle typically leads to:
<p>Principle 5: System approach to management Identifying, understanding & managing interrelated processes as a system, contributes to the organization's effectiveness & efficiency in achieving its objectives.</p>	<ul style="list-style-type: none"> ❖ Integration & alignment of the processes that will best achieve the desired results. ❖ Ability to focus on the key processes. ❖ Providing confidence to interested parties as to the consistency, effectiveness & efficiency of the organization. 	<ul style="list-style-type: none"> ❖ Structuring a system to achieve the organization's objectives in the most effective and efficient way ❖ Understanding the interdependencies between the processes of the system ❖ Structured approaches that harmonize & integrate processes ❖ Providing a better understanding of the roles & responsibilities necessary for achieving common objectives & thereby reducing cross-functional barriers ❖ Targeting & defining how specific activities within a system should operate ❖ Continually improving the system through measurement & evaluation
<p>Principle 6: Continual improvement Continual improvement of the organization's overall performance should be a permanent objective of the organization.</p>	<ul style="list-style-type: none"> ❖ Better performance through improved organizational capabilities. ❖ Alignment of improvement activities at all levels to an organization's strategic intent ❖ Flexibility to react quickly to opportunities. 	<ul style="list-style-type: none"> ❖ Employing a consistent organization wide approach to continual improvement of the organization's performance ❖ Providing people with training in the methods & tools of continual improvement ❖ Making continual improvement of products, processes & systems an objective for every individual in the organization ❖ Establishing goals to guide & measures to track continual improvement ❖ Recognizing & acknowledging improvements

Concept of the Quality management Principles	Key benefits of the quality management principle	Applying the quality management principle typically leads to:
<p>Principle 7: Factual approach to decision making Effective decisions are based on the analysis of data & information</p>	<ul style="list-style-type: none"> ❖ Informed decisions ❖ An increased ability to demonstrate the effectiveness of past decisions through reference to factual records. ❖ Increased ability to review, challenge & change opinions & decisions. 	<ul style="list-style-type: none"> ❖ Ensuring that data & information are sufficiently accurate & reliable ❖ Making data accessible to those who need it ❖ Analyzing data & information using valid methods ❖ Making decisions & taking action based on factual analysis, balanced with experience & intuition
<p>Principle 8: Mutually beneficial supplier relationships An organization & its suppliers are interdependent & a mutually beneficial relationship enhances the ability of both to create value</p>	<ul style="list-style-type: none"> ❖ Increased ability to create value for both parties. ❖ Flexibility & speed of joint responses to changing market or customer needs & expectations. ❖ Optimization of costs & resources. 	<ul style="list-style-type: none"> ❖ Establishing relationships that balance short-term gains with long-term considerations ❖ Identifying & selecting key suppliers ❖ Sharing information & future plans ❖ Establishing joint development & improvement activities ❖ Inspiring, encouraging, recognizing improvements & achievements by suppliers

2.9 Twenty quality elements

Based on the above principles twenty quality elements in ISO 9001 have been developed by the International Organization for Standardization. The elements are (International Organization for Standardization, 1998). The twenty quality elements are related with quality functions required for each element which is important for the organization quality improvement. The elements and quality functions are organized as shown in Table 2.4.

Table 2.4 Twenty quality elements (ISO, 1998)

Elements		Quality Functions Required
E1	Management responsibility	<ul style="list-style-type: none"> ❖ Define, document and publicize quality policy ❖ Define, document responsibility, authority and interrelations of staff ❖ Identify and provide adequate resources ❖ Appoint quality manager ❖ Review quality systems on a regular basis
E2	Quality system	<ul style="list-style-type: none"> ❖ Establish, document and maintain quality system ❖ Prepare and effectively implement documented procedures. ❖ Define and document how quality planning is conducted for a project or contract, including preparation of a quality plan
E3	Contract review	<ul style="list-style-type: none"> ❖ Review tender before submission ❖ Review contract before signing ❖ Review variation order before acceptance and transfer amended requirements to functions concerned
E4	Design control	<ul style="list-style-type: none"> ❖ Plan design activities ❖ Identify and review design input ❖ Review, verify, and validate design input
E5	Document and data control	<ul style="list-style-type: none"> ❖ Review and approve documents prior to issue ❖ Review and approve document changes prior to issue ❖ Control distribution and updating of documents
E6	Purchasing	<ul style="list-style-type: none"> ❖ Evaluate and select subcontractors on basis of capabilities for quality ❖ Exercise appropriate control over subcontractors ❖ Review and approve purchasing documents prior to release ❖ Specify arrangements for verification and product release of subcontractors product or work at subcontractors premises if required ❖ Allow the client or his representative to verify subcontracted product or work at the contractor/subcontractors premises where specified in contract

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Elements		Quality Functions Required
E7	Control of customers supplied product	<ul style="list-style-type: none"> ❖ Control verification, storage, and maintenance of customer-supplied product
E8	Product identification and traceability	<ul style="list-style-type: none"> ❖ Identify material and semi-finished product from receipt and during all stages of production, delivery, and installation, where appropriate ❖ Provide unique identification of individual product or batches where specifically required
E9	Process control	<ul style="list-style-type: none"> ❖ Identify, plan, and control production, installation and servicing processes, including provision of documented procedures and suitable equipment ❖ Assign qualified operators to carry out special processes
E10	Inspection and testing	<ul style="list-style-type: none"> ❖ Conduct receiving inspection and testing of incoming materials and components ❖ Conduct in-process inspection and testing of semi-finished work in accordance with quality plan ❖ Maintain signed-off records of inspections and tests
E11	Control of inspection, measuring and test equipment	<ul style="list-style-type: none"> ❖ Use inspection, measuring, and testing equipment capable of necessary accuracy and precision ❖ Calibrate the equipment at prescribed intervals, or prior to use, and indicate its calibration status ❖ Review previous results when the equipment is found to be out of calibration
E12	Inspection and test status	<ul style="list-style-type: none"> ❖ Indicate by suitable means the conformance or nonconformance of product or work with regard to inspect and performed
E13	Control of non-conforming products	<ul style="list-style-type: none"> ❖ Identify and segregate, when practical, any nonconforming product or work ❖ Review and dispose of the nonconforming product or work by an authorized person ❖ Inspect and/or test the product or work again after repair

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Elements		Quality Functions Required
E14	Corrective and preventive action	<ul style="list-style-type: none"> ❖ Investigate cause of nonconformities, including client complaints ❖ Take corrective/preventive action to eliminate cause/potential cause of nonconformities ❖ Implement and record changes to document procedures resulting from corrective/preventive action ❖ Ensure that corrective/preventive action is taken and that it is effective
E15	Handling, storage, packaging, preservation and delivery	<ul style="list-style-type: none"> ❖ Establish methods of handling product that prevent damage or deterioration ❖ Use designated storage areas to prevent damage or deterioration ❖ Assess condition of product in stock at appropriate intervals ❖ Protect product during delivery
E16	Control of quality records	<ul style="list-style-type: none"> ❖ Retain quality records for prescribed period ❖ Maintain quality records in such a way that they are identifiable, retrievable and secured against damage, deterioration, or loss
E17	Internal quality audits	<ul style="list-style-type: none"> ❖ Plan and schedule internal quality audits ❖ Assign independent personnel to carry out internal quality audits ❖ Conduct follow-up audits if necessary
E18	Training	<ul style="list-style-type: none"> ❖ Identify training needs of staff ❖ Provide training required
E19	Servicing	<ul style="list-style-type: none"> ❖ Verify that servicing meets specified requirements
E20	Statistical techniques	<ul style="list-style-type: none"> ❖ Identify the need for statistical techniques in quality control Implement and control the application of statistical techniques

2.10 Purpose of quality management in the construction industry

The U.S. Army Corps of Engineers, (2004) states that Construction Quality Management “CQM” is the performance of tasks, which ensure that constructions are performed according to plans and specifications, on time, within a defined budget, and a safe work environment. For purposes of this study, quality is defined as conformance to properly developed requirements.

For a construction project, quality begins with requirements carefully developed, reviewed for adherence to existing guidance and ultimately reflected in criteria and design documents which accurately address these needs. Therefore, the designer establishes the quality standards and the contractor in building to the quality standards in the plans and specifications, controls the quality of the work.

The purpose of CQM is the Government’s efforts, separate from, but in coordination and cooperation with the contractor, assure that the quality set by the plans and specifications are achieved. CQM is the combined effort of the contractor and the Government. The contractor has primary responsibility for producing construction through compliance with plans, specifications, and accepted standards of the industry (U.S. Army Corps of Engineers, 2004).

