Addis Ababa Institute of Technology

Department of Civil and Environmental Engineering

Effectiveness of Quality Management System (ISO 9001- 2008) Implementation in Ethiopian Construction Consultants

By

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DECLARATION

I, the undersigned, declare that this study entitled "Effectiveness of Quality Management System (ISO 9001- 2008) Implementation in Ethiopian Construction Consultants" is my own work. I have undertaken the research work independently with the guidance and support of the research advisor. This study has not been submitted for any degree or diploma program in this or any other institutions and that all resources of materials used for the thesis have been duly acknowledged.

Declared by

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This is to certify that the above declaration made by the candidate is correct to the best of my knowledge

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Selamawit Tigestu

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Contents

LIST OF TABLES

LISTS OF FIGURES

List of Abbreviations

ASQ	American Society for Quality
AACCSA	Ababa Chamber of Commerce & Sectorial Associations
CCl	Commission of Climatology
DQS	Data Quality Service
ESA	Ethiopian Standards Agency
FIDIC	International Federation of Consulting Engineers
GDP	Gross Domestic Product
GVPC	Gross Value of Production for Construction
GDCF	Gross Domestic Capital Formation
ISO	International Standard for Organization
IAF	International Accreditation Forum
LEG	Leadership Expert Group on Quality
MoUED	Ministry of urban and economic development
NSB	National Standards Body
QMS	Quality Management System
QM	Quality Management
QC	Quality Control
QA	Quality Assurance
QSAE	Quality and Standards Authority of Ethiopia
SQC	Statistical Quality Control
TQM	Total Quality Management
UCBP	University Capacity Building Program

Abstract

The construction industry in Ethiopia has faced problems in delivering projects. Time overrun, cost overrun and insufficient quality are common for many projects. These problems are caused by a number of factors such as poor project cost estimation, price escalation of construction materials, poor project planning, poor project follow-up, poor design quality, human resource problem, and poor financial and equipment management. Due to this, customer satisfaction is rare for many projects. Engineering consultants are among the major construction parties responsible for critical activities and performance of projects. Therefore, this research attempts to introduce effective Quality Management System implementation approach to achieve predetermined objectives set by the consultants in delivering projects to satisfy customers. It is about developing a Quality Management System which adequately fulfills the requirements set by ISO 9001 2008 standard. Quality Management System is a tough approach which advance the way of doing things through introducing standard procedures to the company activities to achieve the best result. Procedures are developed for the company activities based on the ISO 9001 2008 standard requirements to have consistent way of doing things and make continuous improvement on the procedures to maximize the output.

The aim of this research is to identify the effectiveness of implementation of Quality Management System in Ethiopian construction consultants and challenges in the application of the system and to recommend improvement actions that will make the system effective.

To attain this objective, the study specifically explores the current involvement of the construction consultants in utilizing ISO 9001 2008 standard QMS, effectiveness of implementation of ISO 9001 2008 QMS in Ethiopian Construction Consultants, Quality Management System implementation challenges and measures to implement the system effectively.

The study also attempts to introduce QMS principles, standard requirements and tools to establish the system. Consultants attempt on the implementation of QMS is evaluated according to the ISO 9001 2008 standard requirements.

Both quantitative and qualitative analysis has been done for the survey. The results of this research have confirmed that the performance of Ethiopian consultants with respect to effective implementation of ISO QMS is poor. It is due to lack of adequate knowledge on activities to make the system effective, the difficulty to interpret the standard requirement, lack of top management commitment and engagement of employees, lack of technical expertise to establish and control the implementation of the system, lack of intensive internal audit, and lack of exhaustive surveillance audit made by the certification agent.

The survey results also show that the involvement of construction consultants in the country on QMS is negligible. From the total number of 350 consultants less than 3% of construction consultants have been certified for the system. This is because QMS benefits are not clearly understood by the consultants. However QMS strongly improve the project performance as well as customer satisfaction through providing standard processes for company activities and allowing continuous improvement to these operating processes. Based on the findings this study proposed area of efforts for the improved implementation of the system.

Key Words: Quality management, ISO QMS principles, ISO 9001 2008 standard requirements, standard procedures, continuous improvement and customer satisfaction.

1. Introduction

1.1. Background

Construction industry makes significant contributions to the socio-economic development process of a country. Its importance emanates largely from the direct and indirect impact it has on all economic activities. It contributes to the national output and stimulates the growth of other sectors through a complex system of linkages. It contributes to employment and creates income for the population and has multiplier effects on the economy [1].

In the Ethiopian economy, the construction industry has important contributions as demonstrated by its share in the GDP. For instance, the share of the sector in the total GDP averaged at about 5.2 percent in the period 2002/03- 2006/07. Also, the development of the construction industry can be measured using its Gross Value of Production (GVPC). According to this report, the GVPC at constant market price is 18.9 billion in the year 2006/07. The share of construction GVP in the gross domestic capital formation (GDCF) is 68.4 percent in the year 2006/07 and averaging at 66.9 percent for the whole period starting from 2002/03 [1].

However, this sector has faced various challenges starting from its early stage up to its booming course. The industry is shallow except its booming which is triggered by the rapid and continuous economic growth of the country. There is lack of favorable environment which promotes competitiveness and continuous improvement. It is believed that transforming the sector is very important [2].

According to the research finding of a recent study at the London School of Economics (LSE) in UK, it has reported that, management practice in Africa is poor as compared to Europe and North America. According to this report, Ethiopia is the second from the last followed by Mozambique which indicates that the management practice in Ethiopia is even far behind from those poor performing developing countries in Africa. The results revealed that the level of construction project management practice in this companies in terms of adapting general project management procedures, project management functions, tools & techniques to be unsatisfactory. Hence, the level of practice in terms of safety, risk and time management, planed costs and other variables such as quality, and resources utilization was found to be very low [3].

The construction industry lags behind other industries in practicing standard quality management system. According to the data from the Ethiopian Standard Agency, engineering consultants certified to implement quality management system are less than 3% among 350. The adequacy and effectiveness of quality management activities is also another issue to be addressed.

From the literature search, Quality Management System is an essential concept which enables to have consistent and effective management in an organization through having standard quality management procedures. It facilitates a business, to attain the objectives or project scope that has been defined in the organization strategy. It ensures the achievement of stability and reliability regarding the techniques, equipment, and resources being used in a project. All project activities are integrated and aligned towards the achievement of quality products. It ensures that the customer is satisfied by meeting their requirements hence these efforts commence by identifying the customer needs and expectations, and culminate in their contentment. It keeps an organization assess itself constantly and make continuous improvement. It is achieved through an integrated effort among personnel at all levels by continuously improving performance. As it is applied in other sectors a commitment to this system has a potential to involve in construction industry and make improvement on a company [4].

In Ethiopia there are significant numbers of construction companies. Also new contractors and consultants emerge every year. According to the data from MoUWD there are more than 350construction consultants registered under the regulatory body in the year 2017. Hence, it is worth to study on the topic of QMS in order to insure the sustainable development of the companies.

The study will demonstrate standard requirements and principles of Quality Management and techniques are considered practical in the engineering consultant companies. The study examines the effectiveness of current quality management activities and identifies Quality management implementation challenges. Hence it will aware the consultants to engage on improvement activities and gain the associated benefits.

1.2. Problem Statement

Quality management systems based on international standards benefits manufacturers, service providers, users, consumers and regulators and supports sustainable development, so its popularity is relevant today [5]. According to the ISO Survey, the numbers of certificates have been issued by certification bodies that are accredited by members of the International Accreditation Forum (IAF).A total of 1,644,357 valid certificates were reported in the ISO Survey 2016 [6].

In an attempt to employ quality as a key component of the success of construction businesses today, it requires a well-implemented QMS in order to ensure its effectiveness. The main aspects of successful construction projects are to deliver projects with high quality and on time, complete project with minimum expenses, and satisfy customers, as the construction project success criteria. Doubtlessly, ISO 9001 provides a proper “environment” that assists construction projects in achieving these goals (Mane and Patil, 2015) [29].

However the results of a survey on Quality in construction by FIDIC has clearly indicated that the failure in construction quality is a big problem worldwide. In order to attract customers, ISO certification should be a trend in most industries including construction industry [13].

Similarly, many construction companies in Ethiopia are frustrated in their effort to improve quality through the use of Quality Management. With guidance from GIZ International Services’ as the project management and implementation agent for the UCBP program, under the capacity of the Ethiopian construction sector, the first companies in the Ethiopian construction sector received an ISO certificate on February 2008 [30]. Total of 8 contractors was certified by German company (ZERT) through GTZIS [38].

However there is no change until the year 2017. According to the data from the Ethiopian Standard Agency, only 7 construction consultants are currently registered for certification of ISO 9001 2009 for the same year. These circumstances show that there is a gap in using QMS as a tool for better quality management.

According to the study “Study of Quality Management in Construction Industry” by Ashokkumar Quality Management has increasingly been adopted by construction companies as an initiative to solve quality problems and meet the needs of the final customer. However, implementing

QMS principles in construction industry is not much easy because of the multiple parties involved in the process and due to its unique characteristics so that it needs to have strong commitment [16].

Therefore, the rationale for conducting this research is to study the Maturity of Current Quality Management Practice and major challenges towards the implementation of the system to find improvement actions.

1.3. Objective

General Objective

- To identify the effectiveness of implementation of ISO 9001 2008 standard QMS in Ethiopian construction consultants through the three basic elements of standard QMS which are **Adequacy of Manual**, Organizations **Standard Operating Procedure** and **Documentation** requirements.

Specific Objectives

- To identify the understanding of ISO 9001 2008 quality management system in the consultants
- To identify the effectiveness of implementation of QMS in Ethiopian Construction Consultants based on ISO 9001 2008 standard requirements categorized under the three elements
- To identify Quality Management System implementation challenges
- To identify measures to overcome the challenges and to implement the QMS effectively and
- To develop a conceptual framework for the effective implementation of the system

Research questions

The research will address the following questions:

- Do the consultants have sufficient knowledge on standard requirements to establish ISO QMS?

- Does the consultants' QMS comply with the basic elements of standard QMS and full filled the requirements set by the ISO 9001 2008 standard document under this elements.
- Do the consultants duly consider the ISO 9000 series of quality standards for the effective implementation of the system
- What are the problems and challenges in the implementation of the QMS in Ethiopian construction consultants
- What are shall be taken to make the system effective

1.4. Scope and limitation of the study

The study area is limited to certified grade 1, 2 and 3 construction consultants in Ethiopia. Grade 1, 2 and 3 represents as high level consultants and carry out a high value of works. International consultants and construction management consultants are excluded from the study.

Also there was a limitation on acquiring sufficient data from the sample construction consultant offices. This was due to the reason that the system is not fully practiced by the companies. It is even on very few consultant offices that the system exists. There was also lack of background data on previous QMS practice in Ethiopian construction companies due to the limited research papers on the specific area to be referred.

2. Literature Review

2.1. Introduction

There are many definitions of quality available in the literature. These definitions attributed to quality are stated as follows:

- The most general and succinct definition: According to Joseph Juran, quality means “fitness for use;” according to Philip Crosby, it means “conformance to requirements.”[10]
- Quality is the degree to which an object (entity) [e.g., process, product, or service] satisfies a specified set of attributes or requirements [Cooper 2002] [7].
- Quality as fitness for purpose concept that stresses the need to meet generally accepted standards such as those defined by an accreditation or quality assurance body, the focus being on the ***effectiveness of the processes*** at work in the institution or programme in fulfilling its objectives and mission. Sometimes quality in this sense is also Labeled as: (i) a value for money approach owing to the implicit focus on **how the inputs are effectively and efficiently used by the processes** and mechanisms involved or (ii) the value added approach when results are evaluated in terms of changes obtained through various educational processes e.g. teaching and learning processes) [15].
- Several statistical organizations have developed lists of quality dimensions, which, for international organizations, are being harmonized under the leadership of the Committee for the Coordination of Statistical Activities (CCSA). The European Statistics Code of Practice defines quality in terms of the institutional environment, statistical processes and statistical output. It encompasses all aspects of how well statistical processes and outputs fulfill expectations of all of their users and stakeholders. Regarding this Good quality of statistics is not just meeting user needs but also includes addressing respondent concerns and ensuring institutional environment is impartial, objective, comprising sound methodology and have cost effective procedures [9].
- W. Edwards Deming defined quality as follows:
  Good quality means a predictable degree of uniformity and dependability with a quality standard suited to the customer. This definition is about the same or consistency of conformance and performance, and keeping the customer in mind [11].

