AN EVALUATION OF QUALITY MANAGEMENT SYSTEMS AT THE DESIGN STAGE OF CONSTRUCTION

BY

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DECLARATION

This project is my original work and has not been presented in any university

.... 11/12/09...............

Signed: Mutie C.M. Date:

This project has been submitted for examination with our approval as university supervisors.

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.... 11 December 2009

Signed Date

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DEDICATION

To the three most treasured women in my life;

My dear lovely wife, Emmah Nungari for her steadfast love, selfless support, unending encouragement and enduring sacrifice- You are the true embodiment of beauty and splendour, grace and virtue.

My two daughters-Tehillah and Thamani-your smiles make it all worthwhile!

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LIST OF ABBREVIATIONS

AAK	-Architectural Association of Kenya
BORAQS	-Board of Registration of Architects and Quantity Surveyors
IQSK	-Institute of Quantity Surveyors of Kenya
RIBA	-Royal Institute of British Architects
QMS	-Quality Management System
TQM	-Total Quality Management
QM	-Quality Management
QC	-Quality Control
QA	-Quality Assurance

ABSTRACT

"Quality is never an accident, it is always the result of high intention, sincere effort, intelligent direction and skillful execution. It represents the wise choice of many alternatives." – Willa Foster

Changing client demands, increased general awareness and increasing globalisation have seen a gradual change in the way building products are perceived. The processes involved in delivering these building products have also come under scrutiny with a view to meet the new and changing demands of a more demanding and informed society in a rapidly developing technological time.

This study focuses on the application of quality management systems to the design process of delivering built products in Kenya. Previous studies have focussed on the building stage and this study seeks to examine the awareness of quality management systems during the design processes, investigate the extent of use of such quality management systems at this stage and seeks to identify the barriers to the implementation of quality management systems during design. Whilst this is not a guarantee of eventual quality built products, it is premised that this enhances the chances of the same being accomplished. This study is undertaken with a view to recommend strategies of enhancing the knowledge and implementation of quality management systems during the design process of construction.

The study bases its theoretical framework on quality concepts as utilized in the manufacturing sector. It examines the evolution of quality management through various stages and as postulated by various pundits over time. An understanding of the construction industry- its uniqueness and difference as compared to manufacturing is sought and application of quality management systems at various stages of delivery of the built product in particular, during the design process, is also examined giving an indication of the challenges posed therein.

Data was collected from architects who are the main design consultants during the design process through questionnaires and from key informants who included an engineer and a client through interviews. The analysed data indicates that there is a general understanding of quality as a concept and there is a perceived need of some form of quality management systems during the design process. Further analysis indicates that despite the affirmation of the need of quality management, quality management systems are barely used in the design process mainly due to lack of knowledge of the same and when this knowledge exists, an improper understanding of the implementation of quality management systems during the design process. This is attributed to the rudimentary understanding of quality management systems which are geared towards inspection of the product being built rather than inbuilt quality and relegated to the contractors as the building entity instead of being the responsibility of all building participants as postulated in the theory of Total Quality Management.

The study concludes with the recommendation of a shift in attitude and culture of quality management amongst architects through the training of quality management systems and the application during the design process along the principle of building in quality and involvement of all stakeholders in the pursuit of a quality built end product. This training will hopefully facilitate proper understanding of quality management systems and their application at the design processes.

CHAPTER ONE

THE PROBLEM AND ITS SETTING

1.0 Introduction

To ensure the good quality of the final product is the main objective of the application of quality management procedures (Abrantes et al, 1991). Quality management has now become a major aspect of all industries and the construction industry is no exception. In an increasing competitive market, firms involved in the delivery of construction products and services have to guarantee their clients a quality finished product. This is more crucial for an industry such as construction where the products are expensive, complex, immovable and long lived. They seldom offer scope for repetition, they have to be built where they are needed and, if not designed or built correctly, there is usually little that can be done to put things right at a later stage (Ashford, 1989). Crucial to the delivery of such quality products is the quality of processes that produce the product (Harris and Frank, 2006).

According to Young and Franks (1982), the traditional project procurement system has passed the test of time and is responsible for most of the buildings seen today. It is the most common procurement system utilized in Kenya- up to 85 % (Kimani, 1993). It categorises the construction process into two main distinct stages; design and tender (Pre-Contract) stage and the building (Post- Contract) stage. Kimani (1993) notes that the pre-contract stage of construction is the most critical period in the life of a project. Despite this, most of the studies involving quality management have been focused on the building/post-contract stage, evidenced by the lesser availability of material on quality aspects at the pre-contract stage. This is partly due to the evolution of the concept of quality which according to Harris and Frank (2006) has gone through the following stages;

- Quality Control and Inspection- This introduced inspection to stages in the development of goods and services to ensure that they are undertaken to specified requirements.

- Quality assurance- This was developed to ensure that specifications are consistently met.
- Total Quality Management-Based on the philosophy of continuously improving goods and services.

With many firms within the construction industry stuck on the first stage of quality evolution, Quality Control and inspection, it is imperative to devolve the responsibility of quality management to all stages and importantly to the design process as an improvement of the processes will lead to a higher standard of final product (McGeorge and Palmer, 2002). The further assert that the idea behind this is that it is not output which should be quality controlled but processes.

Kwakye (2007) stated that within the construction process, there is no contravention of quality standards until the site is opened and building starts. It is, however, the authors hypothesis that quality begins right from the point where pen meets paper to form the first conceptual sketch for any particular project. Ashford similarly faults the control of quality through inspection alone and states that "there has to be a better way, and there is" (Ashford, 1989). The final quality of any finished product or service starts with the design of the product. From there, quality should be built into the product at every step. Chase, et al. (2001) states that the quality specifications of a product derive from decisions made relative to the quality of its design. McCaffer (1990) stated that a significant number of quality failures are generated in the design office. This indicates the need not only to limit quality systems and procedures to the building stage but from the beginning-design stage.

In a more informed society with increasing demands of satisfaction from the users of the end products of the construction process, lack of quality in building can no longer be just explained away. While there have been tremendous improvements in the construction industry, this improvement, it has been argued, is only in regard to certain aspects of the construction process (McGeorge and Palmer, 2002). The element of customer satisfaction has not fully taken root in the construction industry and this forms the crux of Total Quality Management- customer focus. To facilitate this customer satisfaction, a look has to be given to the first instance the customer places an order for the specific product and in this case a building. The designer, an architect or an engineer is entrusted with the responsibility of transforming the customers' desire to a tangible product through a process of design and building. As the initial contact person, s/he holds the fundamental key to the form and most importantly, the quality of the eventual final product. This embodies the definition of Total Quality Management (TQM).

While not negating the importance of inspections and checks during the building/post-contract phase, it is therefore inferred that the beginning of quality management in the delivery of a built product begins at the design/pre-contract stage, during the design process.

1.1 Problem statement

'The problem that the construction industry has is one of a poor quality culture (McGeorge, et al, 2002)'.

The above statement captures the construction industry, not only globally but also locally. This is echoed by Tam and Le (2007) who state that less satisfactory performance in the construction industry has led to the belief that construction products cannot be completed within budget and desired quality. They further state that although quality management is implemented by many organizations, serious problems can still be found in construction processes and products.

The Kenyan construction industry has occasionally been blamed for general poor quality and there is absolutely lack of general quality assurance in the industry (Dindi, 2004). This lack of quality in construction products is evidenced by the run down infrastructure and frequent reports of building collapse in our towns. Such occurrences are variously reported including the collapse of a building on 9th April, 2009 in Mombasa[1].

Following the collapse of a building along Ronald Ngala Street in Nairobi in January 23rd, 2006, the following were some of the comments made;

"This is all about building standards," Kenyan Army Brig. George Kyaka, who was leading the military response.

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[1] http://www.nation.co.ke/News/-/1056/559038/-/u3t8bt/-/index.html, accessed on 10th April, 2009

"It is very important that we put in place mechanisms to ensure that only properly designed buildings are built," Vice President Moody Awori.[2]

The same is captured in a speech by Hon. Ndiritu Muriithi, Assistant Minister, Ministry of Industrialization during the workshop on safety and quality in the building and construction industry on 22nd May 2008 at the Kenya Bureau of Standards Headquarters, Nairobi -

"Over the last five years, a number of buildings some under construction and others completed have collapsed in Nairobi and other major towns in Kenya. Most of these failures have been attributed to the quality of steel, concrete and lack of appropriate professionalism in the processes that produced the structures concerned."[3]

Various task forces have been formed over the years in an attempt to identify the causes of the frequent building collapse in Kenya. A committee formed to review and harmonize the building laws of Kenya have identified the following causes;

a) Uncontrolled physical planning
b) Inadequate controls and enforcement in construction
c) Unethical practices and corruption
d) Easy entry by unqualified people in the construction industry
e) Unequal application of the law
f) Judicial application
g) Approval of building plans by unqualified or unprofessional people.
(Daily Nation Newspaper, Pg. 47, April 30th, 2009).

According to Dindi (2004), the success of a construction project is determined by the relationship between the following three variables;

- Time
- Cost
- Quality

Mbatha (1986), Talukhaba (1989) and Mbeche and Mwandali (1996) have established that time and cost performance of construction projects in Kenya are poor to the extent

[2] http://www.foxnews.com/story/0,2933,182474,00.html, accessed January 11th, 2009

[3] http://www.industrialization.go.ke.php.htm/section.asp?ID=61 accessed January, 11th, 2009)

that over 70% of projects initiated in Kenya are likely to escalate in time with a magnitude of over 50%.

While many studies have focussed on the time and cost parameters, quality has not been given its due attention maybe due to the assumption that qualified consultants of good repute and standing would give quality design products (Dindi, 2004). This assumption which is based on the rules of professional conduct to which the design professionals are supposed to adhere to may not be valid due to the erosion of ethical and moral norms in the fabric of the wider society (Talukhaba, 1999). Further studies into quality in construction have mainly focussed on the building processes alone.

The contractors have often been blamed for poor workmanship but it is noted by Taylor and Hosker (1992) that "there was need to control quality over the whole production chain, testing the end-product only was too late since it became largely the detection of failure. McCaffer (1990) states that quality cannot be inspected in- it must be planned for and built in. He further quotes from the BRE report which indicated that 50% of its catalogue of failures in low rise houses was due to design. He further states that there is ample evidence that a significant number for quality failures are generated in the design office. It is further noted that for any built product, the final quality starts with the design of the product. From there, the quality should be built into the product at every step (Chase, 2001).

As such, all the players in the construction process have a responsibility in delivering a product that meets the expected standards, for the desired function to the satisfaction of the customer. For quality assurance to be entirely successful, all the components of the many services and construction activities which contribute to the finished building should have quality standards which comply with a common standard (Taylor and Hosker, 1992).