2.11 Factors affecting quality of building construction projects

Tan and Lu, (1995) grouped the elements affecting quality of the building construction project into eight criteria and every criterion is divided into several impacting factors as depicted in Table 2.5. Those factors are a success factors that affects quality of building construction projects.

The quality criteria’s for the impacting factors are: Manpower qualified to achieve project mission; requirements, and objectives; Conformance to codes and standards; Conformance to owner’s requirements; Conformance to design process and Procedures; Conformance to schedule requirements; Conformance to cost requirements; Completeness of and conformance to output standards and Constructability. The quality criteria’s for the impacting factors are organized as shown in Table 2.5.

Table 2.5 Impacting factors affecting quality of a construction building project

No.	Quality criteria	Impacting factors
1.	Manpower qualified to achieve project mission, requirements, and objectives.	<ul style="list-style-type: none"> ❖ Capability of project manager ❖ Capability of design staff ❖ Capability of supporting staff
2.	Conformance to codes and standards.	<ul style="list-style-type: none"> ❖ Owner's willingness to abide by the agreed rules and standards. ❖ Utilization of the correct edition and articles. ❖ Consistency of the rules and standards.
3.	Conformance to owner's requirements.	<ul style="list-style-type: none"> ❖ Accuracy of owner's stipulated requirement. ❖ Clarity of owner's requirements. ❖ Changes to owner's requirements
4.	Conformance to design process and Procedures	<ul style="list-style-type: none"> ❖ Completeness of engineering design manuals, and guidelines. ❖ The effectiveness of the quality control program. ❖ The enforcement of engineering change control.
5.	Conformance to schedule requirements	<ul style="list-style-type: none"> ❖ Monitoring and control of schedule and performance ❖ Number of engineering design changes ❖ Reasonableness of the schedule
6.	Conformance to cost requirements	<ul style="list-style-type: none"> ❖ Number of engineering changes ❖ Clarity of the scope of work and statement of work ❖ Reasonableness of the cost estimates and budget
7.	Completeness of and conformance to output standards	<ul style="list-style-type: none"> ❖ Completeness of data and information ❖ Clarity of illustrations and classifications ❖ Consistency of the contents ❖ Accuracy of the data and methods
8.	Constructability	<ul style="list-style-type: none"> ❖ Timeliness and completeness of supply of equipment and material ❖ Utilization of common and standardized construction methods and materials ❖ Audit of design for Constructability

According to Ashokkumar .D, (2016), states some of the factors that affects construction quality. Those factors are failure factors that affect the quality of building construction projects:

- **Limitation of Finance:** This was the main factor of construction and in every type of work where contractor had to plan for financial payment to eliminate the risk because it might affect the project.
- **Limitation of Communication:** Construction site sometimes was located in rural areas or far away from the community. It might be a cause which affected transportation causing difficulty and delay, therefore it was a limitation that contractor had to consider.
- **Limitation of Labour and Wage:** In many different local areas, the problem related to labour such as lack of skilled labour, complex work, not being able to find labour might occur, which might be causes of work difficulty, delay and low quality.
- **Limitation of Building Plan and Construction Detail:** Problems of building plan and construction detail were found such as drawing not clear, drawing mistake, so they also became big problems in construction.
- **Limitation of Material and Equipment:** Some construction works might use special machines or equipment which contractor had to study carefully regarding performances, suitability for work and prepare enough equipment for each work.
- **Limitation of Time:** finishing construction project on time is very important for the success of construction project. If not time constraints in schedule affect the other elements of construction projects like quality and cost. This may lead failure on construction project.
- **Limitation of Construction Methodology:** Construction works in some areas could not be performed by regular method because there were buildings around construction site, so the contractor had to find new methods that were suitable to construct and sometimes used specialist engineer when some construction works were in step of construction.
- **Limitation of Rule or Regulation:** This problem also greatly affected construction such as problem from traffic which had an effect on transportation, problem of labour hiring, problem of building construction regulation, etc.
- **Training Policies:** Looking into the general training policy, the ISO 9001 registered companies have more concern on the training of their employees than the nonregistered

ones. They not only pay for the course fees, but also allow them to receive training during working hours. For non-registered companies, the company may reimburse the course fees but employees have to attend training sessions outside of working hours. Moreover, regular training programs on technical and computer knowledge were commonly provided in many companies. The most popular training program organized by ISO 9001 registered companies was quality knowledge.

- **Lack of co-ordination among departments:** Coordination is very important for project successful. Because co-ordination between the departments is failed that may leads to wrong execution or may affect the sequence of work. For example consider the MEP (Mechanical Electrical Plumbing) department not properly co-ordinate with execution team, now execution team done the plastering work before plumbing works are not done due to lack of coordination. Here definitely rework required so automatically quality is misplaced.

2.12 Summary of the literature review

This chapter of the thesis reviews issues related to QMP both in a global and Ethiopian context. Construction works are carried out in the form of projects. Construction projects have five distinctive objectives to be managed like: scope, organization, quality, cost and time. From those objectives quality of construction projects is the main objective to be managed. Quality may mean different things to different people: some takes it to represent customer satisfaction; others interpret it as compliance with contractual requirements; yet others equate it to attainment of prescribed standards. The International Organization for Standardization (ISO) formally defines quality as the ‘totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs’ (ISO, 1998).

In this chapter quality and words related to it are defined like: quality planning; quality assurance; quality control; quality management systems; and total quality management. Those words are necessary to understand because necessary to establish quality system. The other things covered under this chapter are critical success factors in total quality management (Customer Focus, Process Improvement, and Continuous Improvements).

Quality planning as a set of activities whose purpose is to define quality system policies, objectives, and requirements, and to explain how these policies will be applied, how these objectives will be achieved, and how these requirements will be met.

Quality assurance is oriented towards prevention of quality deficiencies. It aims at minimizing the risk of making mistakes in the first place, thereby avoiding the necessity for rework, repair or reject. Quality control also refers to the activities that are carried out on the production line to prevent or eliminate causes of unsatisfactory performance. Quality assurance is broader than quality control in its activity. In other word quality control is one part of quality assurance. The other term related with quality is total quality management which is broader than the concept of both quality assurance and quality control.

The critical success factors in Total quality management are customer focus, process improvement and continuous improvements. In the TQM philosophy, total customer satisfaction is the goal of entire system, and a pervasive customer focus is what gets us there. The function of the construction industry is to provide customers with facilities that meet their needs. For a company to remain in business this service must be provided at a competitive cost.

The other word is process improvement which is very important in TQM concept. A process is a way of getting things done. A process consists of the tasks, procedures and policies necessary to carry out an internal or external customer need. According to the TQM philosophy if the process is correct, so will be the end result (product). Thus the organization should work to improve the process so as to improve the end product or service.

Continuous improvement is the way of achieving specific objectives by step by step process which is essential part of the company. This process consists of nine steps as below: identify the process; organize a multi-disciplinary team to study the process and recommend improvements; define areas where data is needed; collect data on the process; analyze the collected data and brainstorm for improvement, determine recommendations and methods of implementation; implement the recommendations outlined in step six; collect new data on the process after the

proposed changes have been implemented to verify their effectiveness; and circle back to step five and again analyze the data and brainstorm for further improvement.

The other issues covered under this chapter are: the cost of quality; the reporting of quality related costs had been limited to inspection and testing; and other costs were accumulated in the overhead accounts. Quality related costs are much larger than had been traditionally reported, generally in the range of 20 to 40% of revenues. Quality related costs are not only related to manufacturing operations, but to ancillary services such as purchasing and customer service departments as well. Most of the costs are result of poor quality and are avoidable.

The quality management principles can be used by senior management as a framework to guide their organizations towards improved performance. These principles are not elements against which the organization can be directly assessed but their influence can be seen throughout the standard. The eight quality management principles are: customer focus; leadership; involvement of people; process approach; system approach to management; continual improvement; factual approach to decision making; and mutually beneficial supplier relationships. Based on the above principles twenty quality elements in ISO 9001 have been developed by the International Organization for Standardization. Those elements also briefly explained in this chapter.

The other issues covered under this chapter are the common factors that are mostly affecting the quality of construction in terms of successful QMP currently being faced by Ethiopian construction companies are much the same as those which have been experienced by construction companies elsewhere in the world. The elements affecting quality of the construction process are the components of both construction inputs and construction processing. These elements are: (1) all things-related to design- come from the designer and/or the owner side; (2) the prime contract between the owner and the contractor;(3) all things related to raw material and its suppliers;(4) all the main working labor in the project;(5) the main working equipment in the project;(6) the main subcontractors in the project;(7) the planning of the project site area;(8) the management teams and their shared tasks; and (9) all things required to activate the above elements and to execute the project activities.