- Quality is a subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1. the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies. [10]
- In the quality management field, quality has a more specific meaning. According to ISO 9000, quality is defined as "A degree to which a set of inherent characteristics fulfills requirements". If those inherent characteristics meet all requirements, high or excellent quality is achieved. If those characteristics do not meet all requirements, a low or poor level of quality is achieved [8].

  Therefore, the ISO definition goes further in that it may include related characteristics beyond product or service but goes deeper to the processes and systems within organization. A customer may specify some or all these characteristics. A problem or nonconformity in any of these areas may lead to customer dissatisfaction. An organization must ensure that it has systems and controls to assure that it can consistently fulfill all these requirements and enhance customer satisfaction [8].

  The needs of customers vary and change over time. Therefore, companies should review quality requirements periodically. Requirements may come from regulatory, statutory, industry and other sources. An organization must be aware of and ensure that all these diverse requirements are defined and met. It could therefore be stated that ‘quality’ includes all of the characteristics of an organization’s products, services, processes, support and management system that contribute to meeting requirements and enhancing customer satisfaction[8].

2.2. Measuring Quality

a) **'Quality in fact' Vs. 'quality in perception':-** The providers of services or goods that meet specifications achieve quality in fact. A service or product that meets the customer's expectations achieves quality in perception. In other words, a product can be of high quality and yet it may not meet customer's needs and vice versa [18].

b) **'Product quality’ and 'process quality':-** there is a difference between 'Product quality’ and 'process quality'**.** 'Product quality’ refers to the quality of elements directly related to the physical product itself whereas 'process quality' refers to the operational process that causes the product to be either acceptable or not [18].

For instance, 'product quality' in the construction industry may refer to achieving quality in the materials, equipment and technology that go into the structure.
whereas 'process quality' may refer to achieving quality in the way the project is organized and managed in the three phases of planning and design, construction, and operation and maintenance [28].

Leadership Expert Group on Quality (LEG), which was formed in 1999, in its final report (Eurostat (2002)) highlights the need to distinguish between different types of quality. Product quality is the quality of the output. In the case of a statistical organization this is the quality of the data and services provided. These products are generated by an underlying process or sequence of processes, and so the product quality is likely to be affected by the process quality. The report states that 'in theory, good product quality can be achieved through evaluations and rework. However, this is not a feasible approach since it is costly and time-consuming. Instead, it is believed that product quality will follow from improvements in process quality.' So improving process quality is a key aim. The report goes on to explain how 'the process quality is improved by identifying key process variables (i.e. those variables with the greatest effect on product quality), measuring these variables, adjusting the process based on these measurements, and checking what happens to product quality. If improvements do not materialize, alternative adjustments are made or new key variables are identified and measured. This is an example of the so-called PDCA (Plan, Do, Check, Act) cycle advocated by the late W. Edwards Deming in the spirit of continuous improvement.' This theory led to the third recommendation of the LEG, relating to process quality: 'Process measurements are vital for all improvement work [17].

2.3. Different Approaches to Achieve Quality and Alternative Quality Philosophies

The following are different quality approaches until the time of Quality Management.

1- **Quality inspection:-**The Company started to employ teams of inspectors to compare or test the product with the project standard. This was applied at all stages covering the production process and delivery, etc. The purpose of the inspection was that the poor

quality product found by the inspectors would be separated from the acceptable quality product and then would be scrapped, reworked or sold as lower quality [22].

2- **Quality control: -** It is the specific implementation of the QA program and related activities. Quality was controlled through supervised skills, written specification, measurement and standardization. Effective QC reduces the possibility of changes, mistakes and omissions, which in turn result in fewer conflicts and disputes [18].

3- **Quality assurance: -** QA is a program covering activities necessary to provide quality in the work to meet the project requirements. It involves establishing project related policies, procedures and standards training, guidelines, and system necessary to produce quality. Quality assurance is all planned and systematic actions necessary to provide adequate confidence that a structure, system or component will perform satisfactorily and conform with project requirements.QA provides protection against quality problems through early warnings of trouble ahead. Such early warnings play an important role in the prevention of both internal and external problems [18].

4- **Quality Management System**

Quality management (QM) is a process that focuses not only on the quality of the product but also on the means to achieve it. It is centered on the following four activities: quality planning, quality control, quality assurance and quality improvement. [23].

A QMS can be defined as the managing structure, responsibilities, procedures, processes, and management resources to implement the principles and action lines needed to achieve the quality objectives of an organization [32].

A qualitative QMS does not in itself make an organization more profitable, efficient or customer focused, but it will give to an organization the ability to do anything better [32].

ISO QMS is the organizational structure, procedures, processes and resources needed to ensure the delivery of an organization's quality products and services. ISO 9001 provides an appropriate framework to implement the required change management processes. The framework helps identify the most appropriate policies, procedures and records [23].

5- **Total Quality Management:-** involves the understanding and implementation of total quality management principles and concepts in every aspect of business activities. Total Quality Management demands that the principles of quality management must be applied at every level, every stage and in every department of

the organization. The process of quality management would also be beyond the inner organization in order to develop close collaboration with suppliers [22].

Also the following are widely used management philosophies in the history of successful business;

1. **Six Sigma: -** the intention of the Six Sigma concept is to achieve, and improve quality in order to ensure customers satisfaction and consequently customers' loyalty. The following are definitions six sigma by different scholars [33].
    - Pande et al. (2000) commented that Six Sigma is a comprehensive and flexible system for achieving, sustaining, and maximizing business success. It is driven by close understanding of customers' needs and disciplined use of **facts**, **data**, and **statistical analysis**.
    - Slater (2001) stated that the Six Sigma approach provides a **very specific control program** with **control techniques** that ensure continuation of improved processes.

    In six sigma, senior management is ultimately responsible for the success of the project through the provision of sufficient support, resources, and strong leadership. The implementation of GE-6 · is thus top-down. The chief executive officer (CEO) is usually the driving force who sets up the vision, develops the strategies, and drives the changes [33].

    Apart from the critical role of the CEO, other players also have their specific roles (Henderson and Evans, 2000): this are 'Champions' which are usually the senior managers, 'Master Black Belts (MBBs)' which are the full-time teachers and consultants 'Black Belts (BBs)' who have the key operational role in the program as full-time Six Sigma players and 'Green Belts (GBs)' which are the process owners who, led by the BBs. Training is dominant activity to equip them to the six sigma activities. The training courses are comprehensive and cover team leadership skills, measurement and analytical tools, especially statistical methods, improvement tools, planning and implementation skills, and so on[33].

The following table shows comparison between TQM/QMS and six sigma [33].

Table 2.1. Comparison of TQM/QMS and Six Sigma

TQM/QMS	**GE-6**
TQM over-emphasizes customer satisfaction	GE-6・focuses on both customer satisfaction and financial performance
TQM is essentially a system of continuously improving the quality of every aspect of business life.	GE-6・focuses on radical change (which is also integrated with vision and strategy)
TQM emphasizes that every person is involved in quality improvement at all levels	GE-6・uses specially designed roles and disciplined training to progress the radical changes
TQM considers every aspect of quality.	GE-6・initially emphasizes the key processes related to customer needs, but gradually extends its improvement scope
the statistical tools used in TQM are quite basic,	GE-6σ uses more advanced SQC tools
TQM has a bottom-up management style	GE-6σ gives emphasis to top-own leadership
Change coming from TQM is progressive.	GE-6ƒã emphasizes fast change and significant re-engineering
The improvement steps are Plan Do Check Act as discussed later in this paper	The improvement step is; Define’, ‘ Measure’, ‘Analyze’, ‘Improve‘ or Design, and ‘Control or‘ Verify’ (DMAIC).

2. Balanced Score Management (BSC)

The BSC is an organizational framework and tool for describing, implementing, and managing strategy at all levels in the organization. The BSC technique translates an organization's strategy into terms that can be easily understood, communicated, and acted upon by people inside and outside the organization. The BSC suggests that the organization be reviewed from four perspectives, i.e., customer, internal business process, learning and growth, and financial. These perspectives assist organizations in developing metrics, collecting data, and analyzing data. Kaplan and Norton use the BSC as a process for translating strategy into action that turns the organization's strategic vision into clear and understandable objectives within those four perspectives. BSC approximately weighs each of the four perspectives equally, by allocating measures to each perspective [34].

Once objectives are determined for each perspective, the next developmental step is to develop similar objective themes that are brought together in a cause-and-effect relationship. These themes form the basis of communicating the organization's strategy to employees and other interested parties. The next step is to find suitable metrics to assess the validity of whether the organization is actually achieving its objectives. The final step in the BSC process is determining how often the measures are monitored [34].

2.4. Selection of Management System for the Construction Industry

Businesses are increasingly making use of a variety of management systems, methodologies, and tools−including ISO 9000, total quality management (TQM), Six Sigma, and the balanced scorecard (BSC). In all of these practices, quality is the main focus [33].

The implementation of ISO 9000 and TQM systems can be used to improve the quality of products and services and to raise the effectiveness of **process management**; implementation of the Six Sigma program can raise the level of customer satisfaction, process performance, and resources management; the implementation of BSC can improve strategy planning and long-term profitability; and so on [33].

As in the manufacturing industries, the construction industry should focus on process quality [18]. ISO 9000 quality management system is an achievable goal to many service organizations

as a means of improving **internal processes** and **product** or **service** quality. Organizations that view certification as an opportunity to improve internal processes and systems will get broader positive results from ISO 9000 quality management systems (Llopis and Tarí, 2003). ISO 9000 quality management systems bring clearer and more apparent working procedures and responsibilities (Lundmark and Westelius, 2006) [5].

2.5. The ISO Standards and Quality Management System

2.5.1. ISO Quality Management Standards

ISO is a worldwide federation of national standards bodies (ISO member bodies) which develop and publish International Standards. ISO is a non-governmental organization that forms a bridge between the public and private sectors. On the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.[22]

Company registered as complying with ISO standards has demonstrated to an accredited third party. Processes have been documented and the company is systematically audited that they are following the policies and procedures necessary to produce high quality products. [22]

The entire series of **ISO 9000** consists of the following standards, which represent an international consensus on good quality management practices: [22]

(a**) ISO 9000:2015**, Quality management systems – Fundamentals and vocabulary. This Standard describes the fundamentals of quality management systems and specifies the terminology used in ISO 9000[23].

(b) **ISO 9001:2008**, Quality management systems – Requirements. These requirements can be applied to all types of organizations, both in the public and private sector, regardless of size or industry group. They can help both product and service organizations achieve standards of quality that are internationally recognized and respected throughout the world. It is the only standard in the ISO family against which organizations can be certified (or registered) through a third-party audit process [23].

(c**) ISO 9004:2009,**

It is a quality management approach for the sustained success of an organization. This Standard focuses on achieving sustainable success in today's complex, demanding and ever-changing environment by meeting the needs and expectations of customers and other stakeholders [23].

An interesting facet of this Standard is that it promotes self-assessment as an important tool, which enables ongoing review of the level of maturity attained by the QMS. However, it should be noted that the self-assessment tool is not a substitute for a third-party audit process, which is fundamental to ISO 9001[23].

(D) ISO 19011:2011

This is the second edition and the first was ISO 19011:2002.This international standard provides guidance for internal and external audits of management systems. Effective audits ensure that an implemented QMS meets the requirement specified in ISO 9001[22].