Hence, a study into the aspects that would result in an increased customer satisfaction through an improvement in the quality management process during the design process would increase the opportunity for better end products for the customers use. It is hypothesised that utilization of quality management systems and tools during the design process gives a better chance of having a quality built product.

This study intends to give insights into the extent of awareness of quality management techniques, the extent to which quality management tools are utilized during the design process and attempts to identify what factors affect quality management during the design process.

1.2 Objectives of the study

1. To investigate the extent of application of quality management systems during the design process as a means of achieving Total Quality Management
2. To investigate how quality management techniques are utilized during the design process
3. To identify the factors that affect quality management during the design process

1.3 Research questions

1. To what extent are the design professionals aware of quality as a concept and quality management systems utilization during the design process?
2. To what extent are quality management systems and techniques utilized during the design process?
3. What are the factors that affect quality management during the design process?

1.4 Significance and justification of the study

1. This study advances the study undertaken by Dindi (2004) titled Quality Management: A challenge for the Kenyan Construction Industry. The research which focused on the building/ post-contract stage reported in its findings that quality management in construction in Kenya is in its early developmental stages and the very idea of quality management is still very new in the construction industry. It further noted that design plays a crucial role in the final quality of constructed facilities and in their performance. Hence, this study seeks to provide further insights on quality management by examining quality management systems during the design processes.

2. The study seeks to explore the application of quality management techniques during the design process. This will give insights into understanding and recommend means of adaptation of the techniques for application and relevance in this particular field
3. The research anticipates identifying the factors that affect quality management during the design process in the local construction industry. Understanding of these factors will lead to better understanding and implementation of quality management techniques during the design process leading to a better finished product.
4. The research will contribute to the knowledge of quality management in design firms and setting up the ground for further research on the subject. The study will complement past studies done on quality management especially at the building stage to facilitate a wholesome approach to quality management in construction.
5. The study seeks to give recommendations which will be used to develop training manuals and facilitate the understanding of quality management systems for use at the design stage, most specifically by architects, and in extension, other design consultants.

1.5 Scope and organization of the study

The study is limited to Nairobi due to limitations of time and finances and focuses on the architectural design aspects of the design process in private projects. The focus enables an in-depth analysis of a particular discipline rather than a general overview of all the disciplines involved in the design process. Private projects are envisioned to be more subject to quality measures and controls as the clients are more defined rather than public/government projects whose clientele/ end user is more diverse and many a times ambiguous.

The study is organized in five (5) chapters.

Chapter one discusses the problem of quality management at the design stage of construction. It states the problem and study area, study objectives, significance and justification, scope and organization of the study.

Chapter two is the literature review. The chapter dwells on the understanding of quality- historical evolution and theories postulated on the same. A look at quality management and construction is also undertaken. An understanding of the traditional procurement system is sought as well as the various stages of the construction process. Focus is eventually at the design process and the quality management systems applicable.

Chapter three is the research methodology and design. It covers a description of the study area and population, data collection methods and the data analysis.

Chapter four discusses the data collected as it relates to design quality and use of quality management systems at the design stage in Kenya.

Chapter five presents the conclusions and recommendations from the research undertaken.

1.6 Study Assumptions

1. The findings based in Nairobi are representative of the conditions in the wider Kenyan context
2. The findings from previous research on quality management techniques at the building stage are fairly accurate.
3. Competence of the design professionals in terms of their qualification and ability to deliver.

1.7 Definition of terms

- Quality-Ability to conform to requirements or specifications (McGeorge and Palmer, 2002). The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (BS 4778 Part 1, Clause 3.1)[4].

[4] Clause 3.1 further notes that;

a. in a contractual environment, needs are specified whereas in other environments, implied needs should be identified and defined

b. in many instances, needs can change with time; this implies periodic revision of specifications

- Quality Management- all activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system (BS EN ISO 8402).
- Quality management system (QMS)- All activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system (BS EN ISO 8402)
- Total Quality management (TQM) - A management approach of an organization, centred on quality, based on the participation of all members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society (BS EN ISO 8402, 1995).
- Quality Control (QC) - Operational techniques and activities that are used to fulfil requirements for quality (BS EN ISO 8402, 1995).
- Quality Assurance (QA)-All the planned activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality (BS EN ISO).
- Construction-This term is used to refer to the entire process of delivering a built product from design, tendering and procurement to actual building (e.g. Construction sector, industry).
- Building- Operationalized to mean the act of constructing something

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c. Needs are usually translated into features and characteristics with specified criteria. Needs may include aspects of usability, safety, availability, reliability, maintainability, economics and environment.

CHAPTER TWO

LITERATURE REVIEW & THE THEORETICAL FRAMEWORK

2.0 Introduction

Quality as a concept has many definitions and this challenge has been enhanced by the variant views from different authors. Noting that despite quality being known since time immemorial, it has until these last few years had a rather subjective connotation (Cnudde, 1991).

The application of this concept into a unique sector-construction industry- has further compounded the challenge. The uniqueness of the construction sector is attributed by Cnudde (1991) to;

a) The uniqueness of the work (each site constitutes a prototype)
b) The number of activities involved in a building and
c) The multiplicity of parties.

The construction industry has been noted to be different from other sectors where quality procedures have been implemented to various levels of success.

An understanding of the procurement methods for construction, the building process and eventually focussed at the design stage and process will offer insights of how the design phase contributes to the eventual end product. An in-depth examination of quality as a concept as postulated by various proponents will form the back bone of understanding and lead to the eventual application of quality methods and techniques at the design stage of construction to enhance the delivery of a quality construction product.

2.1 Quality and quality management

2.1.1 Definition of Quality

Quality as a concept requires a clear cut definition as it is perceived differently by different authors. This perception leads to quality being termed as subjective because what one party may consider satisfactory may not be so with regard to another (Dindi, 2004). Some design professionals believe that quality is measured by the aesthetics of the facilities they design. According to Stasiowski and Burstein (1997), this traditional definition of quality is based on such issues as how well a building blends into its surroundings, a building's psychological impacts on its inhabitants, the ability of a landscaping design to match the theme of adjacent structures, and the use of bold new design concepts that capture people's imaginations.

Quality can also be defined from the view point of function, by how closely the project conforms to its requirements. Using this definition, a high quality project can be described by such terms as ease in understanding drawings, level of conflict in drawings and specifications, economics of construction, ease of operation, ease of maintenance, and energy efficiency (ibid).

Arditi and Gunayrdin (1997), define quality as meeting the legal, aesthetic and functional requirements of a project. Requirements may be simple or complex, or they may be stated in terms of the end result required or as a detailed description of what is to be done. But, however expressed, quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements. Quality is also defined as the "ability to conform to requirements or specifications" (McGeorge and Palmer, 2002). Juran (1986) simplified this definition to "fitness for use." These varying views of quality therefore make it a hard word to define. As such, the best definition of quality is that which is not necessarily indicative of special merit, excellence or high status, but is rather solely used in an engineering sense, in which it conveys the concepts of compliance with a defined requirement, of value for money, of fitness for purpose, or customer satisfaction (Ashford, 1992).

For the purpose of this study, the operational definition of quality is taken as the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (BS 4778 Part 1, Clause 3.1)[5].

2.1.2 Quality Management

The achievement of quality is through a management process. This is the process by which the delivery of a quality product is assured. The quality of the product is a direct result of the quality of the processes that produce the product (Harris and McCaffer, 2000).

Quality management is hence defined as;

" all activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system "(BS EN ISO 8402).

Harris and McCaffer (2000) state that quality management has to provide the environment within which the tools, techniques and procedures can be deployed effectively leading to operational success for the company. The role of quality management is not an isolated activity but intertwined with all the operational and managerial processes of the company. Crosby (2000) stated that quality management is a policy reflecting the fundamental concept that all work is a process.

Quality management is embodied in basic principles which are founded on the works of Juran and Deming and summarized by Ashford (1989) as follows;

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[5] Clause 3.1 further notes that;

a. in a contractual environment, needs are specified whereas in other environments, implied needs should be identified and defined

b. in many instances, needs can change with time; this implies periodic revision of specifications

c. Needs are usually translated into features and characteristics with specified criteria. Needs may include aspects of usability, safety, availability, reliability, maintainability, economics and environment.

a) The management of quality is crucial to top company survival and merits the personal attention and commitment of top management
b) The primary responsibility for quality must lie with those doing the work. Control by inspection is of limited value.
c) To enable production departments to accept responsibility for quality, management must establish systems for the control and verification of work, and must educate and indoctrinate the work force in their application.
d) The costs of education and training for quality, and any other costs which might be incurred, will be repaid many times over by greater output, less waste, a better quality product and higher profits.

These principles required that the management should devote its attention to the improvement and maintenance of quality not because someone else might oblige them to do so, but because it was a desirable end in itself (Ashford, 1989).

2.1.3 Evolution of Quality Management

The idea of quality is not new and has its origins in inspection-based systems used in the manufacturing industry (Asher, 1992). Quality was historically regarded as a matter of inspection and of correcting discovered faults, rather than managing the production process so as to eliminate faults (Kennedy, in McCabe, 1998). Quality control concerns can be traced from as early as the reign of King Hammurabi of Babylonia (2123-2081 BC) where he introduced laws as a means of ensuring compliance with standards. Quality controls were introduced and enforced ad hoc over time until the industrial revolution when new production methods led to changed relationship between traders and their customers. Taylor and Hosker (1992) note that purchasers were soon began demanding certainty in quality as never before. Thus were born comprehensive specifications and contract conditions. From this crude and elementary processes emerged the principles of quality assurance (and by extension quality management) as they are understood today. This has been refined over time, over varying circumstances and situations, including the Second World War, to the current situation.

Noting that quality is a journey rather than a destination, quality can then be traced over various stages;

a) Inspection

Inspection involves activity such as measuring, examining, testing or gauging one or more characteristics of an entity and comparing these results with specified requirements in order to establish whether conformity is achieved for each characteristic (BS EN ISO 8402). When conformance is not achieved, the product is corrected until it meets that particular specification. Inspection can be costly as it functions on already completed products or services.

b) Quality Control (QC)

This is regarded as an extension of inspection. It involves the operational techniques and activities that are used to fulfil measurement for quality. Specifications and inspections of completed parts, sub-assemblies and products are used to design, produce, sustain and improve the quality (Dindi, 2004). Data is collected for use in statistical techniques. From the information gathered, indications of where certain problems are occurring and remedial measures thereafter employed.

c) Quality Assurance (QA)

In an attempt to shift from curative to preventive measures of achieving quality, quality assurance seeks to utilize recognized quality management systems. This is captured in the definition of quality assurance- all the planned activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality (BS EN ISO). It requires the use of procedures. Audits can gauge the effectiveness of the procedures and if not being adhered to, they can be re-written or the users given more explanation on what is required.

d) Total Quality Management (TQM)

This is viewed as a follow up of quality assurance. Sensing that customer needs, requirements and expectations involved more that providing a product or service, industry began to integrate quality into all areas of operation (Dindi, 2004).