2.13 Research gap

The gap considered the missing piece or pieces in the research literature, is the area that has not yet been explored or is under-explored:-

Quality management system require having the organizational structure, responsibilities, procedures, processes and resources for implementing quality management such that there is a guiding framework to ensure that every time a process is performed the same information, method, skills and controls are used and practiced in a consistent manner. Total Quality Management (TQM) has been defined as a comprehensive systematic, integrated, consistent, organization-wide effort dedicated to customer satisfaction through continuous improvement. With its primary focus being the involvement of everyone, TQM has the potential to improve business results, greater customer orientation and satisfaction, worker involvement and fulfillment, team working and better management of workers within companies. However, the construction industry in Ethiopia has been slow to embrace the concept of TQM.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Overview of the research process

The study is conducted in three stages. First stage is literature review. The literature review was started with the introduction to quality management. In the introduction to quality management, the definition of quality and other related term was reviewed and the literature would also review the importance of quality management in construction industry. Moreover, the literature also reviewed the factors affect quality of construction during construction stage. Furthermore, articles and notes about the quality management were searched. All literatures are reviewed deeply by referring the previous research paper, article, journal and etc.

At second stage, an interview was conducted with experienced project manager face-to-face to obtain the information about their current practices in quality management system of their company, the factors affect quality of construction was identified by the building contractors. Then questionnaires also take placed.

3.2 Sample size

According to construction industry development and regulatory bureau the total numbers of grade one contractors registered and also renewed their licenses in 2016 budget year are 169. From this populations grade one Ethiopian building contractors and grade one general contractors assessed with the focus limited to Addis Ababa city which are registered with the name Addis Ababa. 54 building contractors and 35 general contractors that mean a total of 89 numbers of populations are obtained. The other contractors are excluded because of the above criteria's.

To select the sample size from 89 companies; Eq.3.1 shown below was used for unlimited population (Creative Research System, 2001):

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2} \dots\dots\dots [Eq.3.1]$$

Where: SS = Sample size
 Z = Value (e.g. 1.65 for 90% confidence level)
 P = Degree of variance between the elements of population (0.5)
 C = Confidence interval (0.05).

$$SS = \frac{1.65^2 \times 0.5 \times (1 - 0.5)}{0.05^2} = 272.2 = 273$$

Correction for Finite Population, use [Eq.3.2] below:

$$New\ SS = \frac{SS}{1 + \frac{SS-1}{POP}} \dots\dots\dots [Eq.3.2]$$

Where: POP= population

$$New\ SS = \frac{273}{1 + \frac{273 - 1}{89}} = 67.3 = 68$$

From 89 a total 68 questionnaires were distributed from these 52 questionnaires returned this means 76 percent of response rate which is acceptable for research.

3.3 Interviews

The interview was conducted face-to-face with the interviewees asking questions selected individuals. The interview is a useful technique for collecting data which would probably not be accessible using techniques such as desk study and questionnaires. Unstructured (open) types of interview were conducted with building contractors representative (engineers) to gather information on: organization quality management; organization quality problem; factors affect the quality of construction projects; and the sub factors important for the quality of construction. The information collected used to support of the literatures in order to include them in the questionnaires. In this thesis interview is used instead of desk study because of lack of data from the companies on quality management practices.

3.4 Questionnaire design

It is simplest and time saving method to collect data effectively from a huge numbers of respondents. Formulating questions from the identified variables, the questionnaire was designed

to gather data from professionals with building contractors side that were involved in building projects in Addis Ababa. This questionnaire survey has both open-ended and closed-ended questionnaires. The respondents were asked to rate the questions on the five-point scale of ordinal measures. **Section one:** Company profile **Section two:** asked to what extent the quality concept is understood in the company. **Section three:** respondent's rank of the main factors affecting quality and the sub factors under each main factors. These helps to understand the degree of effect they have on quality practices. **Section four:** respondent's rank of the sub-factors affecting quality. As this section contains sub factors affecting quality correlated to their main factors, it will be used as to establish quality system based on their ranking.

3.5 Research analysis

The descriptive statistics are a method of analysis that provides a general overview of the results and used to analyze the result of questions. Rating scale is one of the most common formats for questioning respondents on their views or opinions of an event or attribute. In this regard, participants were asked to indicate the level of the implementation components of facility management and causes of problems on building facility management implementation by rating them on five point scale, (Very low important (1), Low important (2), Medium important (3), high Important (4), Very high important (5)). Relative Important index is used to rank the factors and the findings were presented in a table. The formula for the calculation of RII used is [Eq.3.3]:-

$$\text{Relative importance index (RII)} = \frac{\text{Total point}}{(P*N)} \dots\dots\dots [\text{Eq.3.3}]$$

Where: P = population (contractors number = 52)
N = number of point (5 for these thesis)

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter analyses the data gathered from questionnaires and interviews. This chapter includes the general information about respondent contractors' profile that helps the research to get the necessary information from the firm. Then concept of quality and quality management adopted in the construction process are assessed. Finally factors affecting quality practices in the building construction projects also investigated. Data were captured and the responses were analyzed using the Microsoft Excel software package. Then the information is ranked in different position by using relative important index.

4.2 Analysis and discussion of data from interview

The interview was conducted face-to-face with the selected interviewees by asking questions and explanations. Semi-structured interview were conducted with contractors representative (engineers) to gather information on organization quality management, organizations quality problems, factors affecting the quality of construction projects and the sub factors important for the quality of construction. The information collected used to support the literatures in order to include them in the questionnaires in other word to merge to form questionnaires.

The interviews are conducted on 7 project managers, 1 office engineer head and 2 office engineers. A total of 10 respondents are participated. From those respondents 8 of the respondents work in GC-1 contractors and the remaining 2 office engineers work in BC-1 contractors. All the respondents experienced on building projects for 3years and above.

The interview consists of four questions those four questions prepared to meet the objectives of the thesis. The first question is how can quality expressed in building constructions projects? For these question five answers are identified those answers are: meeting specified requirements;

work without defects and wastes; expensive work (high cost); good appearance and customers satisfaction. This shows quality doesn't have clear meaning or common meaning in the construction industry. Common understandings are very important to understand each other's and to create quality management systems. The second question is what do you think the major objectives of quality management in construction companies? For this question four answers are obtained those answers are: Increasing profit; elimination of defects; to get good reputations in order to get additional works and safe work. These shows how the objectives of the companies are different to different companies having different objectives are not the problem but having incorrect objectives are the problems. So, quality objectives of the companies should be related with more of with the quality works. Third interview question is the quality improvement program of companies which is the respondent of this thesis works in for this question only two answers are responded: quality control/quality assurance and ISO 9001 QMS system.

The fourth and the final question is what are the factors that affects the quality of building construction projects for this interview question 14 factors are responded that are: 1) the drawings and specifications do not specify clearly the intentions of the designers; 2) poor workmanship; 3) the contractors pay more attention to complete the works on schedule and control the costs to within budget than to achieving quality in construction; 4) poor co-ordination exists between the contractors and the subcontractors as well as the nominated subcontractors; 5) the contractors cannot plan and control the works; 6) contractors lack provides the end products on site in accordance with the design and specifications; 7) the contractors do not know how to establish a quality system to control the works; 8) the contractors do not use good quality construction materials; 9) lacks storage and handling system; 10) lacks of good utilization of equipment; 11) contractors lacks of finance; 12) skill and experience contractor's staff; 13) the location of the site; 14) the projects complexity. Those factors have some similarity with the factors mentioned on literature part. Those factors are failure factors or the causes for poor quality management practices in building construction projects. Then those factors are arranged as success factors and merged with the factors collected on the literature part to design questionnaires like observed in the Appendix-A.

4.3 Analysis and discussion of data from questionnaire

4.3.1 Rate of response and contractors profile

The contractors included in this research are grade one contractors registered with the name Addis Ababa only. From this contractors foreign contractor and government contractors is not included. The total numbers of contractors fund are 89 from these 54 building contractors and 35 general contractors. For this thesis a total of 68 questionnaires distributed out of this 37 building contractors and 31 general contractors. The numbers of questionnaires retrieved are 52; this means 76 percent of response rate which is acceptable for research. The questionnaires response rates are organized as shown in Table 4.1 below:

Table 4.1 Questionnaires response rate

Class	Questionnaires distributed	Questionnaires returned	Percent of Reponses
Bc-1	37	30	81
Gc-1	31	22	71
Total	68	52	76

The firms years of experiences are summarized in Table 4.2 the results shows 69.2% of the contractors have more than 10 years experiences in the construction industry. The others (25%) of the contractors have 5 to 10 years experiences in the construction industries. The remaining contractors (5.8%) have less than 5 years' experiences. The majority (94.2%) of the contractors have more than 5 years experiences as understood from results. This helps the study to get enough information on quality management practices. Table 4.2 shows firm's years of operations.