2.5.2. An ISO 9001 Quality Management System

The requirements of this International Standard are generic and are intended to be applicable to all organizations, regardless of type, size and product provided[12]. According to ISO, the certification process is expected to provide confidence that the organization has a quality management system that conforms to the applicable requirements of ISO 9001. In particular, it is expected that the organization [22]:

(a) Has established a quality management system that is suitable for its products and processes, and appropriate for its certification scope;

(b) Analyses and understands customer needs and expectations, as well as the relevant statutory and regulatory requirements related to its products;

(c) Ensures that product characteristics have been specified in order to meet customers' and statutory/regulatory requirements;

(d) Has determined and manages the processes needed to achieve the expected outcomes (conforming products and enhanced customer satisfaction);

(e) Has ensured the availability of resources necessary to support the operation and monitoring of these processes;

(f) Monitors and controls the defined product characteristics;

Aims to prevent non-conformity and has systematic improvement processes in place to:

i. Correct any occurrences of non-conformity (including product non-conformity detected after delivery);

ii. Analyze the cause of non-conformity and take corrective action to avoid its recurrence;

iii. Address customers' complaints;

(h) Has established an effective internal audit and management review process, and is monitoring, measuring and continually improving the effectiveness of its quality management system.

In general, Quality systems are the result of the **quality policy** established by the executive management team and the two most important elements which are **quality manual** and **organization's standard operating procedures**as mentioned earlier. When developing the quality manual, it is advised that attention be paid to the known QMS ISO 9000 series of quality standards[14].

a. **Quality Policy:** is the course or principle defining the commitment to quality by an organization's senior management, including a framework for setting quality objectives.
b. **Quality Objectives:** are performance indicators for measuring the progress of the quality system; for example, the number of hours of staff training per year, the number of discharge measurements made, etc
c. **The Quality Manual: -** is a document that defines the scope of the Quality Management System and that outlines documentation related to the standard to be achieved. It includes or references documented procedures and describes how processes interact to form the QMS. It can be either a high level document with little detail regarding how work is performed, or it may include considerable detail.
d. **Standard operating Procedures: -** It is important to have standard procedures and work instructions together. QMS can be achieved through having effective operation trough identifying and managing interlinked, cross-functional processes, to meet a target set by the organization and achieve user satisfaction.

The quality department is responsible for preparation of the quality manual and the standard operating procedures. This department must work with all other

departments within the organization to provide them with the guidelines they need to assure quality in their operations.

Each individual department should have a hand in developing the quality manual, but the ultimate responsibility for writing and maintaining it rests with the quality department.

However, the adoption of a QMS is influenced by the needs, objectives, the products/services provided, the processes employed and the size and structure of the organization.

2.5.2.1. ISO 9001 Standard Quality Management Principles and System Requirements

The ISO 9000, ISO 9001 and related ISO quality management standards are based on the seven Quality Management Principles. These principles are a set of fundamental beliefs, norms, rules and values that are accepted as true and can be used as a basis for quality management. The Quality Management Principles can be used as a foundation to guide an organization's performance improvement [23].

The following are Quality Management Principles developed and updated by international experts of ISO/TC176, which is responsible for developing and maintaining ISO's quality management standards [23].

1. **Customer focus**

The primary focus of quality management is to meet customer requirements and to strive to exceed customer expectations.

2. **Leadership**

Leaders at all levels establish unity of purpose and direction and create conditions in which people are engaged in achieving the quality objectives of the organization.

3. **Engagement of People**

It is essential for the organization that all people are competent, empowered and engaged in delivering value. Competent, empowered and engaged people throughout the organization enhance its capability to create value.

4. Process Approach

Consistent and predictable results are achieved more effectively and efficiently when activities are understood and managed as interrelated processes that function as a coherent system.

5. Improvement

Successful organizations have an ongoing focus on improvement.The Plan-Do-Check-Act (PDCA) cycle is the operating principle of all ISO management systems standards, including ISO 9001. By following this cycle, an organization will effectively manage and continually improve [22].

Plan: Establish objectives and draft plans (analyze organization's current systems, establish overall objectives, set interim targets for review and develop plans to achieve them).

Do: implement your plans

Check: Measure and monitor your actual results against your planned objectives

Act: Correct and improve your plans to meet and exceed your planned results

6. Evidence-based Decision Making.

Decisions based on the analysis and evaluation of data and information are more likely to produce desired results.

7. Relationship Management

For sustained success, organizations manage their relationships with interested parties, such as suppliers.

Quality management system requirements are set in the applicable Clauses of ISO 9001 2008. The first three clauses of ISO 9001 are introductory and set the stage for the requirements the remaining four key sections enable the requirements articulated within them to be aligned with key corporate governance functions.

ISO 9001 defines a set of quality management requirements in parts 4, 5, 6, 7 and 8. In general these requirements will depend on many factors including the size and structure of the organization, its operating environment, objectives, available resources, products and services, and organizational processes.

a) **Quality Management System (Clause 4)** – sets requirements to identify, plan, document, operate and control an organization's QMS processes and to continually improve QMS effectiveness. This clause specifies requirements for
    - The establishment of the system
    - Documentation
    - Quality manual
    - Control of documents and
    - Control of records

b) **Management Responsibility (Clause 5)** – sets requirements for top management to demonstrate its leadership and commitment to develop implement and continually improve the QMS. This clause requires the management to focus on;
    - Management commitment
    - Customer focus
    - Establishment and revision of Quality policy
    - Quality Planning including Establishment and revision of Quality objectives and Quality management system planning which involves identifying processes, interaction of processes criteria for control and continuous measurement and control of process.
    - Defining and communicating responsibility, authority within the organization
    - Demonstrating the role of management representative
    - Demonstrating the requirement of internal Communication
    - Demonstrating management review requirements

c) **Resource Management (Clause 6)** – sets requirements to determine, provide and control the various resources needed to operate and manage QMS processes; to continually improve QMS effectiveness; and to enhance customer satisfaction by meeting customer requirements. It demonstrates about the provision of resources, competence, training and awareness for human resource and the importance of Infrastructure and Work environments.

d) **Product Realization (Clause 7)** – sets requirements to plan, operate and control the specific QMS processes that determine, design, produce and deliver an organization's product and services.
    - Planning of product realization
    - Determination of requirements related to the product
    - Review of requirements related to the product
    - Communicating with customers in relation to product information, amendments, and customer feedback
    - Design and development procedures from the input to verification of output stage

e) **Measurement, Analysis and Improvement (Clause 8)** – sets requirements to plan, measure, analyze and improve processes that demonstrate product and QMS conformity and continually improve QMS effectiveness.
    - Information relating to customers' perception
    - Inter Monitoring and measurement of processes and products internal audit
    - Control of nonconforming product
    - Analysis of data
    - Continual improvement quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions

2.6. Benefits of QMS

Successful implementation of quality management systems can contribute to an increase in product quality, improvements in workmanship and efficiency, a decrease in wastage, and increased profit. An external quality system covers activities aimed at inspiring confidence in the client that the supplier's quality system will provide a product or service that will satisfy the client's quality requirements [20].

Adequate implementation of QMS brings the following for an organization [37].

- To review business goals, and assess how well the organization is meeting those goals;
- Identify processes that are unnecessary or inefficient, and then remove or improve them;

- Review the organizational structure, clarifying managerial responsibilities;
- Improve process interfaces and internal communication;
- Improve staff involvement by identifying the role of their output to the business, and by involving them in the review and improvement of their work.
- Better management and a more effective organization;
- Improved quality of products and services;
- Workers' satisfaction and more commitment to the organization;
- Improved customer satisfaction;
- Improve relations with suppliers;
- Improved promotion of corporate image.

2.7. ISO 9001 Certification and Registration

ISO 9001:2008, "certification" refers to the issuing of written assurance (the certificate) by an independent, external body (the Certification Body) that has audited an organization's QMS and verified that it conforms to the requirements specified in the standard. "Registration" means that the auditing body then records the certification in its client register. The organization's QMS has therefore been both certified and registered. For practical purposes, the difference between the two terms is not significant and both are acceptable for general use. "Certification" is the term most widely used worldwide, although registration is more commonly used in North America. The two are also used interchangeably [23].

According to ISO, the certification process is expected to provide confidence that the organization has a quality management system that conforms to the applicable requirements. Many organizations successfully adopt a QMS without an ISO 9000 certification, relying on their internal review procedures to keep the whole process on track. IS0 9000 certification leads to formal review and approval of the QMS by an outside body and, more importantly, the certification body will review the QMS every six months. Certification was never a requirement of any of the standards in the ISO 9000 family –this came from customers [23].

2.8. Quality Management in Construction Organization

There is great potential for quality improvement in the construction industry. In today's competitive world, the term 'quality' and its concepts are vital for the construction industry. There

is not much time nor resources to waste. Reworks and delays are not acceptable. As in the manufacturing industries, the construction industry should focus on process quality [18].

ISO 9000:2008 generally defines “quality" as “the degree to which a set of inherent characteristics fulfill requirements”. This means that in the construction industry, quality appears to be achieved whenever the needs of all those entities and individuals involved in projects or production or provision of services are fulfilled. Hence, in construction, project requirements are the key factors that define quality in the process of construction. The process of construction can be broken down into three main phases, namely, (1) the planning and design phase, (2) the construction phase, and(3) the maintenance and operation phase. In the construction industry, quality can be defined as meeting the requirements of the **designer**, **constructor** and **regulatory agencies** as well as the **owner**. Further, quality can be characterized as follows [18].

- ✓ Meeting the requirements of the owner as to functional adequacy; completion on time and within budget; lifecycle costs; and operation and maintenance.
- ✓ Meeting the requirements of the design professional as to provision of well-defined scope of work, providing means to obtain adequate field information prior to design; means to assemble and use a qualified, trained and experienced staff; provisions for timely decisions by owner and design professional; and contract to perform necessary work at a fair fee with adequate time allowance and adequate budget to perform all the above activities.
- ✓ Meeting the requirements of the constructor as to provision of contract plans, drawings, specifications, and other documents prepared in sufficient detail to permit the constructor to prepare well priced bill of quantity or competitive bid; timely decisions by the owner and design professional on authorization and processing of change orders; fair and timely interpretation of contract requirements from fielded inspection staff; and contract for performance of work on a reasonable schedule which permits a reasonable profit.
- ✓ Meeting the requirements of regulatory agencies (the public) as to public safety and health; environmental considerations; protection of public property including utilities; and conformance with applicable laws, regulations, codes and policies.

2.8.1. Adoption of Quality Management in the Construction Industry

Project design and construction planning are carried out based upon a standard derived from relevant codes, owner requirements, and design company standard practice. Construction is then managed to conform to this composite standard as interpreted by the constructor. Quality assurance usually occurs after completion, and in some cases, after partial compensation. This process results in the following trends [18].

- Quality is designed into and evaluated for each individual project each time
- No feedback system exists for reexamining quality control work. Correction only occurs when the owner, designer, or building authority points out defects in the project. This makes quality evaluation difficult.
- Since post-completion correction of unacceptable work is hided and the defect that occurs during construction is usually corrected or concealed before top level management or the owner discovers it, this led no change in procedures, and allows the defect to reoccur during the next project. It is difficult to establish a data collection system to build an information base that could lead to early identification of defects for the next phase.
- No mechanism exists for practical implementation of standards. There are no efficient means for inputting new information and, thus, maintaining relevant standards.
- No system exists to manage quality throughout the design/construction process.

In construction, failure can result from malfunction on the part of constructor, designer, or even owner. In most cases however, it is the result of a combination of actions by several or all of these parties. The quality management organization must, therefore, have the ability to deal effectively with all parties involved. The following are characteristics for a properly organized quality control program in the construction industry [18].

- Quality management in the planning and design, construction, and operation and maintenance phases is integrated through the construction management project delivery system.
- The quality standard is derived from a current database created through feedback from previous projects, providing a more uniform and comprehensive standard.
- Feedback expands the quality data base to eliminate repetition of the identified defects.
- Defects are identified and corrected early.