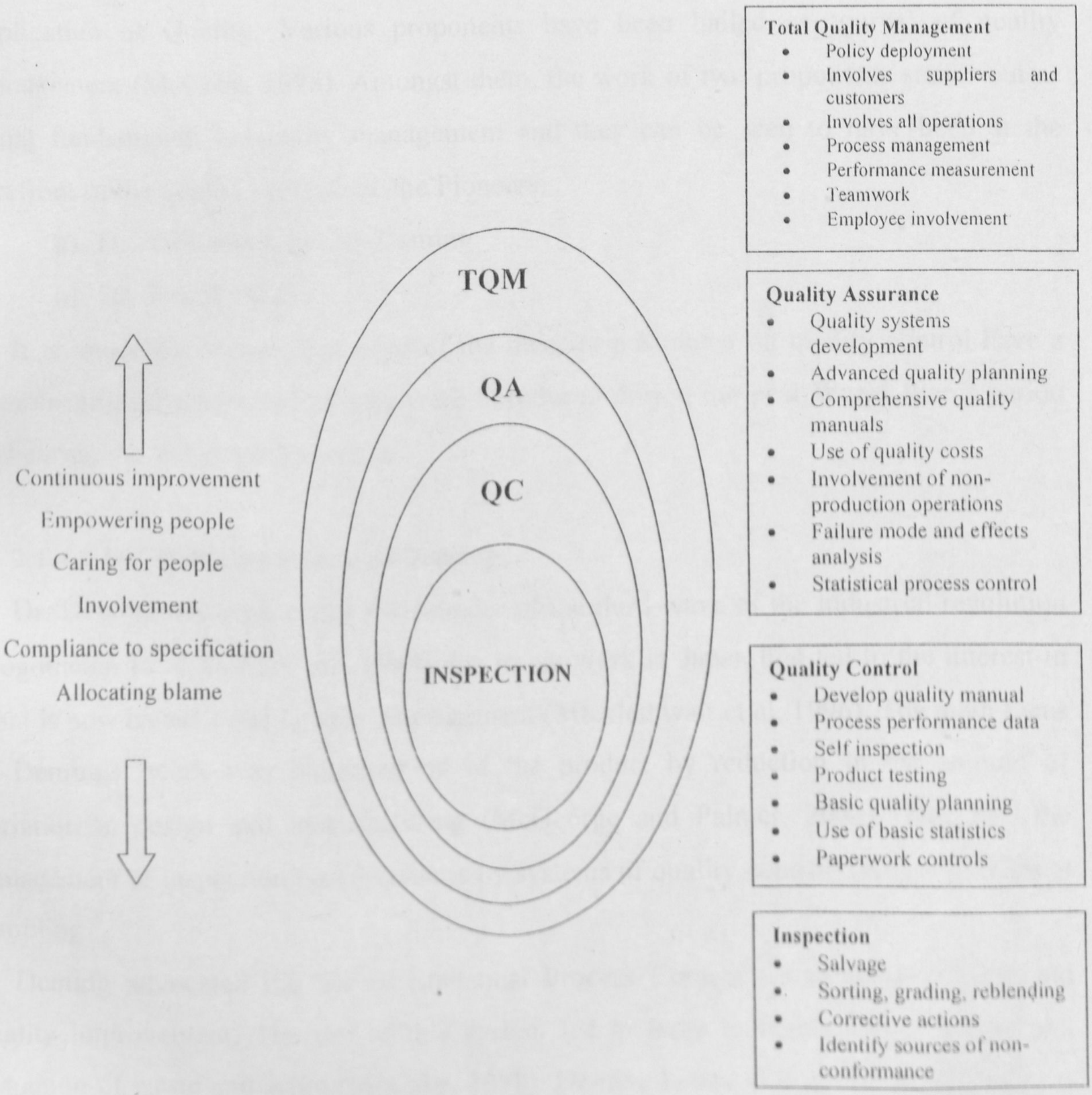
Unlike quality assurance, total quality management (TQM) is less formal, having neither systems nor procedures (McCabe, 1998). It is considered to be a philosophy which requires change in attitude, management style and culture. It is defined in BS EN ISO 8402 as a management approach of an organization, centred on quality, based on the participation of all members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society. Robbins (1994) in McCabe (1998) list five essentials of TQM;

i. Intense focus on the customer
ii. Concern for continual improvement
iii. Improvement in the quality of everything
iv. Accurate measurement
v. Empowerment of employees.

The philosophy of TQM focuses on giving the customer an excellent service and/ or product by the use of continuous improvement, employing quality tools and techniques, and by emphasizing the importance of people (McCabe, 1998). As such it encourages every person or organisation involved to contribute to the overall effort of improvement. The transition to TQM underlines the philosophy of planning and building in quality rather than inspecting for quality as advanced by McCaffer (1990).

This is summed graphically below;

Fig. 2.1 The four stages of quality management



Source: McCabe, 1998

2.1.4 Proponents and Theories of quality

Over time, various theories have been advanced to understand the concept and application of Quality. Various proponents have been hailed as 'gurus' of quality management (McCabe, 1998). Amongst them, the work of two proponents stands out as being fundamental to quality management and they can be seen to have been at the forefront of the quality revolution, the Pioneers;

a) Dr. Williams Edwards Deming

b) Dr. Joseph Juran

It is important to note that most of the theories postulated on quality control have a manufacturing background as they were introduced during the post World War 2 period and during the industrial revolution.

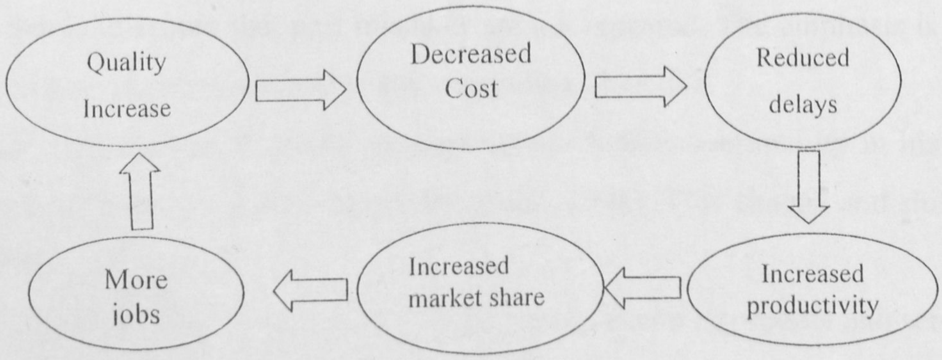
2.1.4.1 Dr. Williams Edwards Deming

Dr. Deming has been called the founder of the third wave of the industrial revolution (Logothetis, 1992, in McCabe, 1998) due to his work in Japan that led to the interest in what is now called Total Quality Management (Micklethwait et al, 1996). The main focus of Demings' work was improvement of the product by reduction in the amount of variation in design and manufacturing (McGeorge and Palmer, 2002). This saw the replacement of inspection based systems by systems of quality control based on statistical sampling.

Deming advocated the use of Statistical Process Control for problem solving and quality improvement. The use of this system led to large increases in production and reduction of waste and scrap (McCabe, 1998). Deming believed that the use of SPC was capable of application to any process, regardless of whether or not it was manufacturing.

He further believed that once a quality system was set in motion it resulted in a quality chain reaction-as quality improves costs decrease, as do errors and delays. This causes an increase in productivity and an increase in market share brought about by better quality at a lower price. This is summed up in a quality chain;

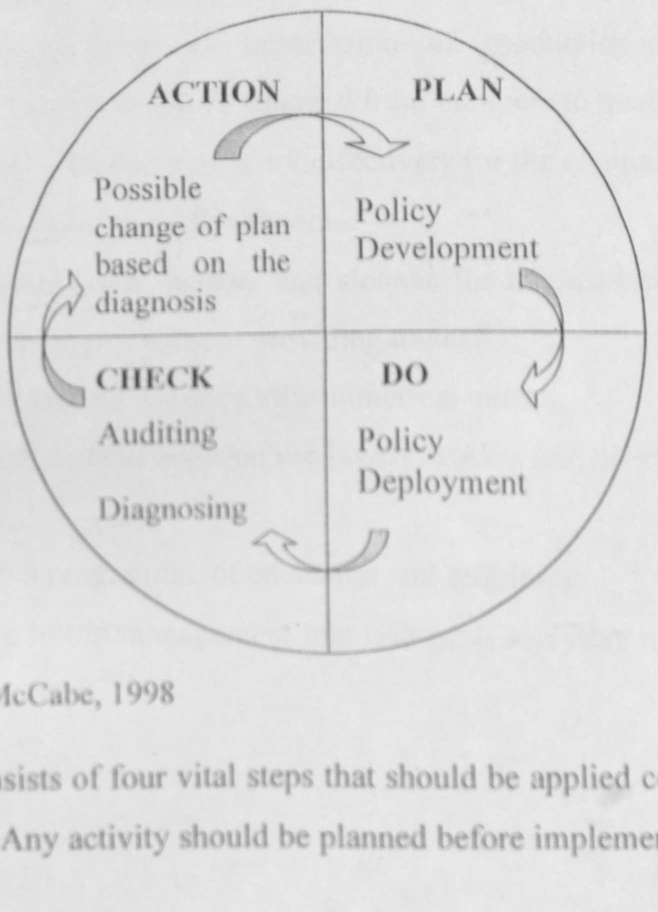
Fig. 2.2- The Deming Chain Reaction



Source: McGeorge and Palmer, 2002

Further to this quality chain reaction, he came up with the Deming Plan also referred to as the PDCA Cycle.

Fig. 2.3 Deming/PDCA



Source: McCabe, 1998

The Deming cycle consists of four vital steps that should be applied continuously and repetitively to every task. Any activity should be planned before implementation. There is need for evaluation to select the best way of implementation of the task. The doing so requires every person involved to implement the plan and collect data during the stage. This data enables evaluation of how effective the plan was. Following the learning that then occurs, corrective action is undertaken and incorporated into future planning of tasks. The aim is to ensure that past mistakes are not repeated. The emphasis is to use the cycle continuously as improvement is a never-ending objective.

Demings' contribution to quality management is further summed up in his 14 points which provide a basis for radical change (McCabe, 1998). This change and shift is at the heart of TQM.