Table 4.2 Firms years of operations

No. year operation	Frequency(n)	Percent (%)
Less than 5 years	3	5.8
5 to 10 years	13	25
10 years and above	36	69.2

The numbers of project executed with those contractors are very high in numbers that means 15.4% of the contractors executed more than 20 numbers of projects in the last five years. The majority 53.8% of contractors executed 11 to 20 numbers of projects. The remaining 30.8% of the contractors executed less than 10 numbers of projects. The contractors participated in these projects have high experiences in building construction projects as shown in Table 4.3 below:

Table 4.3 Numbers of projects executed in the last five years

No. projects	Frequency (n)	Percent (%)
Less than 10	16	30.8
11 to 20	28	53.8
more than 20	8	15.4

The major clients of contractors are public sectors were 61.5% of works are obtained from. The others 38.5% works are obtained from private sectors. According to the sample there are no other sectors are participated in the building construction projects. The client types have major effects on the quality of the construction because the controlling mechanisms and the emphasis they give for quality are different. These data also helps to know which clients are affected by lack of quality works as shown in Table 4.4.

Table 4.4 Firms major clients

Clients	Frequency (n)	Percent (%)
Public	32	61.5
Private	20	38.5
Cooperatives	0	0
Others	0	0

In every construction firm priorities are often given to certain areas or for the factors relatively to each other's in companies. The priority given to some factors within the surveyed contractors in the construction industries have been discussed in this sub-section of the studies. The

respondents were asked to rank the factors from low (1) to high (3), and the results are presented in Table 4.5.

Table 4.5 Priorities given to Some Factors in the company

Factors	Degree of Priority			Total	RII	Rank
	1	2	3			
Meeting Project Time / Deadline	0	19	33	137	0.88	2
Meeting Quality Standards	0	24	28	132	0.85	3
Achieving Success during tender	13	15	24	115	0.74	5
Satisfying Client's brief	9	18	25	120	0.77	4
Meeting Project Cost Budget	0	12	40	144	0.92	1
Meeting Health and Safety Standard	20	11	21	105	0.67	6

* The degree of priority numbers are stand for 1 for low, 2 for moderate and 3 for high

As presented in Table 4.5 the most important and highly prioritized factors by contractors are meeting project cost budget of the project this is obvious because companies are established to make profit that is why they give first priority in their firm. The second priority given by the firms are meeting project time /deadline and the third priorities are to meeting quality standard of the projects. From this ranking quality is comes after cost and time. This implies that a lot of work needs to be done in increasing awareness and making the contractors to focus more on quality. These three variables were subsequently followed by achieving success during tender; satisfying clients brief; and health and safety standards ranked 4th, 5th, and 6th respectively. The literature part of this thesis explained each factors are related to one another for example quality has an effect both on cost and time. If the quality of work increases our profit and our time are saved because reworks are reduced. The other interesting issue is the place given for health and safety standard it is ranked last. This shows safety is not big issue for our contractors. As mentioned on the above every factor is related to each other's if quality is achieved the others issues also have the chances to be achieved.

4.3.2 Quality perception of companies

The quality of building constructions are very difficult to define. First of all, the product is usually not a repetitive unit but a unique piece of work with specific characteristics. Taking building construction as an example, the product can be an entire building, a section of a building or just a prefabricated component that ultimately forms part of a building. Secondly, the needs to be satisfied include not only those of the client but also the expectations of the community into which the completed building will integrate. The construction cost and time of delivery are also important characteristics of quality. All these should be properly addressed in designing the building, and the outcome should be expressed unequivocally in drawings and specifications.

The word quality has different meaning for every construction firm for this reason the contractors asked to select words that define quality. The contractors also asked to select more than one words from the option provided in the Table 4.6.

Table 4.6 Firms quality definition

Define	Frequency (n)	Percent (%)
Expensive	6	7.6
Good Appearance	11	14
Increased profit	5	6.3
Customer's satisfaction	23	29.1
Meeting specification requirement	34	43
Others	0	0

As presented in Table 4.6 (43 %) of the contractors define quality as meeting the requirement specified on the specification. The other 29.1% were given to customer's satisfaction the main reason of contractors are if customers satisfied the quality of the works are good as the same time their reputations also increased. The definitions next to those two definitions are: good Appearance; expensive; and increase profit respectively.

The contractors also ranked what perception they have on quality by selecting those three words or writing their own by the space provided as shown in Table 4.7 below:

Table 4.7 Perception of quality

Words	Frequency (n)	Percent (%)
Elimination of defects	26	38.8
A tool to increase profits	10	15
A competitive advantage	30	44.7
Others	1	1.5

Most of the contractors agreed quality works gives a competitive advantage (44.7%) for the next time to get another works. The next rank is given to elimination of defects by 38.8%; it is the main thing in order to do good works according to the literature of this thesis. A tool to increase profits and others comes next to the above variable by 15% and 1.5% respectively. Let say, if we meet the table requirement at 43% instead of 44.7% it's also ranked first when compared to others words listed in the table because still majority of contractors agreed.

4.3.3 Quality management system

Quality improvement as which emphasizes that quality is the responsibility of every one in an organization: as processes of managing change; as a strategy to improve organizational competitiveness and effectiveness as a value system that emphasizes striving for quality in product or services; and as an approach to doing business that covers the whole organization.

The result as shown in Table 4.8 shows (40.4 %) of the companies does not implement quality management system and (26.9%) implement quality management system recently. The other companies (19.2%) have the intention to develop and implement a quality management system. A small number of companies (13.5%) have implemented a quality system. As we see this results are different from the study of Yimam A. he identified that about 33% of the contractors perform QM but it's not relevant at this time according to my study.

Table 4.8 Quality management system

QM consideration	Frequency (n)	Percent (%)
No	21	40.4
Such a plan is under consideration	10	19.2
A quality improvement program has been implemented recently	14	26.9
A quality improvement plan has been a part of corporate policy for some time now	7	13.5

The construction companies' uses different kinds of quality management system as mentioned on the literatures like total quality management; ISO 9001; quality control /quality assurance; and others. This quality system improves quality of the construction projects and also gives better pictures for the companies. Quality management systems are very important in achieving QMS in the organizations. Types of quality management system used by contractors are presented as shown in Table 4.9 below:

Table 4.9 Types of quality management system

Type of quality management system	Frequency (n)	Percent (%)
ISO 9001	9	17.3
Total Quality Management	0	0
Quality Control /Quality assurance	16	30.8
Others	0	0
Did not answer	27	51.9

Table 4.9 shows the quality management system mostly practiced in Ethiopia they are: ISO 9001 and QC/QA. Contractors have the chance to create their company quality management system but there are no company mentioned other types of quality management system. Table 4.9 shows 30.8% contractors use quality control as their company quality management system. As literature specify quality control monitoring specific project result to determine if they comply with relevant quality standards and identifying ways to eliminate cause of unsatisfied performance contract documents comprise a clear, complete, and accurate description of the facility to be constructed, correctly conveying the intent of the owner regarding the characteristics of the facility needed to serve his or her purposes. The second type practiced by contractors is ISO 9001 with 17.3% which is the latest system know. The third which is not practiced by the contractors is TQM; it works for the totality of the company quality. As stated on literature one of the main principles of the TQM concept is to achieve customer satisfaction and this is an important objective for any organization, including construction firms.

The majority (51.9%) of contractor doesn't have quality management system so, we can imagine what kind's work they do. The company depend on the quality meanly achieve the project

success in every part like for example meet the deadline, meeting the project cost and create safe environment. Therefore, they have to wake up to apply quality system in their organizations.

The quality management system has various objectives as specified in literature review part. Those objectives are: Increase productivity; cost reduction; involvement of employees in the quality building effort and compliance with statutory; and environment and safety requirement. The contractors have the chance to fill their own objectives but companies are not responded in space provided on the question.

Table 4.10 shows the majority (51.9%) of the contractors doesn't have answer. 26.9% of the contractors objectives are to work on compliance with statutory, environment and safety requirement. The others contractors (13.5%) objective is QMS reduce the cost of construction and others (7.7%) select quality management system increase productivity of the contractors respectively.