2.8.2. Industry Specific Quality Management Tools

Quality of codes and standards: - Compliance with codes and standards should be an issue addressed early in the design phase. Without early identification of the appropriate codes and standards, reworking plans and specifications can result in considerable cost and delay. The design professional must be knowledgeable about the provisions of codes and standards before starting the design process because the codes directly control the minimum standards of many components of a project, and are responsible for much of the finished product quality [18].

Quality of drawings and specifications: - Drawings and specifications are sets of documents given to the constructor that provide technical information on materials, performance of the constructed facility, and quality requirements. Drawings documents given to the constructor that show the size and scope of the job, number and size of materials or items for the project and the specifications guides the physical construction of the project. Therefore, quality of the drawings and specifications received from the designer affect the quality of the constructed facility [18].

Constructability of design: -Constructability is one of the major factors that affect the quality of design. The design professional must consider the requirements of the constructor and clearly and adequately communicate the design intent to the constructor. This is done initially with the contract documents, both plans and specifications. In addition to general reviews of constructability, designs must also be reviewed for effectiveness and compatibility with local requirements, including both the initial construction and post construction operations. Both the initial design constructability and the completed operational design should be reviewed in the quality construction programs instituted by the design team members. [18].

2.9. Characteristics of Effective Quality Management Systems Verification of Process

Quality management systems can become cumbersome and bureaucratic if not properly developed, implemented and maintained. Effective quality management systems have common characteristics. These common denominators of quality management, when properly implemented, can improve organization's ability to satisfy customer and manage your processes

and products more effectively. These common characteristics of effective quality management systems are listed below [35].

1. **Quality manual: -** a quality is including scope, justifications for any exclusion, documented procedures and process interaction descriptions. This will specify how a QMS will be observed and emphasize the company's commitments to both continuous improvement and quality. The quality policy and quality objectives are defined, deployed throughout the organization and understood by employees at all levels.
2. **Process base: -** a process is in place and clearly defined to ensure the needs and expectations of customers and other interested parties.
3. **Documented processes: -** Processes are documented in simple to use procedures that are up to date.
4. **Monitoring Processes: -** Metrics are established and monitored for each process. The When a process is not monitored and measured, leaders couldn't know if it is producing the desired outcomes. Inefficiencies will be extensive and it is very difficult to implement corrective actions that really work.
5. **Management commitment: -** Management is committed to use the metrics for process improvements and for communications within the organization as well as for holding people accountable for their performance. The leader follow-up to insure people do what is expected.

   Also the management is involved in the system and reviews the entire system at appropriate intervals to insure the system is functioning as planned, is effective for the business and is being maintained.
6. **Process to prevent non-conforming product or services: -** a process is in place for preventing non-conforming product or services and in the event non-conforming the situation is documented and corrective actions taken. In the case of non-conforming product, the process provides for identification and segregation to prevent it from getting to a customer.
7. **Framework for verification of processes: -** a framework for verification of processes and products is in place and functioning as planned. This includes internal audits of the processes as well as product quality verification at various stages of production. When you have good customer issue (feedback) or audit data, and are trending an issue, the most common reaction is to start a CAR (Corrective Action Report).

8. **Documents and document procedures: -** Any documents needed to ensure the effective operation, planning and control of company processes and any document procedures required by the compliance standard is identified.
9. **Records: -** records such as evidence of conformity to requirements and of effective QMS operation will be required by the compliance standard.
10. **Resources**: - to meet objectives are identified and provided. Resources include people, processes, equipment and infrastructure.
11. **Continual improvement: -** this is a priority action and simple approaches are implemented to involve people throughout the organization in identifying continual improvement opportunities.

A quality management system built on these foundational principles will give the business a competitive advantage and should not be a bureaucratic nightmare. However, While each of the characteristics are supposed to be driving the outcome due to QMS, management commitment/review will drive the evolution of the rest of the key characteristics [35].

2.10. Problems Encountered from Implementing Quality Management

The path to ISO 9001 QMS certification is seldom pleasant and smooth. The implementation of an effective quality system is not an easy task. Among the implementation problems that have been identified by the previous researchers are: [36]

1. **Resistance to change**

Since the burden of operation will be transferred to the employees who must follow every change made prior to certification, resistance to this change is one of the serious problems mentioned in the implementation of ISO 9001 QMS. Therefore, this is the real challenges most company needs to confront in implementing ISO 9001 QMS. The reasons for resistance are as follow:

• Change creates uncertainty and displaces one from a position of comfort as one's knowledge and skill is no longer adequate. The acquisition of new knowledge and skills has become a necessity.

• Change involves additional work. The implementation process involves additional works such as documentation, training, and filling in form.

• The benefits associated with the change may not outweigh the costs involved. Employees may fear that the additional effort and time spent in planning and implementing ISO 9001 QMS will not bring benefits to the company.

• They are too busy with the existing work and do not have the time to implement a new effort like ISO 9001 QMS. In fact, some organization has to plan and implement ISO without additional staff.

2. Lack of top management commitment

Lack of management commitment is one of the major problems encountered during the implementation mentioned by Chew et al. (1996) in Mohammad (2000), Abdul Rahim et al. (2004) and Al-Asiri (2004). Chew et al. (1996) in Mohammad (2000) stated the reason of the problem was due to lack of awareness of the benefits of the quality system.

3. Difficult to interpret the standard and requirement of quality system

Chew et al. (1996) in Mohammad (2000), Tang et al. (1999), Al-Asiri (2004), Lee et al. (2001), Rohayah (2004) and Abdul Rahim et al. (2004) discovered that the standard and requirement of the quality system is hard to understand. It is said that the concept of ISO is being too abstract and difficult to comprehend. Lee et al. (2001) mentioned that translating the standards into the corresponding action require full understanding of the concept and philosophies behind the ISO standards. Without full understanding and the appropriate actions, the required standard of quality is hard to achieve.

Chew et al. (1996) in Mohammad (2000) agreed that some difficulties were encountered when trying to interpret the requirements of the standards within the context of construction industry. Rohayah (2004) however found that it is difficult to understand the requirements of ISO 9001 due to lack of knowledge and resources.

4. Perceived increased in paperwork

Chew et al. (1996) in Mohammad (2000) stated that ignorance or lack of clear understanding of the documentation's fundamental requirements are the cause for the generation of a huge amount of paperwork which is difficult to use and control. However, at some situation, this may have been the original shortcoming of most organizations that they may not have kept

sufficient records or information necessary for monitoring, analyzing and reviewing the firm's performance (Lee et al., 2001).

5. Lack of training for management and employees

Training is important to give understanding and familiarity with the concept of ISO 9001. Lee et al. (2001) found out that this problem could be due to the reluctant of management to commit time and expenses to train their staff. Chew et al. (1996) in Mohammad (2000) also mentioned that some organization perceived that what ISO 9000 is all about is to merely document their quality system and ignored the importance of training employees. Tan (2011) stressed that lack of training as one of the problems in implementing quality management.

Moreover, Low (1994) argued that lack of training among site staff caused to rely heavily on quality manager who has clear understanding on the ISO 9000 concept. Consequently, they will merely listen to the instruction given and then perform accordingly without actually knowing why they are doing it. This created an unhealthy reliance on the quality manager, thus caused the quality concept appeared to become a 'one man' show.

6. High implementation and maintenance cost

Abdulaziz et al. (1999) and Abdul Rahim et al. (2004) agreed that a quality system require high implementation cost. Because of this, many organizations hesitate to implement ISO 9001 QMS since they are unsure whether the benefits gain will cover the cost involved.

However, many organizations misunderstand the cost of quality since they often perceive that the implementation is an extra cost. Actually, it is not the quality is costs but the non-conformance to quality is more expensive. This can be associated with the cost of correcting error, rework, and reacting to customer complaints. (Sia et al., 2006)

7. Poor communication

Kam (2000) stated that poor internal and external communication also being an obstacle to the successful of the implementation of an effective quality system.

8. Lack of participation from consultant

Even though the contractor has implemented a quality management system, the performance of contractor is often affected by the consultants who did not practice Quality Assurance even though they have put much effort on quality improvement. For instance, the discrepancies that always occur in the drawings and specifications have caused delay in construction thus reduce the effectiveness of Quality Assurance (Low, 1994).

9. Poor quality system design

The organization may fail to recognize or comprehend the fundamental requirements of quality management. Thus, it will lead to uneconomic, bureaucratic and high paper generating system (Khalid, 2005).

10. Lack of technical expertise and skills

The appointment of quality consultant is important. Without their expertise or inappropriate consultant involvement, it will be a hindrance to the successful implementation (Mohammad, 2000). Gopalakrishnan et al. (1996) also claimed that failure to appoint quality consultant could lead to unnecessary delays, initial rejection by external registrars and employee dissatisfaction.

11. Lack of resources

Rohayah (2004) mentioned that lack of resources for implementing and maintaining the quality system is due to weak quality work culture, lack of knowledge, and insufficient learning level. She also argued that lack of resources in terms of capital and human resource has caused delay in obtaining ISO 9001 QMS certification. Tan et al. (2009) stated that human resources limitation as one of the human-related problems in quality management in building construction projects.

2.11. ISO 9001 2008 QMS in Ethiopian Construction Industry

By the research made by Teklebrhan Kidanu on the impact of ISO 9001 on certified Ethiopian construction companies it is assessed that weather Ethiopian ISO 9001 certified construction companies have benefited from obtaining the certification and investigate the main reasons if

they have not. In this research it is determined that the ISO 9001 certified construction companies have not got tangible benefit. The main reason for failure is that construction companies do not give much emphasis to internal benefits of the standard such as process efficiency and effectiveness, inadequate training, inadequate motivation etc. In addition to this, the support and encouragement of governmental bodies to certified companies lacks continuity [38].

According to this study ensuring higher productivity and Expecting that ISO 9001 QMS certification will be a requirement for tender internationally and locally in Ethiopia were among the driving forces to implement ISO 9001 by the contractors. The contractors had expected that ISO 9001 is adopted in line with legal requirements so it can be used as a means of fulfilling legal requirements [38].

The university capacity building program (UCBP) and GTZ IS has pushed construction companies to get ISO 9001 certification': The participants stated that the UCBP and GTZ IS were promising that uncertified construction companies will not be allowed to participate especially in construction projects owned by ministry of education. So this has partly contributed for participants to get certified [38].

However, they have not achieved tangible and quantifiable benefit that shows continual improvement satisfactorily as their expectation and also in almost all national tenders, except for some international tender, being ISO certified is not considered as a requirement or as additional value by customers. The extent of achieved benefits of QMS compared to the expected plan was as low as 65% [38].

Main challenges faced during implementation of QMS in Ethiopian Construction Companies Resistance of changes by staff i.e. unwillingness of the staff to implement QMS is the main challenge. Convincing the workers to follow the procedures to implement the system at project site level was difficult. This challenge has happened due to the reason that some employees were not willing to divert from their previous tradition. Especially Engineers are more change resistant than other professionals. The QMS is not implemented as per the manual i.e. the company staff are not using formats and work instructions properly and not following determined process as per QMS requirement. Some staffs could not use and keep the formats and documents" identification number and sometimes also prefer to use formats which are

redundant. Generally there is lack of consistency in level of awareness of ISO 9001 among the staff when starting implementation [38].

However, Yimam Abadir in his MSc thesis, entitled “Project management maturity in the construction industry of developing countries: the case of Ethiopian contractors,” has indicated that ISO 9001 certified or in process to get certified are found to be at relatively higher project management maturity level than the uncertified contractors and not in process to get certified [39].

2.12. Standardization and Certification in Ethiopia

Ethiopian Standards Agency (ESA),DQS a German based standardization company and ISO Quar handled the work of assuring standards in Ethiopia. These companies do their job in cooperation with companies they are working for (their clients). All companies holds the responsibility of issuing and certifying companies based on the **ISO 9001.2008** standard. Addis Ababa Chamber of Commerce & Sectorial Associations (AACCSA) then awards and certifies the accomplishment to International Organization for Standardization (ISO)[25].