1. Create constancy of purpose towards improvement of product and services.
2. Adopt the new philosophy. We can no longer live with commonly accepted levels of delays, mistakes, defective workmanship.
3. Cease dependence on mass inspection. Require, instead, statistical evidence that quality is built in.
4. End the practice of awarding business on the basis of price tag.
5. Find problems. It is management's job to work continually on the system.
6. Institute modern methods of training on the job.
7. Institute modern methods of supervision of production workers. The responsibility of foremen must be changed from numbers to quality.
8. Drive out fear that everyone may work effectively for the company.
9. Break down barriers between departments.
10. Eliminate numerical goals, posters and slogans for the workforce asking for new levels of productivity without providing methods.
11. Eliminate work standards that prescribe numerical quotas.
12. Remove barriers that stand between the hourly worker and his right to pride of workmanship.
13. Institute a vigorous programme of education and retraining.
14. Create a structure in top management that will push everyday on the above 13 points.

2.1.4.2 Dr. Joseph Juran

Jurans' approach to quality was less statistically driven (McCabe, 1998). He developed the concept of company-wide quality management which was a means of disseminating quality through the whole organisation. This placed the responsibility of quality on everyone involved. The success of quality lay in actual implementation.

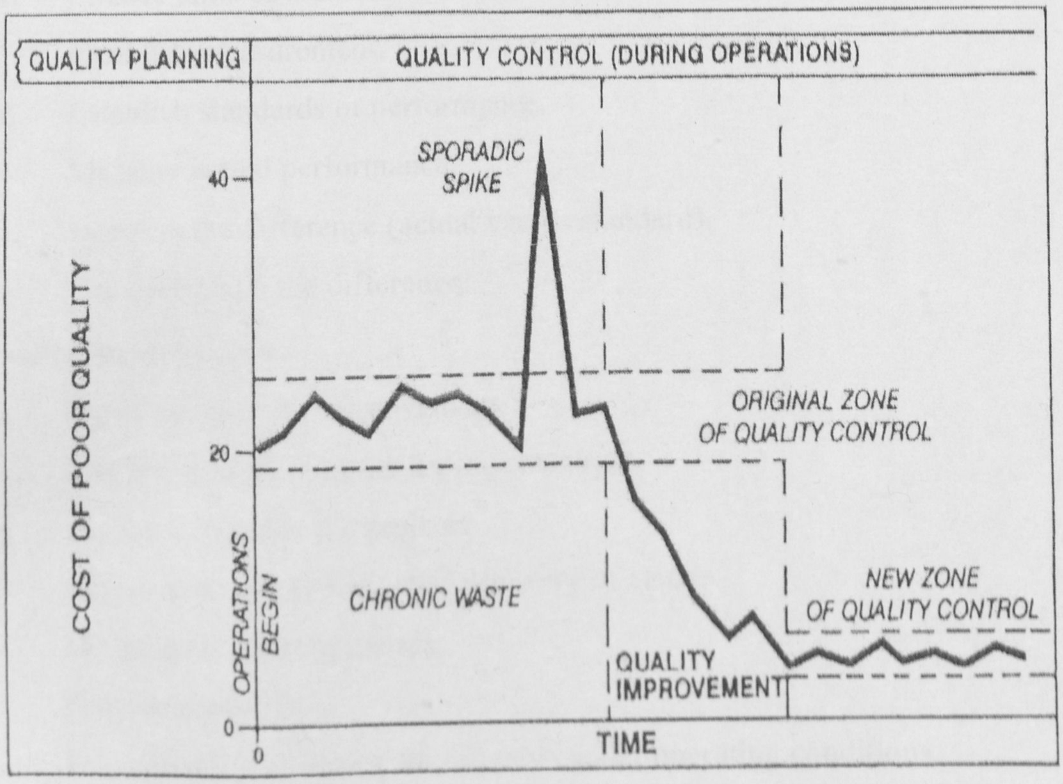
He further postulated that quality requires quality of design, quality of conformance, availability and adequate service. To manage this quality improvement, attention had to be given to the cost of quality. These costs are;

1. Unavoidable Costs: preventing defects (inspection, sampling, sorting, quality control)
2. Avoidable Costs: defects and product failures (scrapped materials, labour for re-work, complaint

Jurans work according to McCabe (1998)is summarized as involving four steps which lead to a quality trilogy as presented in figure 2.4;

a) Clearly identify specific things/projects that need to be done
b) Provide definite plans for achieving what can be done
c) Ensure that people are made responsible for doing certain things
d) Make sure that the lessons that are learned during the previous three steps are captured and used in feedback.

Fig.2.4 Quality Trilogy



Source: Juran, 1986

Juran (1986) stated that the underlying concept of the quality trilogy is that managing for quality consists of three basic quality-oriented processes.

- **Quality planning-**
  i. Identify the customers both external and internal.
  ii. Determine customer needs.
  iii. Develop product features that respond to customer needs. (Products include both goods and services.)
  iv. Establish quality goals that meet the needs of customers and suppliers alike, and do so at a minimum combined cost.
  v. Develop a process that can produce the needed product features.
  vi. Prove process capability—prove that the process can meet the quality goals under operating conditions.

- **Quality control-**
    1. Choose control subjects — what to control.
    2. Choose units of measurement.
    3. Establish measurement.
    4. Establish standards of performance.
    5. Measure actual performance.
    6. Interpret the difference (actual versus standard).
    7. Take action on the difference.
- **Quality improvement-**
    1. Prove the need for improvement.
    2. Identify specific projects for improvement.
    3. Organize to guide the projects.
    4. Organize for diagnosis—for discovery of causes.
    5. Diagnose to find the causes.
    6. Provide remedies.
    7. Prove that the remedies are effective under operating conditions.
    8. Provide for control to hold the gains.

Juran (1986) was of the opinion that the above named processes were universal and is carried out by an unvarying sequence of activities.

Other notable contributors to quality management are;

a) Philip Crosby- postulated that by doing it right the first time, it was possible to build in quality, hence quality could be free. He summed up his theory in the Four Absolutes of Quality Management.[6]

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[6] The Four Absolutes of Quality Management

i. Quality is defined as conformance to requirements, not as 'goodness' or 'elegance'.

ii. The system for causing quality is prevention, not appraisal.

iii. The performance standard must be Zero Defects, not "that's close enough".

iv. The measurement of quality is the Price of Non-conformance, not indices

Source: http://www.hkbu.edu.hk/~samho/tqm/tqmex/crosby.htm, accessed 12th April, 2009.

b) Masaaki Imai- advocated the principle of 'Kaizen' which is accepted to mean continuous, small step improvement (McCabe, 1998). He further advanced the cause for use of total quality control.

c) Armand V. Feigenbaum-advocated a total approach to quality which must involve everybody. He further argued that quality should be built in, prevented rather than inspected out.

2.2 Construction procurement methods

The choice of procurement approach for every building project is fundamental to the construction process. This choice should be made rationally and objectively and no later than before the design process begins (Birrell, 1991). The choice thus made should be based on;

a) The needs of the client

b) The nature and current status of the client

c) The state of the current local building marketplace and

d) The resulting nature of the future building.

This is because the choice of the particular procurement method affects the processes of design, contracting and building which in turn affect the quality, cost and duration of the building project for the client. In light of this, procurement methods now available according to Birrell (1991) and Kwakye (1997) include;

a) Traditional procurement

b) Design build

c) Management contract

d) Construction management and

e) Program/ project management.

Whilst this and possibly other procurement methods have been formulated and utilized, the traditional method of procurement is still prevalent in Kenya. Ashford (1992) argues that the traditional procurement and contractual arrangements have served their purpose admirably in the past but there is a trend within the construction industry to seek other forms of contract more appropriate to today's conditions. Despite this, Talukhaba

(1988) notes that in Kenya, the process of construction and the traditional methods of contracting which were adapted from Britain have virtually remained unchanged. Kwakye (1997) further notes that the traditional system will probably be in use for many years. This system hence becomes the main focus of our study and discussion.

2.2.1 The traditional procurement method

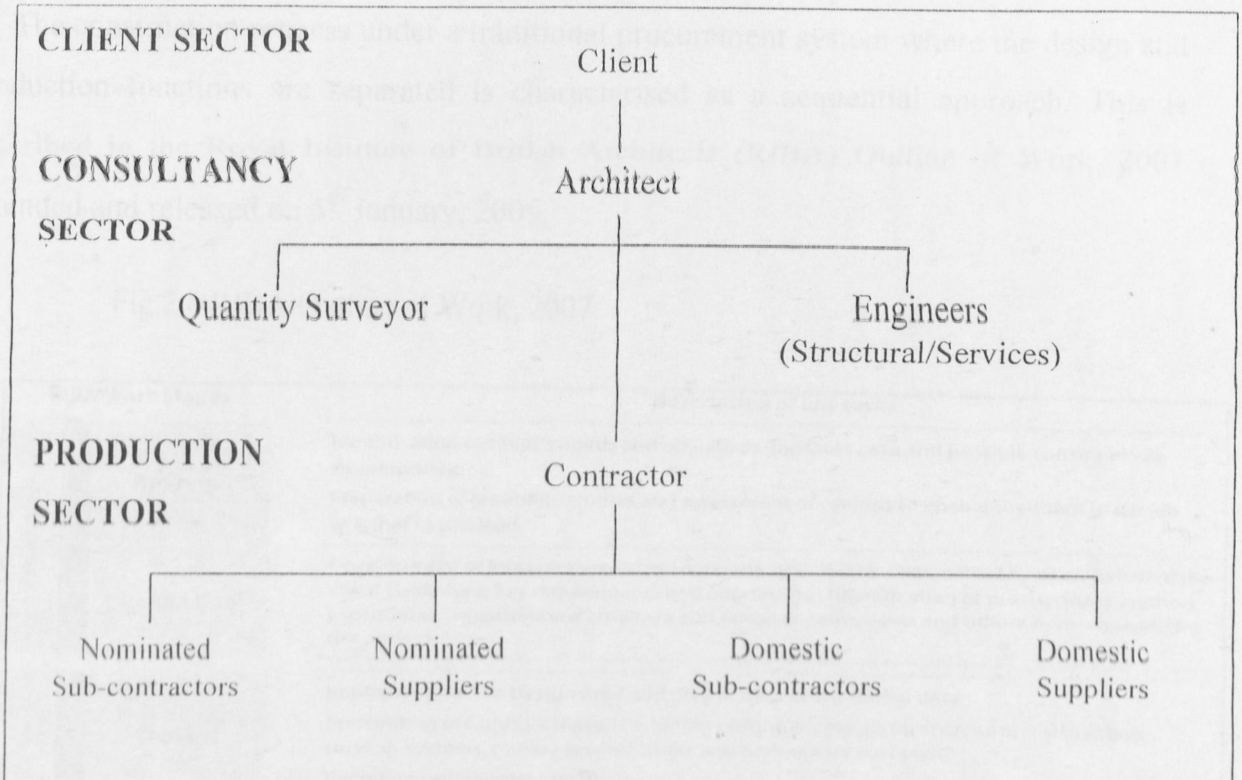
Under this method, the construction process is undertaken by two main groups both working on behalf of the client-

a) Consultants – The consultants are architects, engineers (structural and services) and quantity surveyors who are contracting professionals with diverse skills and hence offer design and management services for a fee.

b) Contractors- The contractors, specialist sub-contractors and suppliers are essentially commercial companies who supply materials/ components and carry out the building production for profit.