Table 4.10 Major objectives of quality management system

Objectives	Frequency (n)	Percent (%)
Increase productivity	4	7.7
Cost reduction	7	13.5
Involvement of employees in the quality building effort	0	0
Compliance with statutory, environment and safety requirement	14	26.9
Others	0	0
Did not answer	27	51.9

4.3.4 Main factors affecting quality of building construction projects

The factors affecting quality of the construction process are the components of construction inputs and process. These factors have an effect on the quality of construction and these factors are ranked on the effect they have on the construction projects or expresses the defect and faulty

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work occurred because of those factors especially some have great effects on construction projects that why the relative important index high. This shows that most of the respondent knows the effect of those factors on quality management practices. These factors are stated as shown in Table 4.11

Table 4.11 Main factors affecting quality

Item No.	Main factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1.	Project (type and complexity) related issues	4	3	21	16	6	167	0.64	9
2.	Design related issues	2	0	4	24	22	220	0.84	1
3.	Contract related issues	0	7	21	15	9	182	0.70	6
4.	Materials related issues	0	6	8	14	24	212	0.81	3
5.	Labors related issues	0	0	12	17	23	219	0.84	1
6.	Equipment related issues	0	6	11	19	16	201	0.77	4
7.	Subcontractors related issues	0	12	8	18	14	190	0.73	5
8.	Site layout of the project	5	7	13	15	12	178	0.68	7
9.	Systems (quality control, cost control, safety program)	1	2	11	13	25	215	0.82	2
10.	Site staffs (cooperation, understanding, experience)	2	1	8	20	21	213	0.82	2
11.	Financial Issues	3	5	10	12	22	201	0.77	4
12.	Owners (public, private)	7	6	22	9	10	171	0.66	8

* Note that the responses are ranked according to the importance of the factors on quality of construction projects. very low important (1), low important (2),medium important (3), high important (4),very high important(5)

Table 4.11 shows design related issues and labors related issues comes first with relative important index of 0.84. These show the problem related to those two factors have high degree of effect on quality in Ethiopia. Design related issues happened mainly because of reliability of all

information used as basis of the products for projects. The other is reliability of design solution and detailed specification. The labor force also has an effect on the project according to the contractors the labor don't have enough skill, miscommunication because of different language they used and they come directly from rural area of Ethiopia. The second variables in the table are systems and site staff with the relative important index of 0.82. The system of the company consists a lot of issues especially related to management that why second on list but these variable need a lot of resources to apply in company. Site staff also another factor comes second on the list which has high effects on the practices of quality. As stated on the literature review coordination was very important for project success because if the co-ordination between the departments were failed that may leads to wrong execution or may affect the sequence of works. The third variables are materials related issues with RII of 0.81. The materials related problems are the major factors that affect the quality of the projects. For example the availability of good quality construction materials and using storage and handling system has great effect on quality of construction.

Those variables were subsequently followed by equipment related issues; financial Issues; execution (continuous supervision, clear procedure); contract related issues; subcontractors related issues; site layout of the project; owner (public, private); and project (type and complexity) related issues respectively. To summarize the ranks: designs, labors, systems, site staff, materials, equipment, financial, subcontractors, contract, site layout, owners and project.

4.3.4.1 The effect of design on quality of building construction projects

The majority of the construction problem occurred because of design according to both the interview and the questionnaires results. The issues raised are: the completeness and consistency of design documents; drawings are prepared in details; conformance to codes and standards; and bill of quantity are detailed and accurate. Those factors are compared according to the importance they have on quality. The completeness and consistency of design documents comes first with RII=0.85 which is very important for quality achievement when it compared with other factors. The design document should be complete to understand fully some people also say if design is complete the work ideally 50% completed even not constructed on the ground. The

consistent of design is very important for constructability of project because reliable designs are easy to apply to the ground. The second variable ranked by the contractors is drawings should be prepared in details the RII is 0.81.

The other factors followed by the above two factors are conformance to codes and standards; and bill of quantity are detailed and accurate with RII=0.80 and RII=0.77 respectively. Those factors are ranked as shown in Table 4.12.

Table 4.12 Design related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Completeness and consistency of design documents.	0	2	9	15	26	221	0.85	1
2	Drawings are prepared in details	0	7	8	13	24	210	0.81	2
3	Conformance to codes and standards	0	5	10	17	20	208	0.80	3
4	Bill of quantity is detailed and accurate.	0	5	13	18	16	201	0.77	4

* The responses are ranked according to the importance of the factors on quality of construction projects. very low important (1), low important (2), medium important (3), high important (4), very high important (5)

4.3.4.2 The effect of labors on quality of building construction projects

Labors are an important resource we use to construct building especially when the resource for equipment are limited and also some work could not be done by equipment only so, using labors are necessary. In our country construction needs a lot of labors because of the capacity we have (the development) but the problem are not that the problem are the skills and the deduction they have for works. In other hand the managements of the company are very important in order to develop the skill and motivations of the labors. The contractors ranked the variables under labors considering the effects on quality practices of building construction projects as shown in Table 4.13.

Table 4.13 Labor related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Communication skills of labors	0	9	10	13	20	200	0.77	3
2	labors experience	0	4	5	17	26	221	0.85	1
3	Motivation System	2	8	12	13	17	191	0.73	5
4	Training courses for labors	0	3	11	15	23	214	0.82	2
5	Income level and wages of labors	0	8	12	14	18	198	0.76	4

* The responses are ranked according to the importance of the factors on quality of construction projects (for example labors experience is very important for the success of quality). very low important (1), low important (2), medium important (3), high important (4), very high important (5)

Table 4.13 shows the level of labors experience is very important on quality practice when compared with the other factors with RII of 0.85. The labors impacts on the quality of the construction are very high but the labor forces did not get enough attention by Ethiopian contractors. So, in order to develop or grow their capacity training courses are important. The second variable selected by the contractors is giving training courses for labors to improve their skills with relative important index of 0.82. The third factor ranked in the table is the impact of communication skills of the labors on the quality of construction project were ranked with RII of 0.77. Communication problem is the main factors which observed in Ethiopia construction project. The main reason is as we know Ethiopia is multi linguistic country this makes it difficult to understand each other on the site. Therefore, Interpersonal relations of labors are important because it reduces the differences they has on working place. The final ranking is given to income level and wages of labors with RII of 0.76. This factor was somewhat low effect on the quality of building construction projects as contractors ranking.

4.3.4.3 The effect of systems on quality of building construction projects

Organizations are a combination of different systems to work together to develop the company. Construction company have different system like quality control and quality assurance system,

cost control system, time control system and safety control system. The above systems are some of them which are considered in this research. The other systems are included under others factors. Those factors mentioned above are ranked according to the degree of importance they have on quality of construction projects as illustrated in Table 4.14 below:

Table 4.14 Systems related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Quality control and quality assurance system	0	0	10	17	25	223	0.86	1
2	Cost control system	4	17	13	11	7	156	0.60	2
3	Time Schedule	4	18	14	10	6	152	0.58	3
4	Safety program	10	22	10	6	4	128	0.49	4

* Note that those factors are ranked according to the importance they have on quality of building construction projects.

Table 4.14 shows implementing quality control and quality assurance system is ranked first with RII=0.86. The literature part of this thesis shows in order to achieve success in quality the best way is to apply quality management system in the company. QC/QA system is one of quality improvement program were used to improve the quality construction work. So, using this system has great degree of influence on quality. QC/QA systems are one of the contributing factors for the success of QMP in contractors firms. The other factor is using cost control system ranked with RII of 0.60 which isn't have direct effect on quality but very important for the quality of construction work. The third and the fourth factors are implement and using time schedule and implement a safety program with RII=0.58 and RII=0.49 respectively. The above three factors cost, time and safety need further study specifically in Ethiopia condition.

4.3.4.4 The effect of site staffs on quality of building construction projects

In construction industry cooperation of site staffs are must to achieve success in time, cost and quality of construction project therefore, without cooperation of site staffs we cannot achieve

project objectives. Like for example cooperation between supervision and contractor's staffs were very important for quality construction.

The other factors were important for quality management is the understanding of supervision staffs about contract administration of the construction projects. The skill and experience of supervision staffs are very important for quality management practices. The contractor's staffs skill and experience are also very important for QMP. The site staffs issues are also ranked by the contractors on the level of importance that have on quality management practices.

The first rank given by the respondents are skill and experiences of contractor's staff with RII=0.82. It is very important for the quality of construction work according to the literature review part of this research. The other factors next to above are: skill and experience of supervision staff; and cooperation between supervision and contractor's staff were ranked with RII=0.78 and RII=0.73 respectively. The last place ranked by the respondents are understanding of contract administration by Supervision staffs with RII=0.68 as shown in Table 4.15.