The evaluation and/or certification of the Client’s management system(s) shall be performed in accordance with the applicable **standards**; the **industry related requirements** (if applicable) and the Assessment and Certification Agreement. The certification body must comply with ISO/IEC 17021. The Certified Quality Auditor is a professional who understands the standards and principles of auditing and the auditing techniques of examining, questioning, evaluating and reporting to determine a quality system's adequacy and deficiencies. The Certified Quality Auditor analyzes all elements of a quality system and judges its degree of adherence to the criteria of quality management system. These auditors shall meet or exceed the qualification guidelines for management system auditors described in ISO 19011:2011 and ISO 9001:2008/2015 and are assessed as competent to perform quality management system audits [25].

3. Research Methodology

Literature Review

The first portion of the study is to demonstrate what total quality management system means from the literature review. Books and journals are the main source for the literature review. Then desk study and structured interview is utilized to obtain data from the sample consultant offices. Finally, an analysis has been done based on the acquired data.

Data collection

Data has been collected from multiple sources. To do this, the study was first done through gathering and analyzing information, already available in print or published form, which we call it a Desk Study. It is to acquire information on the ground conditions regarding the quality management activities in the construction consultant companies.

During the desk study documented data and other useful information which is already available in print at the offices are gathered and reviewed. It was collected in such a way that it is efficient and usable. Then structured interview is carried out after the desk study has been substantially completed. Questions to supplement/reinforce the data from the desk study are identified and used. During the structured interview the remaining important information unidentified from the desk study are obtained.

The study in general employed both primary and secondary sources of data collection. The main sources of the primary data for this research are the desk study and structured questionnaires. Whereas the secondary sources include books, references, journals, websites, and papers related to the research subject, and were reviewed to make the study fruitful.

Also during the structured interview seven questions are developed based on the same criteria to compliment the data from the desk study. The questionings basically focus on the efforts made by the companies towards the comprehensive application of the principles of quality management system.

Sampling

The study has utilized Purposeful and Referral sampling method to select samples from the total population. The total population consists of grades 1, grade 2 and grade 3 construction consultants. This population area where certified consultants exist was identified based on the information from the first data source who is the ESA.

Then sample has taken from the total population again based on the data from the ESA. This is called Referral sampling method. This sampling method is suitable when the sample for the study is very rare or is limited to a very small subgroup of the population. It is a technique in which research participants are asked to assist researchers in identifying potential areas of study.

First ISO 9001 2088 certified Consultants are selected from each grade. Then consultants who remain on the system are selected as a sample for the study and the remaining consultants that are withdrawn from the system are excluded. This is due to the reason that current information regarding the implementation of QMS could be available in these companies.

About the size of the sample, it has been determined through steps. The study has started with two consultants and the sample is increased to four. The findings were similar until this stage with slight differences. Finally one sample consultant is added and the data were generally found reconfirming each other. When no sign of new data comes up any more and results are redundant, the survey has been stopped there and the analysis has continued.

Therefore, from those who remain in the system 5 consultants are selected randomly from the seven consultants.

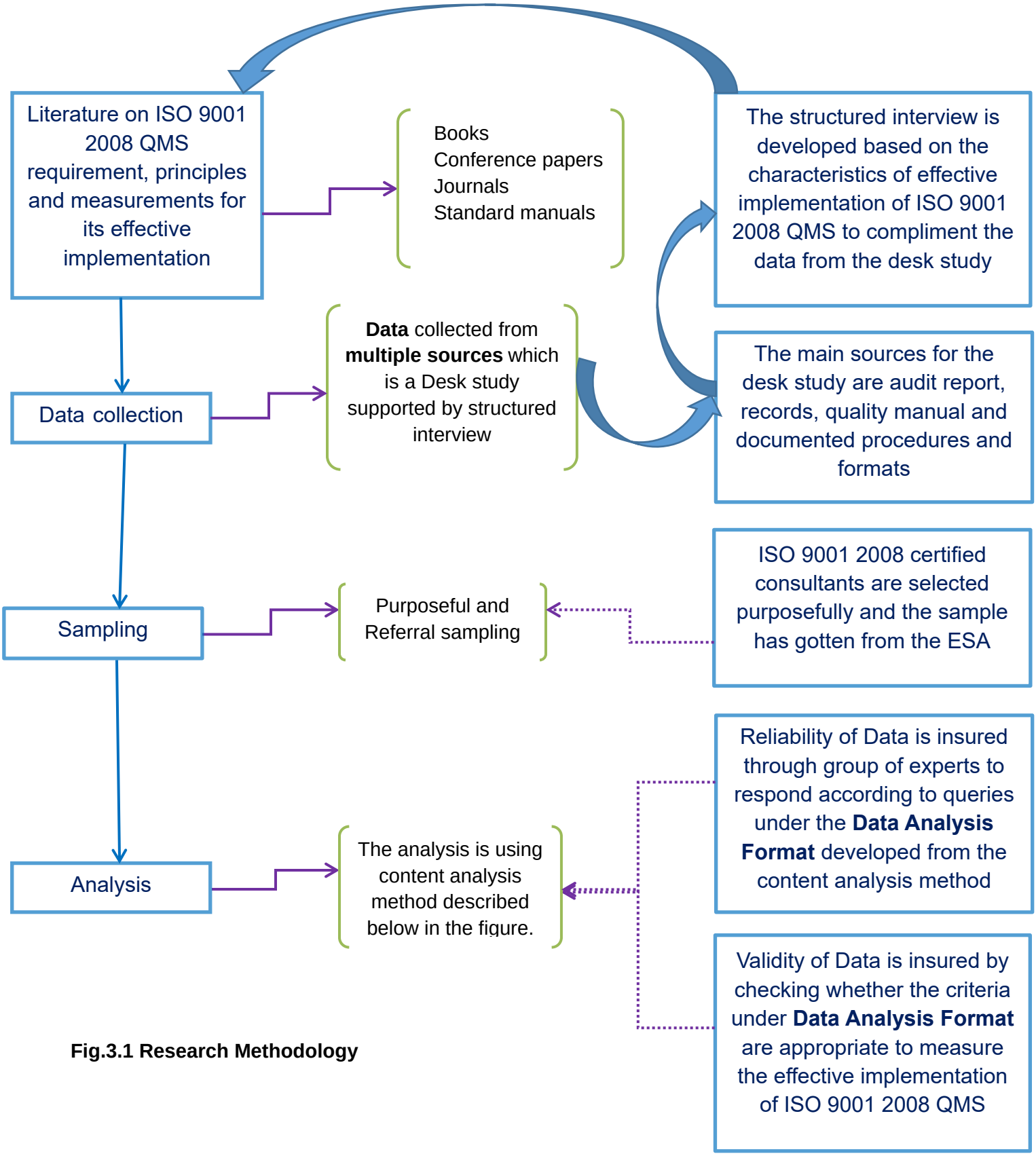

Fig.3.1 Research Methodology

Analysis of Data

The method of analysis used for this study is content analysis. During the desk study data were first extracted from relevant documents. This data are categorized under certain topics for the purpose of analysis. The process of categorization under this method of analysis is shown below in the figure.

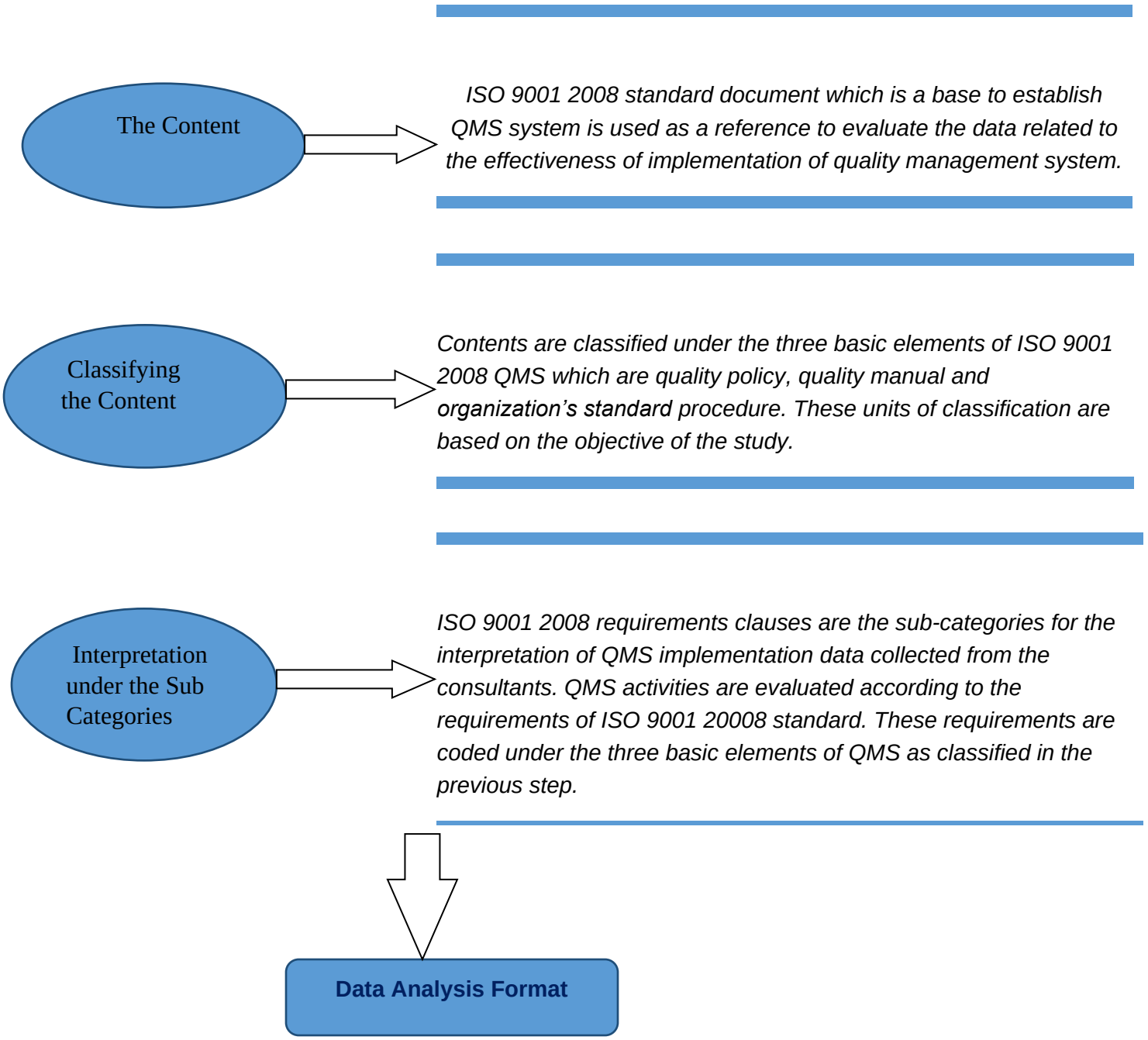

Fig.3.2 Content Analysis of Data

Validity of Data/Content Validity

According to Prajogo the Existing Measurement Instrument of ISO 9001 Implementation Effectiveness in the Manufacturing and non-manufacturing sector is "**Implementation Process"** [40]. As per the literature review, during the implementation, top management, other employees, the reward system, team work, continuous improvement, the understanding of the ISO 9000 itself, and measurement of performance and communication are critical success factors for the successful results brought by ISO 9000 QMS. Continuous improvement of **processes**, **people** and **systems** are also very important factors for a sustainable quality management system [40]. Therefore the research is valid since it is studied under these essential implementation activities. The data from the desk study is verified by the additional information from the interview for its reliability.