There is a separation of the production from the design of the project. This separation embodies the main feature of the traditional procurement system and is illustrated as follows;

Fig. 2.5 Typical Separation of design and production



Source; Kwakye, A. 1997, Construction Project Administration in Practise

Under this arrangement, the Client hires the architect as the principal lead advisor, commonly referred to as the Lead Consultant. The architect is in charge of the whole design and all contract documents and contracting for building. He advises on the choice of the contracting process and acts as an inspector of the building but will not manage the construction process. The building process is carried out and is the responsibility of a general/ main contractor, usually for a fixed sum of money.

The client has the advice of the architect throughout all stages of the procurement process but the architects' capabilities are mainly in the design and constituents of the building rather than in management of complex contracting processes and settlement of contractual matters before, during and after building.

2.3 The construction process

The construction process under a traditional procurement system where the design and production functions are separated is characterised as a sequential approach. This is described in the Royal Institute of British Architects (RIBA) Outline of Work, 2007 amended and released on 5th January, 2009;

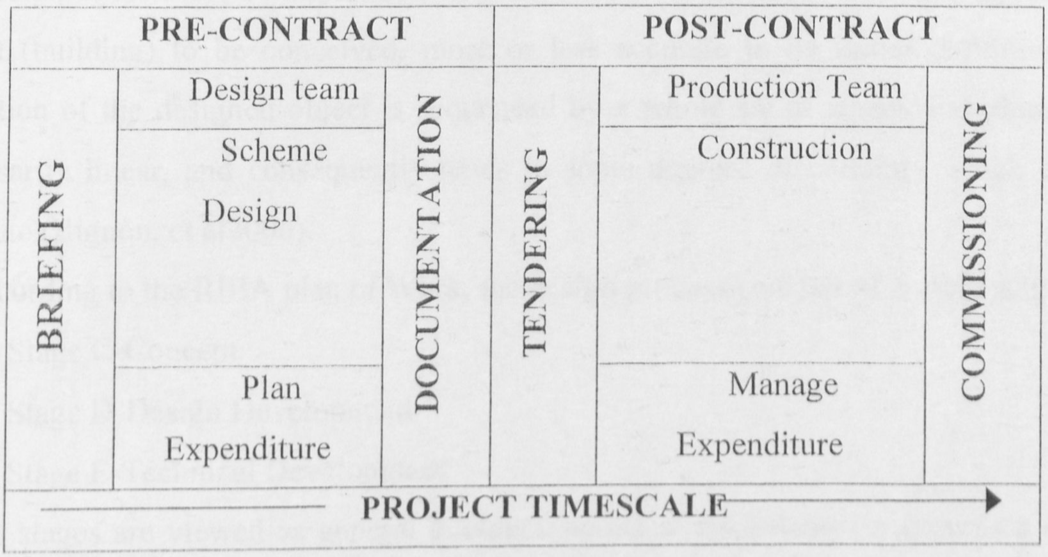
Fig.2.6 RIBA Outline of Work, 2007.

RIBA Work Stages				Description of key tasks
Preparation	A	Appraisal		Identification of client's needs and objectives, business case and possible constraints on development. Preparation of feasibility studies and assessment of options to enable the client to decide whether to proceed.
	B	Design Brief		Development of initial statement of requirements into the Design Brief by or on behalf of the client confirming key requirements and constraints. Identification of procurement method, procedures, organisational structure and range of consultants and others to be engaged for the project.
Design	C	Concept		Implementation of Design Brief and preparation of additional data. Preparation of Concept Design including outline proposals for structural and building services systems, outline specifications and preliminary cost plan. Review of procurement route.
	D	Design Development		Development of concept design to include structural and building services systems, updated outline specifications and cost plan. Completion of Project Brief. *Application for detailed planning permission.*
	E	Technical Design		Preparation of technical design(s) and specifications, sufficient to co-ordinate components and elements of the project and *information for statutory standards and construction safety.*
Pre-Construction	F	Production Information	F1	Preparation of production information in sufficient detail to enable a tender or tenders to be obtained. *Application for statutory approvals.*
			F2	*Preparation of further information for construction required under the building contract.*
	G	Tender Documentation		*Preparation and/or collation of tender documentation in sufficient detail to enable a tender or tenders to be obtained for the project.*
	H	Tender Action		*Identification and evaluation of potential contractors and/or specialists for the project.* *Obtaining and appraising tenders; submission of recommendations to the client.*
Construction	J	Mobilisation		Letting the building contract, appointing the contractor. Issuing of information to the contractor. Arranging site hand over to the contractor.
	K	Construction to Practical Completion		Administration of the building contract to Practical Completion. Provision to the contractor of further information as and when reasonably required. Review of information provided by contractors and specialists.
Use	L	Post Practical Completion	L1	Administration of the building contract after Practical Completion and making final inspections.
			L2	Assisting building user during initial occupation period.
			L3	Review of project performance in use.

Source: http://www.ribabookshops.com/site/title_pdfs/08012009172725.pdf, accessed March 30th, 2009.

The outline indicates the clear demarcations of the Pre-contract and Post-contract stages. This can be outlined along a project timescale as below;

Fig. 2.7 Sequential activities

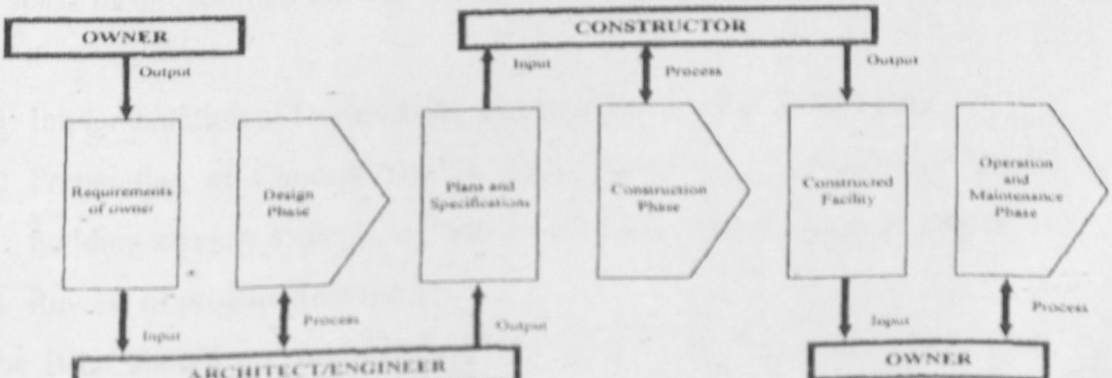


Source: Source; Kwakye, A. 1997, Construction Project Administration in Practise

Under this sequential series, Kwakye (1997) further states that each stage has to be completed and approved before proceeding to the next. These inter related processes (Fig. 2.2) are constrained by time, resources and performances.

This process is similarly described by Arditi et al (1997) as below;

Fig. 2.8 Construction process



Source: Arditi et al, 1997.

For the purposes of this study, the focus is on the design n process.

2.3.1 The Design Process

"The first objective of a design process is still to define an answer to an unsatisfied need" Poveda &Thorin (2000).

Design in architecture underlies a targeted objective, represented in most cases by an object (building) to be conceived, more or less accurate in its initial definition. The evolution of the designed object is sequenced by a whole set of stages and phases, not necessarily linear, and consequently tends to some degrees of certainty which are not absolute (Bignon, et al2006).

According to the RIBA plan of Work, the design process consists of 3 main stages:

a) Stage C-Concept

b) Stage D-Design Development

c) Stage E-Technical Development

The stages are viewed as general guidance points as each design project is a unique one and the uniqueness of the projects implies an identification of the particular activities of each project (Bignon, et al2006).

a) Stage C: Concept:

This stage has also been previously referred to as the Outline proposals Stage (CABE, 2004). Stage C begins when the architect's brief has been determined in sufficient detail. The Client is assumed to have formulated the full brief in detail following the preparation stage under which an appraisal has been done based on the Clients idea and there is a clear sense of direction on the way forward. The three main tasks as outlined in Fig. 2.2 are;

a) Implementation of Design Brief and preparation of additional data.

b) Preparation of Concept Design including outline proposals for structural and building services systems, outline specifications and preliminary cost plan.

c) Review of procurement route.

The Brief should not be modified substantially after this point. Depending on the procurement route, changes after this stage can incur additional cost or lengthen the schedule of the project.

b) Stage D-Design Development

This stage (also referred to as Scheme Design stage) involves;

a) Development of the concept design to include structural and building services systems,

b) Updating of outline specifications and cost plan, and

c) Completion of Project Brief.

This stage determines the general approach to the layout, design and building in order to obtain authoritative approval of the client on the outline proposals. The project brief will be fully developed and detailed proposals will be made and compiled as a design report.

c) Stage E-Technical Development

This stage also referred to as Detail and Production Stage, is summed up as the preparation of technical design(s) and specifications, sufficient to co-ordinate components and elements of the project and information for statutory standards and building safety. It generally involves;

a) Completion of the brief with decisions made on the planning arrangement, appearance, building method, outline specification and cost of the project.

b) Preparation for application for statutory approvals for building project.

In effect, during this Stage final proposals are developed for the Project sufficient for co-ordination of all its components and elements to realise the building. It must be noted that in traditional procurement, any further change in location, size, shape, building method or cost after this time is likely to result in abortive work (CABE, 2004).

Previously, stage F, G and H as indicated on figure 2.6 were included in the design phase. These stages involved action which was to prepare for tender action. Certain design elements in these stages include final decisions taken on every matter related to design, specification, building and cost. This led to the eventual completion of production drawings, schedules and specifications.

2.3.2 The design participants

Each stage in the construction process involves a wide range of participants (Fig. 2.1) with practical and professional skills. These skills are different in discipline, carrying out separate but interrelated functions of design, engineering, costing, pricing and production. Due to the complex nature of the building product and processes involved (Kwakye, 1997), the input of a large number of participants is necessary. Good coordination among them and their individual roles is essential for a satisfactory outcome (Abrantes et al, 1991). The participants who are thus engaged are mainly unaccustomed to working with each other and, hence, project activity imposes a special demand on team building and motivation. In addition, each participant should be made aware of all the governing conditions, objectives, responsibilities, relationships and other basic parameters of the construction project.

Whilst we are limiting ourselves to the design stage and in particular, to the architects, it is imperative to have a good understanding of the other design participants in the construction process. This is because a successful design relies heavily upon the integration and open communication between the client and the design team (Griffith, 1990).