Table 4.15 Site staffs related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Cooperation between Supervision and Contractor's staff	0	11	12	12	17	191	0.73	3
2	Understanding of contract administration by Supervision	3	10	9	13	15	177	0.68	4
3	Skill and experience of Supervision staff	0	7	11	14	20	203	0.78	2
4	Skill and experience Contractor's staff	0	2	12	16	22	214	0.82	1

4.3.4.5 The effect of materials on quality of building construction projects

The construction industry needs a lot of materials both in type and amount so using this resources effectively are very essential. According to literature review part of this thesis all material purchased should satisfy the standards or building control authority requirements. Here

are materials related factors are ranked according to their level of importance for quality as shown in Table 4.16 below:

Table 4.16 Materials related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Applying material management system	0	8	7	22	15	200	0.77	2
2	Cooperation between contractor and material suppliers	2	9	19	12	10	175	0.67	4
3	Construction materials quality	0	6	11	10	25	210	0.81	1
4	Storage and handling system	0	12	6	20	14	192	0.74	3

Table 4.16 shows availability of good quality construction materials are very essential and ranked first with relative important index of 0.81. According to the contractor, the materials purchased itself very decisive on the quality of the construction projects. Purchasing good quality materials are very important because construction materials have direct effect on the quality of building construction project. The second important factor is using a complete material management system with the relative important index of 0.77. The third factors ranked by the contractors are using storage and handling system with RII =0.74. The fourth is cooperation between contractor and material suppliers with RII=0.67.

4.3.4.6 The effect of Equipment on quality of building construction projects

The construction sites are characterized by a high level of activity as men and equipment move materials, tools and design information one place to another. Certain degrees of inefficiency are normal, depending on the size and complexity of project, the constraints of procedure, and the degree and effectiveness of detail planning and scheduling. As the use of modular and prefabricated construction method increases using construction equipment are must in construction process. The use of equipment will reduce cost, improve safety and yield higher

quality of the construction project so; using equipment in construction project gives us success. Here are equipment related factors were ranked as shown in Table 4.17 below:

Table 4.17 Equipment related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Availability of Equipment	0	2	15	23	12	201	0.77	1
2	Equipment management system	0	9	13	20	10	187	0.72	3
3	Measurement of equipment Productivity	2	7	18	14	11	181	0.70	5
4	utilization of equipment	0	8	19	12	13	186	0.71	4
5	Equipment maintenance	0	6	15	21	10	191	0.73	2

There are a lot of activities performed by equipment on building project like excavation, compaction, lifting, moving, mixing, spreading, crashing, and cutting etc. All those work are very important for good quality construction work. In construction project the rate of quality are calculated by using different formula which helps us to know the loss of the works.

The results in Table 4.17 shows the effect of availability of Equipment were rated first with RII=0.77. The lacks of construction equipment by the contractors reduce the quality of project, because construction equipment performs better than human on the activity mentioned above. The construction equipment fasten construction of the building this gives benefit for the contractors to work the project without time stress. Us we know the stress to finish the project is the cause for defect works. Equipment maintenance, equipment management system and utilization of equipment were ranked 2nd,3rd and 4th respectively on the effect they have on quality. The last factor is measurement of equipment productivity with relative important index of 0.70.

4.3.4.7 The effect of finance on quality of building construction projects

Financial issue is the main factors affecting construction success especially when there is no proper financial control and management. Cash flow problem may cause inefficiency of construction Company (contractors). Inefficiency contractors may also affect quality construction. This indicates that with a good cash flows management, companies could be kept efficient and financially healthy. Cash flow in construction is the money that is moving (flowing) in and out of company with some time. Finance related factors are ranked as shown in Table 4.18 below:

Table 4.18 Finance related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	The amount of contractors cash flow	3	10	14	15	10	175	0.67	1
2	The non-delay of interim payments	5	16	8	14	9	162	0.62	2

The results in Table 4.18 shows the amount of contractors cash flow are ranked first compared with the non-delay of interim payments with relative important index of 0.67. But these two factors affect indirectly the quality of the building construction. Interim payments can be agreed in advance and paid at particular milestone, but they are more commonly regular payments the value of which is based on the value of work that has been completed (this is the actual value of the work completed, taking into account variation etc.). The interim certificate provides the mechanism for the client to make payments to contractor. So, the delay of these payments may cause the construction to stop and lagging of the work because of this the material on the site is affected the time problem is also happened. Therefore, the qualities of constructions are in question.

4.3.4.8 The effect of subcontractors on quality of building construction projects

The main problems of contractors are doesn't give emphasis on subcontractors because contractors are busy with own works they don't give time to assess the works of subcontractors. According to the informal interview of professionals the selection system of contractors has problems in the beginning because they select subcontractors by friends or by knowing each other not by the capacity of subcontractors. This is the main cause for poor quality management practices in building construction projects. Sub-contractors related factors are ranked as shown in Table 4.19 below:

Table 4.19 Subcontractors related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Company's methods and procedures of selecting subcontractors	0	8	10	18	16	198	0.76	2
2	Cooperation between subcontractors and contractor	0	7	13	20	12	193	0.74	3
3	System to evaluate subcontractors performance	0	10	12	16	14	190	0.73	4
4	Subcontract conditions	0	6	10	21	15	201	0.77	1

Table 4.19 shows subcontract conditions have great impact on the success of construction quality according to the ranking of contractors with RII=0.77. The second and the third factors are company's methods and procedures of selecting subcontractors and cooperation between subcontractors and contractors were ranked with RII=0.76 and RII=0.74 respectively. The final ranking were given to using a system to evaluate subcontractors performance with RII=0.73.

4.3.4.9 The effect of contract on quality of building construction projects

Contract documents consists so many things like for example quality control prices. This prices are for obtaining samples; performing contractor quality control testing; performing tests for

contractor quality control testing; performing tests for contractor process control; providing inspection; exercising management control; submitting a written control quality Plan, maintaining control charts; submitting the records and certifications; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work. So, these costs help the contractors to keep the quality of construction. Contract related factors are ranked as shown in Table 4.20.

Table 4.20 Contract related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Cooperation between parties involved in contract	3	5	17	14	13	185	0.71	1
2	Previous relations between parties (good or bad)	7	14	8	11	12	163	0.63	3
3	A written contract with conditions clear and fair and responsibilities distribution is clear	6	10	11	12	13	172	0.66	2
4	Using a standard contract	7	16	10	8	11	156	0.60	4

Table 4.20 shows the cooperation between parties involved in contract were ranked first with RII=0.71. The construction works needs the cooperation and works of different bodies as stated on the contract of project. The second ranking is given to written contract with conditions clear and fair and responsibilities distribution is clear with RII=0.66. The other factors comes after the two factors are previous relations between parties and using a standard contract were ranked with RII=0.63 and RII=0.60 respectively.

4.3.4.10 The effect of site layout on quality of building construction projects

Site layout of the project is very necessary for the success of the project. Issues related with the site layout are: Site layout is large and suitable for movement of labors and equipment, site layout is organized well, site layout has storage areas for materials and site is clean. Those factors are identified and modified as shown in Table 4.21 below:

Table 4.21 Site layout related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Site layout is large and suitable for movement of labors and equipment	2	16	16	11	13	179	0.69	2
2	Site layout is organized	0	10	17	13	12	183	0.70	1
3	Site layout has storage areas for materials	1	16	15	14	8	174	0.67	3
4	Site is clean	3	15	13	12	9	165	0.63	4

Table 4.21 shows the site layout organized well sub factor were ranked first with RII=0.70. The Site organizations of the projects are very necessary for the project success both for quality and safety of the project and also important to handle materials, equipment and other things which need care on the site. The site layout should be large and suitable for movement of labors and equipment were ranked second with RII=0.69. Third and the fourth issues are site layout has storage areas for materials and site is clean with RII=0.67 and RII=0.63 respectively ranked. The cleanness of the site layout were very important especially for materials stockpiled on the site otherwise the quality of materials are affected and also the reason for poor QMP.

4.3.4.11 The effect of owners on quality of building construction projects

The owner should set the direction for the upcoming construction project. Past experience of highly successful construction project has clearly demonstrate that early and active involvement of the owner has major impact on safety and quality performance of all contractors on the job. The slight additional cost required at the beginning of construction project to implement an effective quality program will provide a high rate of return at project completion. The method of selection of contractors by the owner is very important for the success of construction project. Especially emphasis for quality is very important during selection of contractors. Past job experiences by the contractors are important including quality performances and system of the contractor on managing quality is necessary for the owner to select the contractor as criteria. Owners related factors are ranked as shown in Table 4.22 below:

Table 4.22 Owners related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of Importance					Total	RII	Rank
		1	2	3	4	5			
1	Owner organization nature (Public or Private)	8	13	16	6	9	151	0.58	4
2	The Owner is not delaying to make Decisions	4	8	15	19	10	191	0.73	2
3	Owner's contribution to design	5	14	17	10	6	154	0.59	3
4	Owner's emphasis on quality	0	3	14	22	13	201	0.77	1

Table 4.22 shows owners emphasis (active owners) on quality is ranked first with RII=0.77. The second factor ranked by owners is not delaying to make decisions that mean owner should decide on things on time before things goes wrong (RII=0.73). The third and the fourth factors are: owner's contribution to design and owner organization nature (Public or Private) with RII=0.59 and RII=0.58 respectively.