To implement an ISO 9001 QMS the following details should be attained. [41]

- Commitment from Top Management
- Establish implementation team members which includes representatives from all organizational functions
- Appoint Management Representative (MR) as its coordinator to plan and oversee implementation including;
    - Ensuring that QMS processes are established, implemented and maintained
    - Reporting to top management on how well, or poorly, the QMS is performing, including identifying any needs for improvement
    - Ensuring all employees are aware of customer requirements
- Employee awareness through training on the basic concepts of QMS and the standard, the overall impact on the company's strategic goals, the changed work processes, and the likely work culture implications of the quality system.
- Perform a Gap Assessment including
    1. What is the present operation/process? What already exists?
    2. Analyze the relevant sections of the ISO 9001 standard to determine what is actually required?
    3. Document the "gaps."
- A Quality Policy which addresses the specific requirements of ISO 9001
- Framework for determining Quality Objectives

- Documented Quality Manual, Procedures (as per the minimum requirement of the ISO Standard or additional key processes), Work Instructions, Lists, Forms and Records
- Clearly define departmental functions and identify their interactions.
- A unique identification code to documents
- Revision control and update to documents
- Management review to all of the documentation to ensure it meets the operational needs of the business as well as ISO 9001
- Periodically perform an internal audit to evaluate the effectiveness of your Quality System
- Management Review and respective Corrective Actions for non-conformities
- Continual Improvement based on;
    - Quality policy
    - Quality objectives
    - Audit results
    - Analysis of data
    - Corrective and preventive actions
    - Management review

Therefore, based on the above implementation requirements, the QMS of construction consultants is evaluated. During the analysis questions based on these implementation requirements are answered according to the relevant ISO 9001 2008 standard requirement clauses. Hence this research truly measures what it was intended to measure; and the research is valid.

Reliability of Data

After a period of time, the measurement criteria which were proven valid are tested for its validity. It was submitted to a group of experts, top managements of sample companies, who were not involved on the initial assessment period. After the test, very similar results with slight variations have been achieved and the reliability of the data is insured.

4. Data analysis and Interpretation

Analysis and discussion is done based on the primary & secondary data obtained. The research questions should be addressed one at a time. Statistical results are described in a way that it is performed to answer the research question. At the end of the study, there will be a conclusion and recommendation based on the findings and literature.

4.1. Analysis and Interpretation

The analysis and interpretation is done according to the basic characteristics of effective QMS and based on the ISO standard requirements. Internal activities of the sample engineering consultants under this study have been measured in fulfilling requirements. Also major challenges to implement the system effectively are discussed in this study.

According to the data from ESA among thirteen consultants certified from the year 2009 to 2017 for the ISO 9001 2008 standard six of them have been withdrawn in the year between 2012 and 2017.This was because during the implementation of the system they have taken the system as been non-essential for the success of their company. However, the system remained active for the remaining six companies. Therefore, the following analysis is done on the consultants for whom the system is currently applicable.

4.1.1. Effectiveness of quality management system

The following are summary of results on achieving effective quality management main objectives. It is the result of document reviews and summary of information from the structured interviews. Relevant data has been gathered from the quality representatives of companies who are responsible for the establishment and facilitation of implementation of the QMS. For the sake of the analysis, the measurement criteria of effective quality management system are put under the three main categories; namely Adequacy of Quality Manual, Standard Operating Procedure and Documentation Requirement.

4.1.2. Adequacy of Quality Manual

All the targeted companies of this study have prepared their own quality manual so that there is no problem in fulfilling this requirement. The manual has been contentiously updated throughout the certification years and any change has been recorded in the revision history section of the

quality manual document. However, the adequacy of manual varies between companies. Major deficiencies observed are discussed in the table below;

Table 4.1. Problems on Adequacy of manual

No	Problems observed	Construction Consultants with the Related Problems				
		A	B	C	D	E
1	Objectives which had been set by the companies to be achieved through the system are more general and lack specificity, measurability and time boundedness. Specialized service activities to be delivered by the company are not listed in detail in the company's profile. Hence the scope of the company cannot be recognized by customers. ❖ Quality objective is established by the company to satisfy the interests of customers and regulatory body. As per clause 5.4.1 of ISO standard manual the quality objectives shall be measurable and are established at relevant functions and levels within the organization including for those needed to meet requirements for product. In addition, As per clause 7.1 ISO 9001 2008 standard setting of objective is part of "Planning of product realization". It is stated that the organization shall plan and develop the processes needed for product. Therefore, objectives should be set specific and also to the specialized service activities that the company provides.	√	√		√	√
2	Quality objectives have not been revised during the implementation of the system. It remained the same for the whole certification year.		√	√	√	√

	❖ As per clause 5.6.1 of ISO standard manual, Top management shall review the quality management system including the quality policy and quality objectives. This involves assessing opportunities for improvement and the need for changes.					
3	It is found that there is lack of clarification on how to satisfy the ISO standard requirements on the quality manual document. Ways or methods are not specified to address each requirement in applying the system. There is lack of important operating procedures and formats to fulfill the requirements. ❖ In the introduction section of ISO 9001 2008 standard manual it is stated that the first step to develop process is to understand the standard requirements. Furthermore clause 4.1 of the ISO 9001 2008 standard manual has specified criteria to address the requirements in the system.	√	√	√	√	√

The following chart shows the distribution of problems on the adequacy of manual.

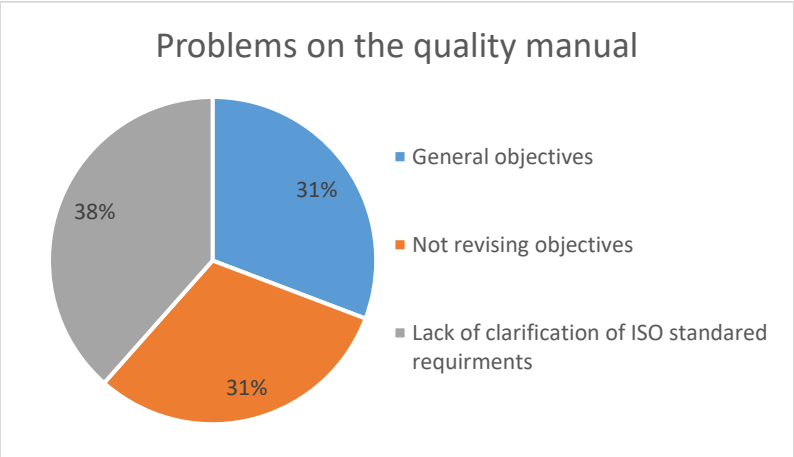

Fig. 4.1.2. Problems on the Quality Manual

According to this data the rates of occurrences of problems regarding quality manual is similar.

4.1.3. Standard Procedures

According to the survey result, consultants under this study have prepared standard operating procedures, formats and work instructions for the implementation of QMS. There is a difference in the procedures based on the type and scope of service provided by the consultants. However, they were seen facing common problems in fulfilling the standard requirements as described in the table below.

Table 4.2. Problems on Standard operating Procedures

No	Problems observed	Construction Consultants with the Related Problems				
		A	B	C	D	E
1	It was observed to fail in identifying important **QMS processes**. For instance, revision request format for the involvement of employees to forward their new idea is one of the commonly absent formats in the system of the consultants. ❖ As per clause 4.1 of ISO standard manual the organization shall determine the processes needed for the quality management system and their application throughout the organization. In addition, as per clause 7.1 of ISO 9001 2008 standard manual, planning and development of processes needed for product realization shall be consistent with the requirements of other processes of the quality management system. Therefore missing other processes of the quality management system will directly affect the performance of the product. They should be developed based on the requirements of relevant clauses of the ISO 9001 2008 standard manual to assist the processes for the specific product developed under clause 7.1 of this manual. They are the major factor for the continuous	√	√	√	√	√

	improvement and effectiveness of quality management system. The procedures facilitate to identify gaps on the core operating (product) procedures and indicate where adjustments are needed to attain quality objectives. These are basically management support procedures, measurement and analysis procedures, customer requirement procedure, and customer satisfaction procedure. .					
2	There is a lack of operating procedures for some critical service activities of the companies. ❖ As per clause 7.1 of the ISO standard manual it is required to establish processes and documents, and to provide resources specific to the product. Therefore, procedures shall be developed in detail for the service activities of the company. Resources are then allocated to each activity. Any changes done on operating procedure is based on the inputs from QMS procedures as stated above. Changes might be initiated from the top management, the quality person, department heads, employees or from customers.	√	√	√	√	√
3	There are inactive existing procedures during the implementation of QMS. No records and documentation has been made and there is nothing to justify the application of these procedures. ❖ Clause 4.2.1 of ISO standard manual states that The quality management system documentation shall include documents, including records, determined by the organization to be necessary to ensure the effective planning, operation and control of its processes.		√		√	√

4	There is a gap in interlinking cross-functional processes. Procedures are developed independently to deliver specific output. When there is a need to hierarchy these processes, there is no indication about where to start or continue one process from the other process. ❖ As per clause 4.1ofISO standard manual it is required to determine processes needed for the quality management system. Also clause 4.2.2 of this manual specifies to describe the sequence and interaction of these processes.	√	√	√	√	√
5	There is a gap on upgrading formats and Procedures to reach the maximum result and achieve organizational objectives. ❖ As per the ISO standard manual, while using a process approach quality management system, there must be emphasis on the importance of processes in terms of added value, obtaining results of process performance and effectiveness, and continual improvement of these processes based on objective measurement. Also clause 8.2.3 this manual states that the organization shall apply suitable methods for monitoring and, where applicable, measurement of the quality management system processes. These methods shall demonstrate the ability of the processes to achieve planned results. When planned results are not achieved, correction and corrective action shall be taken, as appropriate. The measurements should be appropriate to each of its processes in relation to their impact on the conformity to product requirements and on the effectiveness of the quality management system.	√	√	√	√	√
6	When non-conforming activities are determined or any data is collected, it is identified that analysis and preparation of reports have	√	√	√	√	√

	not been done for all non-conformities. ❖ According to clause 8.4 the organization shall determine, collect and analyze appropriate data to demonstrate the suitability and effectiveness of the quality management system and to evaluate where continual improvement of the effectiveness of the quality management system can be made. This shall include data generated as a result of monitoring and measurement and from other relevant sources. The analysis of data shall provide information related to a) customer satisfaction b) conformity to product requirements c) characteristics and trends of processes and products, including opportunities for preventive action and d) Suppliers					

The following chart summarizes the distribution of problems on the Standard Operating procedures

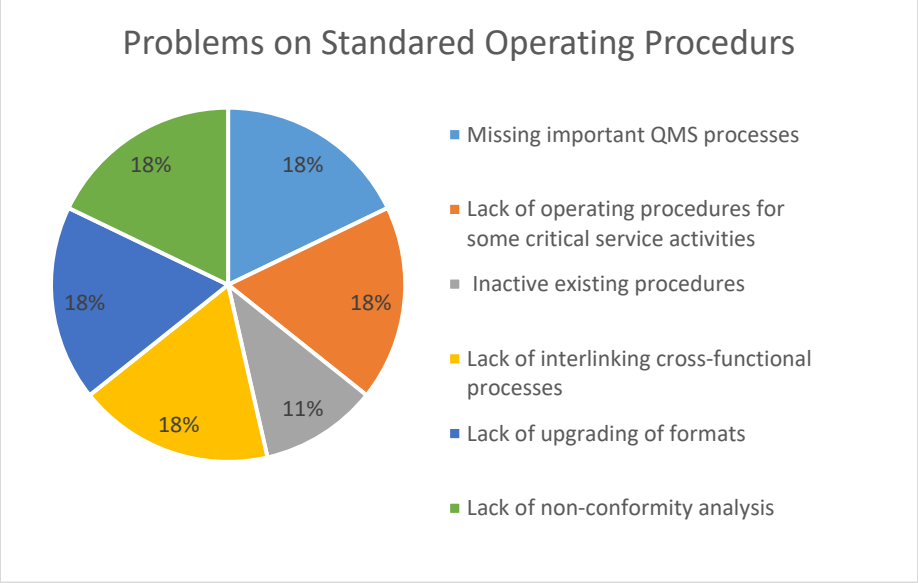

Fig. 4.13.Problems on Standard Operating Procedures

4.1.4. Documentation Requirement

As per the general requirement (Clause 4.2.1.)of ISO 9001 2008 standard manual there is a minimum requirement for documentation. Regarding this targeted companies have fulfilled the requirement. They have documented their procedures and records.