In the traditional procurement method, the Client procures advice from construction professionals, namely the;

a) Architect
b) Quantity Surveyor
c) Structural Engineer
d) Services Engineer.

These four traditionally form the Design team. Their separate functions contribute to the conceptual thinking, produce alternative sketch designs, help to formulate the aims and requirements and assess the viability of the construction project (Kwakye, 1997). All participants are invariably held responsible for the optimal result of a design team-the possible sum of the best individual contributions of every member (Abrantes et al, 1991).

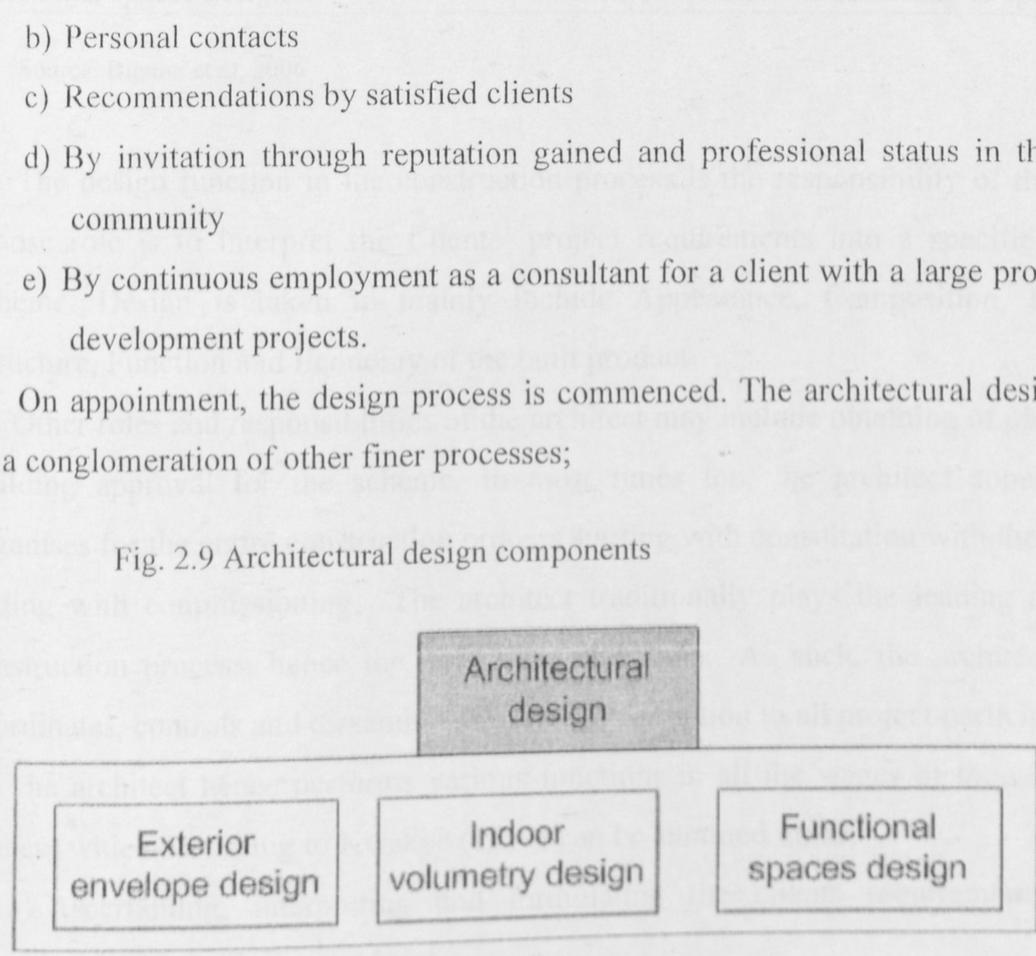
2.3.2.1 The Architect

Traditionally, the architect is the first construction professional a client may wish to appoint. Architecture as a profession is under a strict code of professional conduct which is administered through various legislative means and bodies e.g. Chapter 525 of the Laws of Kenya, by-laws No.3e which prohibit advertisement of their services. Hence, appointment of an architect is done through various channels which are mainly;

a) Competition
b) Personal contacts
c) Recommendations by satisfied clients
d) By invitation through reputation gained and professional status in the business community
e) By continuous employment as a consultant for a client with a large programme of development projects.

On appointment, the design process is commenced. The architectural design process is a conglomeration of other finer processes;

Fig. 2.9 Architectural design components



Source: Bignon et al, 2006

Each of these finer processes can be described as follows;

Table 2.10 Architectural design components

Process	Objective
Exterior envelope design	To insert building in the site
Indoor volumetry design	To organize indoor volumes according to building envelope
Functional spaces design	To distribute functions according to spaces

Source: Bignon et al, 2006

The design function in the construction process is the responsibility of the architect whose role is to interpret the Clients' project requirements into a specific design or scheme. Design is taken to mainly include Appearance, Composition, Proportion, Structure, Function and Economy of the built product.

Other roles and responsibilities of the architect may include obtaining of planning and building approval for the scheme. In most times too, the architect supervises and organises for the entire construction process starting with consultation with the client and ending with commissioning. The architect traditionally plays the leading role in the construction process, hence the term, lead consultant. As such, the architect collects, coordinates, controls and disseminates project information to all project participants.

The architect hence performs various functions in all the stages of the construction process which according to Kwakye (1997) can be summed up as;

a) Ascertaining, interpreting and formulating the clients requirements into an understandable project brief
b) Designing a building to meet the clients requirement and constraints imposed by factors such as statutory obligations, technical feasibility, environmental standards, site conditions and cost,
c) Bringing together a team of construction professionals to give expert guidance on specific points of the clients construction project,
d) Assessing the clients' cost limits and time scale, and specifying the type and grade of materials/ components for use on the construction project

e) Preparing production information for pricing and building and inviting tenders from building contractors

f) Supervising the production on site, constantly keeping the client informed of the projects' progress and issuing production instructions as and when required

g) Keeping the client informed of the status of the projects cost and advising on when payments should be made or withheld

h) Advising on the conduct of the project generally and resolving all contractual disputes between the client and the contractor.

i) Issuing the certificate of completion, the certificate of making good defects and the final certificate of payment.

The architects' responsibilities are similarly described under the normal service of an architect (Cap. 525, Subsidiary Legislation, part.3, 1978) under the four stages of design work;

a) Inception Stage
b) Outline Proposals
c) Scheme design
d) Detailed design and production drawings
e) Tender action to completion

This act includes other services which can be offered by architects under varying circumstances;

a) Additional Services
    i. Sites and Buildings- involving the advising on selection of suitable sites, making inspections on existing premises, making schedules of dilapidations and undertaking structural investigations.
    ii. Feasibility studies-undertaking preliminary appraisals for a project sufficient to enable a client to decide whether and in what form to proceed.
    iii. Development plans-preparation of development plans to be carried out over a large span of time
    iv. Layouts, roads and sewers- where the architect is engaged to provide services for the design of roads and sewers and for making of general layouts for development.

v. Development studies-where a proposed development involves special research and testing e.g. of construction method and materials.

vi. Special drawings-for preparation of drawings for other uses other than for building work e.g. for promotional purposes, for negotiations with other service providers amongst other

vii. Negotiations-where special negotiations are required e.g. for by-law and building approval

viii. Changes in instruction-for extra work to approved drawings arising from changes in the clients instructions or any other cause beyond the control of the architect

ix. Delays in buildings- for additional work arising from delay in building operations beyond the control of the architect.

b) Special Services

i. Town planning

ii. Garden and landscape design

iii. Interior design

iv. Shop fitting and exhibition work

v. Furniture and fittings

vi. Works of art

vii. Quantity surveying, valuing and surveying

viii. Litigation and arbitration

To be able to perform the above named function competently and efficiently, the architect must possess certain competencies including;

a) Foresight

b) Understanding of construction materials

c) Communication and coordination skills

d) Essential design skills and

e) Ability to design within set budgetary limits (Kwakye, 1997).

2.3.2.2 The Quantity Surveyor

The quantity surveyor is responsible for the study of the economies and financial implications of a construction project and hence he would be the appropriate construction professional to advise the client and design team on matters relating to the economies and cost of a proposed construction project. Despite not being a 'designer' per se, the quantity surveyor is part of the design team and is brought into the project at the earliest opportunity to advice on the costs of the various design options proposed since cost is one of the deciding factors in most construction projects.

2.3.2.3 The Structural/ Civil Engineer

The structural engineer acts as adviser to the architect on all structural problems such as stability of the structure, suitability of materials proposed, structural feasibility of the proposed design and sizes of structural members for a construction project (Kwakye, 1997). The structural engineer prepares structural drawings which are then submitted to the local authority for approval after the architectural drawings have received preliminary approvals. This may differ according to the particular local authority as in some cases the architectural and structural drawings are required to be submitted together.

Further to this role, the structural engineer performs structural design and supervises his specialist area of the construction project during production on site.

2.3.2.4 The Services Engineers

The services engineers provide professional input for the provision of Electrical and Mechanical services which include plumbing, electrical, heating and ventilation, air conditioning, sanitation, lifts and escalators amongst others depending on the scope of the particular project. They contribute to the design process to ensure that thermal and visual comfort is achieved effectively.

Accordingly, the services engineers peruse the Clients' brief in terms of requirements and priorities and advise the architect on the most appropriate design solution. The architect makes the necessary provisions for the accommodation of these services as agreed. Drawings indicating their proposals and layouts of the services are prepared and these are included as part of the tender documentation. The services engineers are mandated to ensure that their drawings are correctly interpreted, installed and commissioned.

As earlier noted, these professionals form the design team and they form an important advisory role to the client to ensure that their design solution gives the client and ultimately the end user value for money and affords the most economic production process.

According to Arditi and Gunaydin (1997), drawings and specifications received from the designers affect the quality of the construction. Drawings are the only documents given to the constructor that show the design concept, size and scope of the job. It is critical that drawings and specifications be clear, concise, and uniform. The project must be constructible by those retained to build the project. Design professionals must be familiar with construction materials and techniques that constructors will be using in the project.

2.4 Quality management in construction

2.4.1 Overview of quality and construction

There can be no doubt that the construction industry is an enormously complex one and that as an industry, it does have barriers that appear to prevent the development of a quality culture (McGeorge and Palmer, 2002)

Quality as a concept or term when used in buildings and in general the construction sector faces various challenges in terms of definition. The definition of quality adopted-conformance to specifications is challenged by Hughes (1991) who indicates that conforming to requirements means that if the client specifies poor quality, then that is what will be provided. He further notes that buildings have an aesthetic feature which is used as a measure of quality and refers to a subjective reaction to something which is good. This is a lot more difficult to define, and very difficult to control or assure (Hughes, 1991). He then affirms that quality in a building is primarily a question of perception, and secondarily a question of characteristics.