The owner's contribution to design doesn't have that much effect on quality but if the contractors participated it is good for quality according the interview with professional. The other issue ranked fourth is owner organization nature (public or private) now a day weather public or private doesn't have that much effect because both clients are try to keep quality in their own way. In the past government projects doesn't have that much control especially in terms of quality but now according the interview of professionals the situation is improved in government projects.

4.3.4.12 The effect of projects on quality of building construction projects

The unique character of construction industries are each projects has different from one another. This is the main reason that makes quality management difficult to manage. According to literature review the scope of the project; location of the project; site access and period of the project are the sub factors that affect quality under main factors of projects. The effects of each sub factors of the projects are ranked by the contractors as shown in Table 4.23 below:

Table 4.23 Project related factors affect quality practices

Item No.	Sub-Factors affecting quality	Degree of importance					Total	RII	Rank
		1	2	3	4	5			
1	Scope of the project (type and nature of the project)	3	7	7	20	15	193	0.74	1
2	Location of the project	4	7	20	11	10	172	0.66	2
3	Site access	10	10	13	12	7	152	0.58	4
4	Period of the project	5	11	17	10	9	163	0.63	3

Table 4.23 shows the scope of the project (type and nature of the project) are ranked first with RII=0.74 the importance this factor is high according to contractors. The other factors are location of the project, period of the project and site access with RII=0.66, RII=0.63 and RII=0.58 respectively ranked by the respondent. The type and nature of the project affects the quality as understand from literature review especially when the project is different or complex. The experiences of human resource are very important to solve this problem. In our country there is no that much complex work according to the interview made by informal method. So, the projects don't have that much effect in Ethiopia that is why contractors ranked project on the last position.

4.4 Summary of results and findings

The quality management practices of contractors are assessed in section 4.2 and 4.3 of this thesis both by interview and questionnaires. The first emphases are to differentiate the contractor's works that are public, private and cooperative. According to the result majority of contractors clients are public sectors then private sectors and cooperative comes final. So, this indicates our (Ethiopia) public sectors are more influenced by contractor's quality management activities.

The contractors priorities are also assessed in this section the most important and highly prioritized factors by the contractors are project cost budget this shows most of contractors are focused on how to be profitable but only focusing on cost doesn't bring profit because the other factors like quality work and time are highly important for more profitability of contractors.

The perception of contractors on quality are different the majority of contractors perceived quality works gives competitive advantage for the contractors by creating another work to get in the future. The next perceptions of the contractors are elimination of defects by doing quality works they can increase profit. In general contractors have different perception about quality there is no common understanding about quality this makes it the company direction on quality to manage difficult .

The other issues in this chapter are quality improvement program of the companies also analyzed. Types of quality improvement program are also included in this chapter like ISO 9001, Total quality management, quality control/quality assurance. From these types of quality improvement program quality control/quality assurance is mostly used type in Ethiopia but above half of Ethiopian contractors did not answer what types they use.

The major objectives of the contractors using quality improvement programs are assessed and the result shows compliance with statutory, environmental and safety requirements were the major objective of around 27% contractors. The second objective selected by contractors is cost reduction (around 14% contractors). Almost half (51.9%) of the contractors didn't state their objectives.

The main factors affecting quality of building construction projects are analyzed in this chapter. The number of the main factors are 12 here is their list project, design, contract, materials, labors, equipment, subcontractors, site layout, systems, site staffs, financial and owner. The above main factors have their own sub factors which are 49 in numbers. All the main factors and sub factors are ranked by the contractors which are helpful for the contractors in order to concentrate on the factors that influence highly the quality of the project especially during design quality management system for the company.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions are made based on the objectives of the thesis:

- 1) The contractors involved in building construction projects are aware of the concept of quality and quality management but its application was relatively low, (40.4%). The contractor's main focuses are more on finishing the work on time and with profit than practicing quality.
- 2) The majority of the contractors, (59.6%) don't implement quality management system in their company. The contractors which implement QMS like: ISO 9001 and quality control/quality assurance have better quality understanding and practice than the contractors who doesn't implement quality management system as it understood from the analysis of the study. And also the contractors that implement quality management system have their own objectives about their quality management system this helps them to achieve quality and other related issues like for example success in finance and bidding.
- 3) Building construction projects in Ethiopia are suffering quality problems and this study identified that, design related issues are the most common among the twelve different factors examined in this study and very important for the success of quality practices. Design related issues like completeness and consistency of design document is very important for success of quality.
- 4) Labors related issues are the second most important factors to reduce the quality problem issues in Ethiopia building construction projects. Labors with experiences, training, communication skill, income level and wage of labors, and motivation system are very important sub-factors in order to get high quality.

5.2 Recommendations

The following points are recommended to contractors in order to improve their quality management system.

- 1) The management of contractors should effectively use quality management system to develop or grow the potentials of their employees to increase the quality of construction work and the efficiency of their company.
- 2) Ethiopian contractors should have to give training at different level of the company about quality management techniques.
- 3) The Government bodies should encourage contractors to get ISO 9001 system certificate in their company. For example, by asking contractors about details information about their company quality management system during bidding of public building construction projects and considering ISO 9001 certification as bidding requirement during tender.
- 4) The contractors should give great attention on the factors affect quality like: design related factors; labor related factors; systems related factors; site staff (cooperation, understanding, experience); materials related issues; financial Issues; subcontractors related issues; contract related issues; site layout related issues; owner related issues; and project related issues. The above factors should have to get emphasis according to the importance they have on quality. So, these factors are essential for the contractors to solve quality problem on the construction projects.
- 5) The present study is an essential first step towards highlighting the major issues that need attention to improve the quality of building construction projects in Ethiopia. More efforts are still needed to investigate ways to formulate management systems (policies and procedures) to handle each factor individually.

5.3 Further research recommendations

- 1) Research into the effect of owners, consultants and regulatory bodies on the quality of the building construction projects.
- 2) Research into the comparison of Ethiopian contractors and foreign contractors quality management practices on selected construction company.

REFERENCES

1. Abebe Dinku, 2016, “construction overhaul overdue”, Addis fortune Newspapers online available at: <http://addisfortune.net/interviews/construction-overhaul-overdue/> (Accessed on 29th August, 2016)
2. American Society for Quality, what is quality? Available at: <http://www.asq.org>, (accessed February 15, 2016)
3. Ashokkumar D., 2014, “Study of Quality Management in Construction Industry” available at: <http://www.ijirset.com> (Accessed on 2nd September, 2016)
4. Atkinson, G. (2005). Construction Quality and Quality Standards, the European Perspective, London: E & FN SPON
5. Behzad Abbasnejad, 2013, Poor Quality Cost in Construction: Literature Review Master of Science Thesis in the Master Degree Programme, Design and Construction Project Management Department of Civil and Environmental Engineering Division of Construction Management Chalmers University of Technology Gothenburg, Sweden
6. Chung H.W., 1999, Understanding Quality Assurance in Construction a Practical Guide to ISO 9000 for Contractors, E & FN Spon published in the Taylor & Francis e-library, 2002.
7. Creative research system, 2001, “sample size formula” available at <http://www.surveysystem.com/sample-size-formula>
8. Deming, W.E. 1990, Out of the crisis, Center for Advanced Engineering Study, MIT Cambridge Mass
9. Department of trade and industry, 2015 quality management systems- From quality to excellence available at: <http://www.dti.gov.uk/quality/qms> (Accessed on 18th march, 2017)
10. Fox, M.J. 1995, Quality assurance management. Chapman & Hall. London.
11. GTZ, March 2004, Standards and Quality in Ethiopia, Addis Ababa, Ethiopia
12. International Organisation for Standardisation . 1998. “ISO 9000 Compendium.” 7th ed. Switzerland: International Organisation for Standardisation.
13. Jackson B.J., 2010, Construction Management Jump Start, Wiley publishing, Inc., Indianapolis, Indiana
14. James Harrington H., Frank Voehl, Hal Wiggin, (2012), "Applying TQM to the construction industry", The TQM Journal, Vol. 24 Iss: 4 pp. 352 – 362