These documents, both procedures and records are to ensure the effective **planning**, **operation** and **control** of QMS in the company. However there are some gaps in this area as discussed in the table below;

Table 4.3. Problems on Documentation Requirement

No	Problems observed	Construction Consultants with the Related Problems				
		A	B	C	D	E
1	There have been situations where there is a lack of evidence for monitoring and measurement of product. ❖ As per clause 8.2.4 of ISO standard manual the organization shall monitor and measure the characteristics of the product to verify that product requirements have been met. This shall be carried out at appropriate stages of the product realization process in accordance with the planned arrangements (clause 7.1). Evidence of conformity with the acceptance criteria shall be maintained. Records shall indicate the person(s) authorizing release of product for delivery to the customer (clause 4.2.4). The release of product and delivery of service to the customer shall not proceed until the planned arrangements (clause 7.1) have been satisfactorily completed, unless otherwise approved by a relevant authority and, where applicable, by the customer requirements.	√		√	√	√
2	During the process of documentation and retrieval, difficulties are observed to differentiate documents and records due to the reason that a file name is not attached on them. There are multiple kinds of documents and records documented in a					

	single file but the type of document in side are unknown. ❖ As per clause 4.2.4 ISO standard document, the filing system should allow records to be easily and readily identifiable. It should be indicated in the cover that what kinds of records the files contain.		√	√		

The following is the result on Problems on documentation requirement

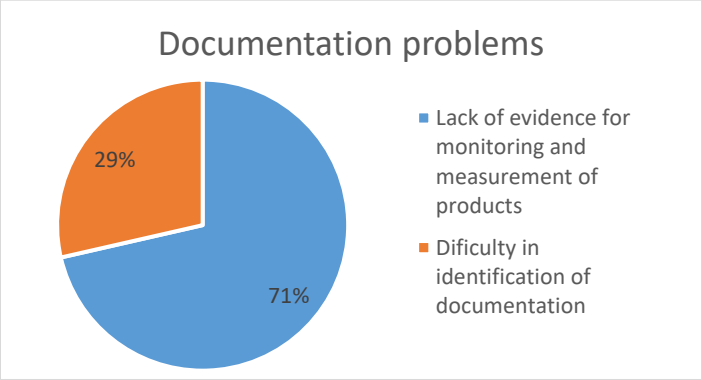

Fig. 4.1.4. Problems on Documentation Requirement

According to the above analysis the problems are abundantly observed in all engineering consultants under the study. The problems encountered are also significant in affecting the effectiveness of the system. The total average result is summarized below in the figure.

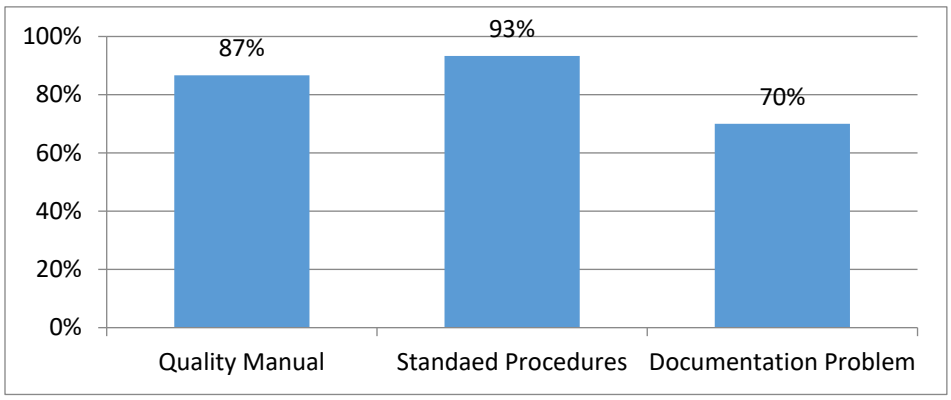

Fig. 4.1.5. Major problems on effective QMS implementation

Above 80% of consultants have not prepared comprehensive quality manuals which fulfill the quality management standard requirements. And what have been missed were basic in influencing the performance of the system. Without addressing all the standard requirements set by the ISO 9001, the system cannot be efficient and the company cannot be benefited from the system. Again above 90% of construction consultants had problems in establishing and upgrading of quality management standard procedures. Since standard procedures are the essential part to apply continuous improvement to the system, these problems should be taken as critical.

Documentation problems have also been observed on the construction consultants under this study. This will hinder the implementation of QMS when there is a need to use the documented procedures, records and other documents. The readily availability of procedures is mandatory in implementing the system. Also missing of documentation of records and other documents affect the use of previous data as an input for continuous improvement of the system.

5. Conceptual Frame work for the Effectiveness of QMS

Implementing a QMS can be challenging and time consuming. It can also distract key people from their regular day to day tasks. However, to minimize disruptions practical solutions assist a company in implementing a QMS to meets the specific needs of its business as well as the requirements of the appropriate standard(s). The following are proposed steps to create an effective QMS in a company.

5.1. Steps for the Creation of an Effective QMS

1. Define and Map Processes

Process mapping is the steps required for the conceptualization and implementation of a QMS and includes the following:

Table 5.1. Process maps

Define processes and Process maps creation	• It starts with determining customer groups both internal and external, customer requirement and defining companies main service process • Involve in defining the interaction sequence of those processes • Will make the organization to visualize and define their processes • Are vital for assigning tasks and the responsible person • It helps in identifying all possible problems that may occur and controlling mechanisms • Indicates documentation expectations

2. Define Quality Policy

Table 5.2. Quality Policy

Quality Policy	• Communicates the duty of the organization

	considering customers requirement and continuous improvement • Addresses the specific requirements of ISO 9001 and for all departments in the company • Achieved through predetermined process identified in the previous step

3. Quality Objectives

Table 5.3. Quality Objectives

Quality Objective	• Is a must and essential portion of Quality management systems • Derivative from the quality policy to change organization quality policy in to actual measurable targets • It should be set up throughout the organization because each departments in the organizations has definite and individual goals to be potentially facilitated by quality objectives to be achieved • It must be measurable to evaluate its achievement towards the organizational goal • Select methods of measurements or critical success factors such as; Financial Performance Product Quality Process Improvement Customer Satisfaction Market Share Employee Satisfaction These performance-based measures provide a device/metrics to determine compliance with the objectives

4. Develop Metrics

Table 5.4. Metrics

Metrics	• For all critical success factors • To keep track of advancement for critical success factors • Are the actual measurements to establish achievement of that goal • Collecting measurements results involves **Data reporting procedure** used to collect specific data and Share the **processed information** with leaders for further actions

The following figure is a matrix to develop quality objective from quality policy and assigning metrics for quality objective.

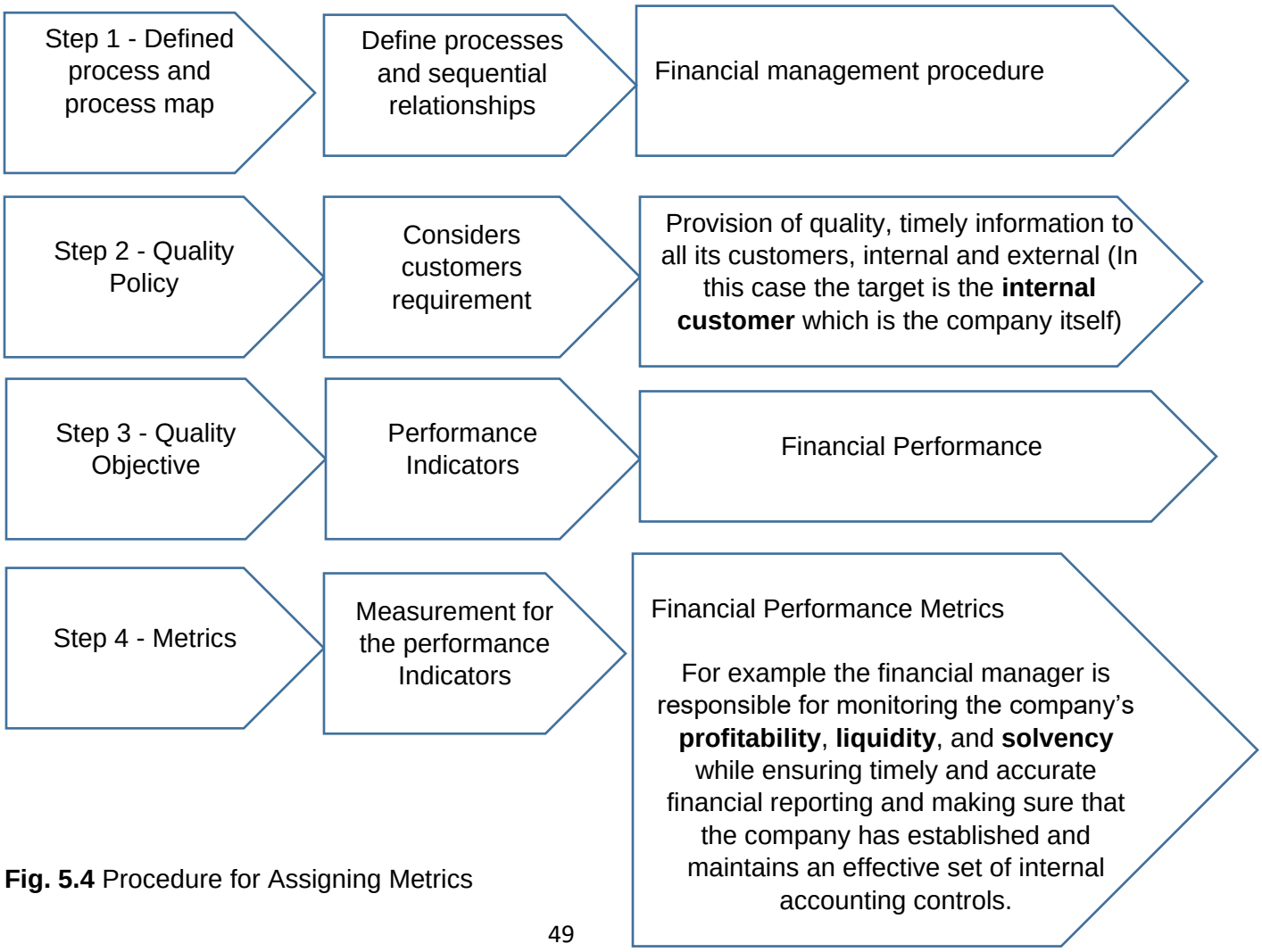

Fig. 5.4 Procedure for Assigning Metrics

- The same procedure will be applied for other department's procedures such as design, supervision and contract administration and also for the external customers.

5. Define Defects for Every Process

Table 5.5. Defining defects

Defining defects	• Defects are **non-conformances** • Defects happen as a **product** flaw or a **process** deficiency • When defect occurs it needs to be first **measured** and **corrected** • Steps to identify the required corrective action are; ✓ Determine defects in product and process ✓ Define a process to record defects ✓ Define a process to report defects in specified formats ✓ Identify the required corrective action

6. Develop Documents and Records

QMS needs to have some documented information and formats. Start with the minimum required document set and add when needed for other procedures.

Table 6.1. Developing Documents

Create mandatory document information	• As per the minimum requirement set by the ISO 9001 2008 standard and based on specific need of the organization. • Are evidences for the appropriate implementation of the system

7. Define Quality Process

Table 7.1. Defining Quality Procedures

Defining quality procedure	• Internal audit, management review, corrective and preventive action process, continuous improvement process, training and development process and communication processes are the basic quality procedures. • Activities for each procedure should be specified. • For example for Internal audit/Self-Assessment the following are major activities ✓ Review of all Processes by Team members on a yearly basis or as needed ✓ Customer Feedback ✓ Internal Department Feedback ✓ QMS Audits

8. Determine Training Needs

Table 8.1.Determining Training Needs

Training is required to;	• Exhibit competency in the job and Some important training areas are- o QMS training o Internal auditor competence, o Corrective action training • Training can happen on job or in separate class room

9. Use Quality Management System

Table 9.1. Using QMS

when utilizing the QMS best result is achieved through activities such as;	• Collect non-conformance and record them. • Review this data for corrective and preventive action. • Perform internal audits and conduct management reviews • Analyze the collected data

10. Measure, Monitor and implement activities to Improve the Performance

Table 10.1. Measuring and Monitoring QM Activities

After analyzing data and intended results;	• Track Quality Objectives and its performance • Define performance yardsticks/metrics • Determine improvement chances in the data by recognizing trends or correlations with the Quality Objectives and its performance
If trends have identified through data and if improvement chances are determined, then it is time to act. Bringing improvement occurs by;	• Arranging your improvement opportunities • Choosing prospects that make a difference • Supporting 'commitment to quality' to attain better results

Keeping all the requirements directs the QMS to its effectiveness and maximum output. The company can incur the benefits from the system through the strong disciplines of the system. Rather it will be just an extra effort without a tangible reward. This will definitely discourage the companies and reject the system.