It is further noted by Griffith (1990) that the interpretation of quality in construction is dependent on the standpoint of the particular individual-client, architect or any other stakeholder. Problems surrounding perception, interpretation and assessment result from the lack of measurement techniques, yardsticks and conclusive tests to determine levels of construction quality achieved.

Five main questions which affect the description of building quality according to Griffith (1990) are;

a) Function- does the building meet the requirements?
b) Life-is the building durable?
c) Economy-Does the building reflect value for money?
d) Aesthetics-is the building pleasing in appearance and compatible with its surroundings?
e) Depreciation-is the building an investment?

These perceptions, interpretations and measurements of quality which are termed as superficial, subjective and hence becomes a matter of judgement are summed up as "quality in construction is determined by expectations" Griffith (1990).

McGeorge and Palmer (2002) view quality in buildings to be evaluated based on a list of seven principal dimensions;

a) Performance- the main reason for having the project along with the main characteristics it must have
b) Reliability-if the building will operate for a reasonable period of time without failure
c) Conformance-the degree to which specification is met
d) Durability- the length of time a building lasts before it needs to be replaced
e) Serviceability-the service given to a building after it is completed, particularly with regards to repair
f) Aesthetics-how the building looks and feels
g) Perceived quality- a subjective judgement of quality that results from image.

They further state that the way to achieve high levels of these principal dimensions is through the management of all the processes that deliver them.

In the construction industry, quality can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner. According to an ASCE study in Arditi and Gunayrdin (1997), quality can be characterized as follows;

a) Meeting the requirements of the owner as to functional adequacy; completion on time and within budget; lifecycle costs; and operation and maintenance.
b) Meeting the requirements of the design professional as to provision of well-defined scope of work; budget to assemble and use a qualified, trained and experienced staff; budget to obtain adequate field information prior to design; provisions for timely decisions by owner and design professional; and contract to perform necessary work at a fair fee with adequate time allowance.
c) Meeting the requirements of the constructor as to provision of contract plans, specifications, and other documents prepared in sufficient detail to permit the constructor to prepare priced proposal 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 field design and inspection staff; and contract for performance of work on a reasonable schedule which permits a reasonable profit.
d) 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.

Quality control/ management in construction typically involve insuring compliance with minimum standards of material and workmanship in order to insure the performance of the facility according to the design[7].

Quality in construction is summed up by Hill (1990) into four categories;

a) Quality of the design process
b) Quality of the building process
c) Quality of the products
d) Quality of maintenance

This places responsibility on the main parties involve in construction-client, designers, manufacturers, contractor and the user (Griffith, 1990).

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[7] http://www.ce.cmu.edu/pmbook/13_Quality_Control_and_Safety_During_Construction.html, accessed January 21st, 2009

Quality control in the construction industry can be looked at as having three elements:

- To produce a building which satisfies the client
- To produce a building where quality is related to the price.
- To produce a building in which sufficient time is allowed to obtain the desired quality[8]

This then poses the challenge of quality in construction- to examine the possibility of addressing the subjective problems associated with describing quality, without compromising the more objective problems of ensuring reliability in function.

2.4.2 Manufacturing versus Construction

As noted before, the concepts of quality were evolved initially to suit the manufacturing industry. Griffith (1990) states that the concepts which have been characteristic of manufacturing industry are somewhat evolutionary within construction practise. Although analogous in part, the design and production of a building differs significantly in many ways from the design and manufacture of products. Hence, the same concepts are also used in construction but there are salient differences which pose various challenges when applied in this field. The differences between the sectors according to Jaafari (2006) include;

a) fragmented structure of the industry with the bulk of the construction business being generated by a large number of firms, often small in size and less inclined to formal methods of work study and management;

b) diffused responsibility, that is, on normal construction projects typically many individual professionals and firms share the responsibility for the specification, design and building of these projects;

c) prototype nature, that is, projects typically resemble 'prototype' products in the manufacturing industry, often carrying unique design features, site characteristics and functions. Thus, the potential for errors to creep in is always present due to the once off nature of the relevant activities and production processes;

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8 http://www.misronet.com/quality_in_construction.htm accessed 12th April, 2009

d) influence of the public, the regulatory agencies and interest groups, which will ultimately affect the functions and configuration of projects, including building methods and associated safeguards to the environment, third party issues and beneficiaries;

e) transient and itinerant labour force, who are not trained to operate under the quality assurance mode of construction, that is, the training in the skilled labour has generally been based on learning how to do the work, not necessarily being one's own inspector to produce zero defect;

f) virtual lack of research and development (R&D). Typically R&D work in construction is confined to that undertaken by the manufacturers of materials and components incorporated into projects; there is little R&D work on lines of projects, such as commercial buildings as a 'product line' or managerial processes in infrastructure works, etc.

These differences are the reasons for the rather slow pace of change in the construction industry with major innovations often getting established at a creeping speed and over many years (Jaafari, 2006). Ashford (1992) further indicates that these differences cannot be ignored, the special factors of construction have to be taken into account.

In construction the nature of the project goals can be very different from those assumed to exist in traditional manufacturing. In manufacturing the process can be considered as separate from the product. Raw materials arrive, are operated upon and leave the factory in the form of finished products. Although different processes may be applied to the product at different stages, the manufacture of the product itself does not directly influence the processes in real-time. In construction, as a building 'grows' it places constraints upon the construction methods, techniques and organisation. In this case there is a much closer relationship between the product and the 'manufacturing' process. This additional complexity in construction makes the process more difficult to plan and to analyse. Unexpected occurrences during building can have far-reaching consequences due to the nature of this feedback and project planning becomes a continuous process. The industry is also very labour-intensive and as such its organisation is essentially one of the management of people rather than of processes (Scott et al, 1995). Aspects such as susceptibility to weather are also crucial (Ashford, 1992).

2.4.3 Challenges to quality management in construction

Quality in construction poses a challenge as it exists at different levels, ranging from the degree to which components of the building meet specification to the degree that the whole building satisfies the customer (McGeorge and Palmer 2002). It may then be judged either in isolation or relative to some other objective measure such as cost. Further, this challenge is compounded by the lack of clear interpretation and measurement of quality in construction as discussed before (2.4.1)

Total quality control is difficult to apply, particularly in construction. The unique nature of each facility, the variability in the workforce, the multitude of subcontractors and the cost of making necessary investments in education and procedures make programs of total quality control in construction difficult. Quality in construction faces a challenge as it does not only address the science and technological aspects, but also manages the physical and psychological aspects of the human element involved (Griffith, 1990). He further notes that within the traditional form of building procurement, quality assurance relies heavily on the individual contribution to implementations from each participant. Given that each party ostensibly acts in isolation, the aims and objectives of quality management are easily compromised and frequently lost. Nevertheless, a commitment to improved quality even without endorsing the goal of zero defects can pay real dividends to organizations.

Griffith (1990) attributes the challenges towards achievement of quality in construction to two main areas;

1. Design-
   a. Detailing
   b. Specification
   c. Legislation
   d. Coordination
   e. Communication

f. Supervision
g. Buildability

2. Building -
    a. Project priorities
    b. Organisation
    c. Information
    d. Control
    e. Supervision
    f. Workmanship
    g. Motivation
    h. Coordination.

It is important to note that despite the fact that building most of the times meets with the requirements specified by the local building regulations and conforms to planning and building approvals, there is no compulsory requirement for most of the participants including design practices to conform to the requirements for quality management systems (Griffith, 1990). At present, this remains to be a voluntary undertaking and influenced to a large extent upon the philosophical or commercial interests of the company and the changing quality culture. This in itself lends itself as a challenge to the implementation of quality systems amongst construction stakeholders.

2.4.4 Quality management system and tools

Quality management systems as per the definition given[9] embraces all the actions an organization (in this case a design firm) takes to achieve its quality policy. According to Ashford (1992), these actions mainly follow organized routines and procedures established in advance (quality system). The elements forming this system will provide quality control and others provide quality assurance. In light of this, various tools have

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[9] All activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system (BS EN ISO 8402)

been used in construction either as part of these systems or independently to meet the demand for quality. Some of the tools utilized include;

a) **Building contracts**

Building contracts provide the framework of a quality system comparable to those described in quality system standards according to Ashford (1992). He further states that the contracts achieve this through;

i. Precise definition of the purchasers requirements
ii. Selection of potential suppliers who can demonstrate both the means and the will to meet the requirements
iii. Surveillance of the works in progress
iv. Verification, at source or after receipt, that the purchased products or services are in conformance with the specified requirements.

Despite it being argued that they are out of date and may not function as well as one would like, they represent the status quo (Ashford, 1992). They provide the parties with a degree of confidence that the construction works designed and built on their behalf will satisfy their needs.

b) **Standards & Certification**

Quality standards have been developed and encapsulated in various forms of documents by various parties over the years. To rationalize this, the British Standards Institution published the British Standards (BS) in 1979 on a number of quality related subjects. While having a very wide application over various sectors, BS 5750 is commonly used as the basis for the application of quality assurance in many industries, construction included (Griffith, 1990). This has had various changes in detail and wording. This provided a foundation for the international standards for quality systems issued in 1987 by the International Organization for Standardization (ISO). The ISO standards dor quality systems are known as the ISO 9000 series (Ashford, 1992).

Firms adhering to the standards can be accredited by various organizations after a process of assessment, approval and registration leading to certification by the certifying body.

Benefits and advantages of certification include;

i. Registration in a national and international system of standards for quality

ii. Use of a recognised registration logo

iii. Long-term assurance to the clients that the quality of product will be maintained to a standard by continued surveillance, control and up-date of the system

iv. Enhancement of reputation and standing especially in maintenance or improvement of market place position against stiff competition.

(Griffith, 1990)

c) **Quality manuals**

This is the main reference document used in establishing and implementing a quality system. Its purpose is defined in BS 5750: Part 0.2 as 'to provide an adequate description of the quality management system while serving as a permanent reference in the implementation and maintenance of that system'. The manual serves two main uses;

i. To inform staff within the organization of the quality policy which has been adopted by management and to advise them by of the means by which the policy will be achieved.

ii. To demonstrate to clients and purchasers that the organization operates a quality system capable of assuring the quality of its products or services.

d) **Quality Plans**

This is a document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project (BS 4778). This specifies how the quality system described in the quality manual will be applied to a particular project.

e) **Quality Audits**

This is a systematic and independent examination to determine whether quality activities and related results comply with planned arrangement and whether these arrangements are implemented effectively and are suitable to achieve objectives (BS 4778). These audits take place at three levels according to Ashford (1992);

i. Internal audits-undertaken by the organization to examine its own systems and procedures
ii. External audits-undertaken by an organization to examine the quality systems of its suppliers
iii. Third party audits- undertaken by bodies with no existing or intended contractual relationship with either the supplier or purchaser. They are made against a recognized system standard and include audits by accredited certification bodies.

f) **Records**

Records are required to demonstrate the satisfactory functioning of a quality system and that the required standards are being achieved (Ashford, 1992).