15. Juran J.M. 1988, quality control handbook, McGraw-Hill Book Co., Inc. New York
16. Kaufmann, T., Wiltschko, T. (2006) D 2.4, Quality Management Concept, Euroroads,
17. Lakshmi R., 2015, “Quality Control and Quality Assurance in Building Construction” available at: [http:// www.internationaljournalsrjg.org](http://www.internationaljournalsrjg.org) (Accessed on 1st September, 2016)
18. Moving from ISO 9001:2008 to ISO 9001:2015 available at:http://www.iso.org/tc176/sc2/public_(Accessed on 6th January, 2018)
19. Project Management Body of Knowledge “PMBOK Guide” (2013) 5th Ed. PMI Inc.
20. Pyzdek, T. and Berger, R.W (1996), “Quality Engineering Handbook”, Tata McGraw-Hill.
21. Sdn.Bhd., 2015, “Quality management system” available at: [http:// www.osh-isis.com/qms/qmsmanual.pdf](http://www.osh-isis.com/qms/qmsmanual.pdf) (Accessed on 3rd January, 2018)
22. Syed M. Ahmed, 2016, Measurement of Construction Processes for Continuous Improvement: Planning Consultant State of Florida, Department of Community Affairs 10-13
23. Tan, R.R. and Lu, Y.G. (1995), “On the Quality of Construction Engineering Design Project: Criteria and Impacting Factors”, International Journal of Quality & Reliability Management. Vol.12, No.5, PP. 18-37.
24. Teklebrhan K., 2014, Assessment of the Impact of ISO 9001 Certification on Ethiopian Construction Companies. MSc Thesis, Addis Ababa Institute of Technology, School of Civil and Environmental Engineering
25. Thorpe, B. and P. Sumner. 2004. Quality management in construction. England: Gower Publishing Limited.
26. U.S. Army Corps of Engineers, construction quality management for contractors available at: <http://www.spa.usace.army.mil/Portals/16/docs/business/cqm/CQM%20Student%20Study%20Guide.pdf> (accessed on September, 2017)
27. Western power distribution (WPD), Quality management system Available at: <http://www.abahe.co.uk/business-administration/Quality-management-systems.pdf> (Accessed on 3rd January, 2018)
28. Yimam Abadir H., 2011, Project Management Maturity in the Construction Industry of Developing Countries (the case of Ethiopian contractors). MSc Thesis, University of Maryland, available at: <http://gradworks.umi.com/14/96/1496393.html>, (Accessed on 2nd September, 2016)

APPENDICES

APPENDIX-A

QUESTIONNAIRE

Title:-Assessment of Quality Management Practices of Ethiopian Contractors
Focused on building construction projects

AIM

The aims of this survey are:

- ❖ To investigate how the concept of quality and quality management is adopted in the construction process.
- ❖ To identify the major factors that is mostly affecting the quality of building construction projects during the construction particularly in execution phase

CONFIDENTIALITY

- ❖ All information provided in this survey will be treated as strictly confidential, no companies or individuals will be identified in any subsequent research report, and all information collected will be used purely for the purposes of academic research.

FEEDBACK OF RESULTS

- ❖ After all surveys are collected and analyzed, feedback on the overall research results will be provided upon request to interested respondents in this study.

CONTACT DETAILS

- ❖ If you have any questions regarding this survey, please do not hesitate to contact:
Biniyam Asefa Phone No. 0913966800 Email :-biniyamasefa7@gmail.com

I. Questions related to company

Please kindly respond to the following questions by ticking (✓) the appropriate box or writing your answer in the space provided.

1. Name of company (Optional) _____

2. Category and class of company _____

3. How long has the organization been operating?

Less than 5 years 5 to 10 years 10 years and above

4. Number of projects executed in the last five years

Less than 10 11 to 20 more than 20

5. The firms major clients

Public Private Cooperative

Others (please specify): _____

6. Priority Given To Some Factors in the company

No.	Factors	Level Priority		
		High (3)	Moderate (2)	Low (1)
1.	Meeting Project Time / Deadline			
2.	Meeting Quality Standards			
3.	Achieving Success during tender			
4.	Satisfying Client's brief			
5.	Meeting Project Cost Budget			
6.	Meeting Health and Safety Standard			

II. Questions related to the practice of quality

7. In your view, which of these words best define quality? (not limited to one answer)

- Expensive
- Appearance
- Increased profit
- Customer's satisfaction
- Meeting specification requirement

Others (please specify) : _____

8. What is your organization's perception of quality?

- Elimination of defects
- A tool to increase profits
- A competitive advantage

Others (please specify): _____

9. Does your organization have a quality management system?

- No (Please go to next section of question)
- Such a plan is under consideration
- A quality improvement program has been implemented recently
- A quality improvement plan has been a part of corporate policy for some time now

10. What type of quality management system do you have?

- ISO 9000
- Total Quality Management
- Quality Control / Quality Assurance

Others (please specify): _____

11. The major objectives of your quality management systems are:

Increase productivity

Cost reduction

Involvement of employees in the quality building effort

Compliance with statutory, environment and safety requirement

Others (please specify): _____

III. Main Factors affecting Quality in construction projects during construction phase (success factors)

12. Please identify (carefully) the degree of importance of factors affecting quality in your construction project by ticking (√) the appropriate box.

Very high important = 5 high Important = 4 Medium important=3 Low important =2

Very low important = 1

No.	Main Factors affecting quality	Degree of Importance				
		5	4	3	2	1
1.	Project (type and complexity) related issues					
2.	Design related issues					
3.	Contract related issues					
4.	Materials related issues					
5.	Labors related issues					
6.	Equipment related issues					
7.	Subcontractors related issues					
8.	site layout of the project					
9.	Systems (quality control, cost control, safety program)					
10.	site staff (cooperation, understanding, experience)					
11.	Financial Issues					
12.	Owner (public, private)					

IV. Sub-factors affecting quality (success factors)

13. Please identify (carefully) the degree of importance of factors affecting quality in your construction project by ticking (√) the appropriate box.

Very high important = 5 high Important = 4 Medium important=3 Low important =2

Very low important = 1

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
1.	Factors related to project	Scope of the project (type and nature of the project)					
		Location of the project					
		Site access					
		Period of the project					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
2.	Factors related to design	Completeness and consistency of design documents.					
		Drawings are prepared in details					
		Conformance to codes and standards					
		Bill of quantity is detailed and accurate.					

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NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
3.	Factors related to contract	Cooperation between parties involved in contract					
		Previous relations between parties(good or bad)					
		A written contract with conditions clear and fair and responsibilities distribution is clear					
		Using a standard contract					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
4.	Factors related to materials	applying material management system					
		Cooperation between contractor and material suppliers					
		construction materials quality					
		storage and handling system					

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NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
5.	Factors related to labors	Communication skills of labor					
		labors experience					
		Motivation System					
		Training courses for labors					
		Income level and wages of labors					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
6.	Factors related to Equipment's	Availability of Equipment's					
		Equipment management system					
		Measurement of equipment's Productivity					
		Utilization of equipment's					
		Equipment maintenance					

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NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
7.	Factors related to Subcontractors	Company's methods and procedures of selecting subcontractors					
		Cooperation between subcontractors and contractor					
		System to evaluate subcontractors performance					
		Subcontract conditions					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
8.	Factors related to site layout	Site layout is large and suitable for movement of labors and equipment					
		Site layout is organized					
		Site layout has storage areas for materials					
		Site is clean					

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NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
9.	Factors related to systems	Quality control and Assurance system					
		Time Schedule					
		Cost control system					
		Safety program					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
10.	Factors related to site staffs	Cooperation between Supervision and Contractor's staff					
		Understanding of contract administration by Supervision					
		Skill and experience Supervision staffs					
		Skill and experience Contractor's staffs					

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NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
11.	Factors related to Financial Issues	The amount of contractor's cash flow					
		The non-delay of interim payments					

NO.	Group	Sub-Factors affecting quality	Degree of Importance				
			5	4	3	2	1
12.	Factors related to Owner	Owner organization nature (Public or Private)					
		The Owner is not delaying to make Decisions					
		Owner's contribution to design					
		Owner's emphasis on quality					

APPENDIX- B

Interview question

- 1) Form your experience, how could quality expressed in building projects?
- 2) What do you think major objectives of quality management in the construction company?
- 3) How does your organization manage quality? Or is there any quality management program your organization implements?
- 4) What are the factors that you think will affect the quality of construction projects during construction phase? Please explain with example.