6. Conclusions and Recommendations

6.1. Conclusions

In this study, the literature review demonstrates that there are standard requirements which need to be satisfied in order to apply QMS in a company. Requirement from the ISO 9001 2008 standard quality manual was the base to evaluate QMS of engineering consultants. The literature review has discussed on the basic principles to set the requirements of this standard manual. It further reveals that there are criteria to say the implementation of QMS is effective in the company. Also the literature has identified tools to implement the system specific to engineering consultants. Accordingly conclusions have been made based on the results of analysis on the effectiveness of QMS and with respect to the basic principles of QMS. Therefore the following have been concluded from this study;

1. There is lack of knowledge on the extent of implementing the system to bring consistency and continual improvement to get the maximum result.
2. The significance/advantages of QMS processes in advancing the service activities are not properly recognized by the consultants.
3. Consultants assume that setting of the procedures once in the establishment of the system is enough and less effort has been made on the continual improvement.
4. It is found difficult to interpret the requirements of ISO standard document to set quality management system. There is lack of understanding the requirements and identifying input procedures/actions to establish the system.
5. There is lack of top management commitment and engagement of employees to implement the system.
6. There is lack of technical expertise and skills to establish and control the implementation of the system.
7. There is lack of intensive internal audit.
8. Surveillance audit made by the certification agent is inadequate in identifying the gap on the system.

All this are challenges to implement QMS in the engineering consultant offices. It is already stated in the literature review that these problems could be potential challenges for the effective implementation of QMS and verified through this study.

Hence this study indicates that implementation of QMS is on an infant stage. Efforts are not adequate to run the system to acquire the ultimate benefit. As mentioned earlier in the analysis, even the number of consultants who certified and remained active on the system are negligible compared to the total sum of grade 1, grade 2 and grade 3 consultants.

6.2. Recommendations

In order to overcome the above problems it is required to take actions and eliminate QMS implementation challenges. The following are recommended measures to fill the implementation gap and achieve better result.

1. Hiring skilled technical experts for the Quality Person Position.
2. Use of the ISO 9004:2009, standard manual as a guidance to interpret the requirements in the ISO 9001 2008 manual, develop the system and maintain its sustainability.
3. Strengthening internal audit through experienced auditors.
4. Proper analysis for the non-conformities and corrective actions.
5. Continuous measurement of the system by the top management.
6. Surveillance audits should be made by auditors with relevant background or experience to the consultants or assistance of auditors by construction industry specific experts.
7. Intensive training on QMS through the assistance of qualified consultants in the field to increase the knowledge of employees and make them familiar with the system.
8. Motivation or guidance for the employees to increase their effort on QMS activities.
9. Arranged meeting or any other communication methods to involve employees for their valuable technical contribution.

In the implementation ISO 9000 managers in organizations must realize that competitive advantage will be generated only if top management is fully commitment to the program implementation from a strategic perspective of effective implementation. Identified barriers should be reduced or eliminated in order to have an effective implementation. Sufficient resources should be assigned to accomplish the remedial activities.

In addition it is preferred that the government establishes mechanisms to encourage consultants for the certification of ISO quality management system. Inclusion of certification as bid evaluation criteria with a certain amount of mark could be a good example for this.

Reference

1. Report on the Ethiopian Economy Volume VI, Ethiopian Economic Association (EEA),2006/07 EC
2. Robel Yohannes, Report on first conference of Ethiopian construction, February 18, 2016
3. Tadesse Ayalew Zakaria Dakhlizoubeir Lafhaj, Assessment on Performance and Challenges of Ethiopian Construction Industry, Quest Journal, Journal of Architecture and Civil Engineering, 2016.
4. The CCl Management Group, an Expert Group on Quality Management for Climatology, Guidelines on Quality Management for Climate Services, Open Panel of CCL Experts – 5 (OPACE 5), World Meteorological Organization, April 2015
5. Adolfas Kaziliūnas, Mykolas Romeris,The Implementation Of Quality Management Systems In Service Organizations, University Ateities, Vilnius, Lithuania, 2010
6. International Organization for Standardation; Organization international, de normalization, The ISO Survey of Management System Standard Certifications 2016, September 2017
7. Emanuel R. Baker Process Strategies Inc. Matthew, J. Fisher and Wolfhart Goethert, SEI, Basic Principles and Concepts for Achieving Quality, Carnegie Mellon University, 2007.
8. Quality management systems - Fundamentals and vocabulary, International Organization for Standardization (ISO), ISO Standard 9000/2005, Geneva, 2005
9. Quality Team of Unit D4,Quality in Eurostat and the European Statistical System ESS, Eurostat, 2010
10. American Society for Quality (ASQ), Glossary, 2004
11. Tirupathi R. Chandrupatla, Quality and Reliability in Engineering, Cambridge University Press, 2009
12. David Hoyle, ISO 9000 Quality Systems Handbook, Fourth Edition, Reed Educational and Professional Publishing Ltd, 2001
13. Anup W S, Arun Kumar H,Post graduate student, SNA Saqhi, Civil Engineering Department, Manipal Institute of Technology, Karnataka, India, Study of Quality

Management System in Construction, international Research Journal of Engineering and Technology(IRJET), Volume: 02,May 2015

14. Raji Al-Ani and Firas I. Al-Adhmawi, Implementation of Quality Management Concepts in Managing Engineering Project Site, Civil Engineering Dept., Al-Isra University, Amman, Jordan M. Sc., Construction Management, Baghdad University, Baghdad, Iraq, 2011
15. Lazar VLASCEANU, Laura GRÜNBERG and Dan PÂRLEA, Bucharest Quality Assurance and Accreditation: A Glossary of Basic Terms and Definitions, 2007
16. Erode Builder Educational Trust's Group of Institutions, D.Ashokkumar Student, Study of Quality Management in Construction Industry Volume 3 ME – CEM, Kangayam-638108, India, 2014
17. Alexis Aitken, Jan Hörngren, Nia Jones, Daniel Lewis, Maria João Zilhão General Editors: Nia Jones, Daniel Lewis, Handbook on improving quality by analysis of process variables, European Commission, Eurostat, 2003
18. David Arditi and H Murat Gunaydin Illinois, Total quality management in the construction process, Institute of Technology, Department of Civil and Architectural Engineering, Chicago, IL 60616, USA, 1997,
19. Rizwan U. Farooqui and Syed M. Florida ISO 9000: A Stepping Stone to Total Quality Management for Construction Companies, International University, Miami, Florida, USA, 2009
20. Abdulaziz A. Bubshait and Tawfiq H. Al-Atiq, ISO 9000 Quality Standards in Construction, 1999
21. Poh Ngoh Kiew1, Syuhaida Ismail2 and Aminah Mohd Yusof, Integration of Quality Management System in the Malaysian Construction Industry, School of Engineering & Advanced Technology, Faculty of Civil Engineering, Universiti Teknologi Malaysia Kuala Lumpur, Jalan Semarak, Kuala Lumpur, 2016
22. Behnam Neyestani,E_ectiveness of Quality Management System (QMS) on Construction Projects, Department of Civil Engineering, De La Salle University, Manila, Philippines.11 December 2016
23. World Meteorological Organization (WMO), Chair, Publications Board, Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services, 2013

24. S.X. Zeng and P. Tian Antai, Overcoming Barriers to Sustainable Implementation of the ISO 9001 system, School of Management, Shanghai Jiaotong University, Shanghai, and C.M. Tam Department of Building and Construction, City University of Hong Kong, Kowloon, Hong Kong, People's Republic of China, 2007
25. Bureau of Assessment Services, Certification General Terms And Conditions, BAS P13-F04 Issue 02 Rev 02; 2017]
26. Tibebu Meride, Ethiopian Standard Agency in Ethiopian Conformity Assessment Enterprise, Faculty Of Mechanical And Industrial Engineering, Industrial Visit Report, 2008EC
27. DQS, Inc. Management Systems Solutions, Auditing and Certification Regulations, 2015
28. Rizwan U. Farooqui (Assistant Professor, Department of Civil Engineering, NED University of Engineering and Technology, Karachi, Pakistan & Ph.D. Scholar, Department of Construction Management, Florida International University, Miami, Florida, USA),Rehan Masood (Site Engineer, Paragon Constructors (Pvt) Ltd., Karachi, Pakistan), Junaid Aziz (QC Engineer, Izhar (Pvt) Ltd, Karachi, Pakistan),Assessing the Viability of Total Quality Management Implementation in Contracting firms of Pakistani Construction industry, August 4-5, 2008, Karachi,, Pakistan
29. Behnam Neyestani, Impact of ISO 9001 Certification Projects' Success of Large-Scale (AAA) Construction Firms in the Philippines, Department of Civil Engineering, De La Salle University, Manila, Philippines, 2017
30. GIZ brochure, University Capacity Building Program (UCBP) Capacity Development for Ethiopia's Construction Sector, GTZ IS International service, January 2009
31. Quality management: then, now and in the future, SHEQ Management, 2015(Was 22)
32. Samir Lleshi, College Dukagjini, Effects of a Quality Management System on the Financial Performance in Banking Sector: Case Study Kosovo Article, January 2017

33. Ching-Chow-Yang, Six sigma and Total Quality Management, Department of Industrial and Systems Engineering, Chung Yuan Christian University Taiwan, R.O.C, 2010
34. Jay Schwartz, The Balanced Scorecard versus Total Quality Management: USA, October 2005
35. The ELSMAR COVE Worldwide Discussion Forums For Industry Professionals, 10 characteristics of Effective Quality Management Systems, Nov 29, 2010
36. Tan Chin Keng, Syazwan Zainul Kamal, Implimentation of ISO Quality Management Systemin Construction Companies of Malaysia, Department of Quantity Surveying Kulliyyah of Architecture & Environmental Design International Islamic University, Malaysia Kuala, Lumpur Malaysia No 01, 2016
37. Hand book for Implementing a Quality Management System in a National Mapping Agency, CERCO Working Group on Quality, 18th August 2000
38. Teklebrhan Kidanu, Assessment of the Impact of ISO 9001 Certification on Ethiopian Construction Companies, Addis Ababa Institute of Technology, School of Civil and Environmental Engineering, Addis Ababa - Ethiopia, March, 2014
39. Abadir H. Yimam, Project Management Maturity In The Construction Industry Of Developing Countries(The Case Of Ethiopian Contractors), Graduate School of the University of Maryland, College Park, 2011
40. Sik Sumaedi Medi Yarmen, The Effectiveness of ISO 9001 Implementation in Food Manufacturing Companies: A Proposed Measurement Instrument, Indonesian Institute of Sciences, Kawasan Puspiptek, Gedung, Setu, Tangerang, Indonesia, 2015
41. ETI Group, Implementing an ISO 9001 Quality Management System, 2014

Appendix 1: Structured Interview Format

1. Have you ever revise/upgrade your quality manual and standard procedures?
   _____
   _____
2. Who participate on revising your quality manual and standard procedures?
   _____
   _____
3. Have you arranged QMS training for your new and permanent employees?
   _____
   _____
4. Have you assisted by quality management consultants?
   _____
   _____
5. What is the educational and professional status of your quality expert?
   _____
   _____
6. When do you make internal auditing
   _____
   _____
7. What is the educational and professional status of your internal auditor?
   _____
   _____