2.4.5 Quality in the Design process

Quality management and its application to the building design process is still a relatively new technique (Rounce, 1998). This may be due to the perceived challenge of measurement of quality design. In an industry which utilizes the final product to make its principles of quality-performance, reliability, conformance, durability, serviceability, and aesthetics (McGeorge and Palmer, 2002) - measurement of design quality and of the design process continues to be an imposing impediment. This is increased by the informality of the design process which facilitates inspiration and creativity (Griffith, 1990).

Despite this, the results of low quality design are variation orders and claims due to frequent changes in the detailed information throughout the project's construction process (Chase, 2001). Rounce (1998) attributes design failures to;

a) Misinterpretation of client needs
b) Poor communications between designers
c) Using incorrect or out of date information
d) Producing inadequate specifications
e) Misinterpretation of design standards

Dindi (2004) point out several aspects that may lead to quality problems at the design level;

a) Lack of proper communication
b) Insufficient details
c) Many variations
d) Insufficient inspection
e) Lack of detailed knowledge of specified materials e.g. performance and durability
f) Experience of the designer

Chase et al (2001) notes that quality management (in the design process) places an emphasis on actions to prevent mistakes rather than quality control which would be identifying mistakes which have already occurred.

The above mentioned aspects which may pose a challenge to design failure, quality management and control during the design process have been summed up in three main categories by Griffith (1990);

a) Reliability of the initial brief
b) Reliability of the design solution and the detailed specification
c) Reliability of all the information that has been used as the basis for the design and product specification.

2.4.5.1 Reliability of the brief

Design in architecture underlies a targeted objective, represented in most cases by an object to be conceived, more or less accurate in its initial definition (Bignon and Zarli, 2006). This initial definition can be termed the as the brief. The ultimate success of a project depends on the quality of the brief, i.e. the ability of a client to clearly describe to the architect the requirements and functions of the desired building, and proposed methods of operation and management[10]. For a successful and reliable brief, the architect should know;

- The clients aims

[10] http://www.architecture.com/UseAnArchitect/WorkWithAnArchitect/WorkWithAnArchitect.aspx. Accessed 2nd Dec, 2009

- The clients' style: Is the client looking for a design in keeping with the existing building? Does the client want a contemporary or high tech design? Is the client concerned about having a sustainable/ecological design?
- The clients' reasons for embarking on this building project
- Authority: Who will be making the decisions? About the designs? About costs? About day-today matters when the project is underway?
- Your overall expectations: What do you hope to achieve by this project? A more comfortable place for you to live in?

At the initial meetings, the architect listens carefully to your intentions and creates a brief, addressing not only design aesthetics but also the function of the building. Timings and budgets for the project are also defined at an early stage and only after the client has approved initial sketches will the ideas be developed further. Consultation with the local authorities and other stakeholders key in formulation of the outline proposals are also consulted at this stage.[11]

This avoids the problems of misinterpretation of the clients' needs and also sets out the grounds for communication between the design team and the client.

2.4.5.2 Reliability of the design solution and specification

Architectural design involves creation of forms and spaces expected to enable the performing of certain functions, which may be intervened by quantitative dimensions and qualitative characteristics of form and space. Drawings which are the main product of the design process and are the representation of the design solution typically show, for example: form, generic type, graphic representation, quantity, relationship, and the size of construction materials (Hall, 2003). The design solution obtained must meet the objectives as stated in the brief and to the customers' satisfaction. As such, it responds to the clients' requirement and constraints imposed by factors such as statutory obligations, technical feasibility, environmental standards, site conditions and cost (Kwakye, 1997).

Hall (2003) further indicates that specifications define the qualitative requirements for materials, products, and workmanship that are the basis for the design intent.

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[11] http://www.architecturecentre.org/_services/design_briefs.htm

Specifications also describe administrative procedures regarding drawings and specifications. As such, it is essential that drawings and specifications be coordinated. If the drawings and specifications are not coordinated, the project may experience many problems and discrepancies and variations potentially causing the Owner and/or Contractor damage (alleviated by monetary compensation).The specifications made should be adequate for correct interpretation by the builder for purposes of executing the building process.

2.4.5.3 Reliability of information

The information obtained from the client in the form of a brief and the communication obtained by the design team in transforming the brief to a built solution should be reliable in form of its adequacy in meeting the demands. This information should be cross checked through a system of review and confirmation of the briefs and establishment of a communication matrix between the design team members. This would result in a quality plan being established to ratify all information used in the design process-whether from the client, based on the architects experience or manufacturers' specification.

2.4.6 Quality of the design team

Understanding that even within the architectural office, one can have various architects working on the same project, each one may have a different background and experience hence creating differences in approach and solutions. It is therefore imperative in the attainment of design quality that there is established a very strict definition of the various design phases, to define the needed contributions of every team member to each phase and guidelines on the fundamental design decisions to be made (Abrantes and Costa, 1990). This leads to a design solution where the final solution is a wholesome result of the best individual contributions rather than a trial and error exercise. Following a workplan as provided for example by RIBA's plan of work would indicate the particular roles of all participants in the design process and this can be broken down to detail even within the particular design firm, in this case, the architectural firm.

2.4.7 Quality of design products

Arditi and Gunayrdin (1997) state that drawings and specifications are the two sets of documents given to the constructor that provide technical information on materials, performance of the constructed facility, and quality requirements. Drawings are the only documents given to the constructor that show the design concept, size and scope of the job, number and size of materials or items, and how they are assembled into a final project. They also indicate that the final product of design work is a set of contract documents (drawings and specifications) to guide the physical construction of the project. Design professionals must then clearly and adequately communicate the design intent to the constructor using the same- both plans and specifications. Quality design therefore extends throughout the construction phase of the project. It has been noted that there are often inconsistencies between the drawings and specifications (Stasiowski and Burnstein, 1994). That is why it is critical that drawings be clear, concise, and uniform. Indeed Gunaydin's findings indicate that the quality of the drawings and specifications received from the designer affect the quality in the design and construction phases, and consequently the quality of the constructed facility.

2.4.8 Quality systems in the design process

The quality systems and tools discussed before (2.4.4) can have their application more specifically in the design process. Ashford (1992) indicates that quality manuals would illustrate and describe the organizational structure of the design team giving job descriptions of each member. This would include a schedule of standing procedures. This would be cross-referenced with other quality standards in the particular firm.

Ashford (1992) further details that the implementation of quality systems during this process would entail;

a) Review and confirmation of the brief to accurately articulate the clients' needs

b) Give the basis for the drawing up of a design quality plan for the work. This would include amongst others;

   i. The staff delegated to manage the work and their responsibilities,

   ii. Summary of design requirements,

iii. Schedules of specifications, standards, codes of practise and statutory regulations to be adhered to,

iv. Schedules of work to monitor and control progress,

v. Communication matrix

vi. Schedule of design reviews and audits

vii. Schedule of records to be produced and retained

c) Control of the design to verify the validity and adequacy of the design and enable creation of working drawings and specifications. This is done through;

i. Calculations- where specific problems and techniques adopted or their solutions are analyzed mathematically in accordance with relevant engineering techniques,

ii. Drawings- the production of relevant drawings along established guidelines of layout, format, scales, drawing numbers, revisions, filing and issue.

iii. Specifications-the examination of specifications for application on each unique project against its merits giving relevant tolerances,

iv. Check and approval- the cross checking provided by relevant superiors to validate the drawings and design products being produced through the system and provide for accountability.

v. Control of design interfaces- many designs require inputs from several technical disciplines. There is hence need to ensure the design work is compatible with the relevant disciplines hence a communication system which will circulate amongst other design participants on the design proposals as they mature so that conflicts or gaps can be detected and resolved in an orderly manner,

vi. Change control-to ensure that the correct editions for the work are used for the performance of any given task and the relevant master copies and subsequent editions are easily located for future reference,

vii. Design reviews- periodic reviews preferably by others outside the project to ensure that the design work is proceeding on the correct lines and to ensure that the objectives raised in the brief are being achieved.

2.5 Summary

The foregoing literature review has discussed quality as a concept, defining quality and tracing the evolution of quality management and the various theories of quality as postulated variously.

A look at the current construction procurement methods leading to an in-depth look at the traditional procurement method as the procurement system under which this study is being undertaken is done to give a background to the construction industry in Kenya. The construction process and the design process in particular have been examined.

Application of quality in the construction industry has been examined with an attempt made at discussing the quality management systems applicable to the design process.

The literature review highlights the systems and tools (contracts, standards and certification, quality manuals, plans and audits and records) which could be used to gauge the use of quality management systems during the design process and measure the effectiveness of the same besides identifying relevant factors which could affect the use of quality management systems during the design process. This gives an outlook of the measures and parameters that would be used to assess the quality of a given design process and the products of the process.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This study sought to establish;

a) The extent to which design professionals are aware of quality as a concept and quality management systems,

b) The extent to which quality management systems and techniques are utilized during the design process, and

c) To identify the factors that affect quality management during the design process.

The study conformed to the ethical standards and legal safeguards as outlined by the Ministry for Higher Education, Science and Technology, National Council for Science and Technology guidelines (2009). This safeguards the privacy of the respondents and the information given is to be used solely for the purposes of research and as such, shall be treated with confidentiality.

The study focused on quality management systems at the design stage of construction and more specifically in architectural firms. As such, architectural firms became the primary area of analysis for the study. The architects represent the core group for the study plus some clients and engineers. The client offered insights from an end-users point of view while the Engineer gave indications of measurement of design quality as they are the immediate users of the design product-drawings and specifications.

3.1 Research design

This was a descriptive study that seeks to investigate the awareness, existence and use of quality management systems by architects with a view to understanding the root cause to low building quality and recommend effective measures of utilization of quality management systems in the design process and stages. It utilized both descriptive and survey designs.

3.1.1 Population

The target population for the study was practising architectural firms within Nairobi. The total number of firms registered by the Board of Registration of Architects and Quantity Surveyors (BORAQS) is 247 against a total number of 1,273 Architects. The BORAQS data base provides an accurate record of all the registered architects and firms in Kenya. It also provides a record of the physical location of the architectural firms. This gave indication that the majority of architectural firms are located in Nairobi. Despite this, it is noted that architects and architectural firms may be registered but not actively practising. Furthermore, architectural work is not confined to the location of the physical office but can be countrywide.

3.1.2 Sample and sampling techniques

Mugenda and Mugenda (2003) suggests that for descriptive studies, ten (10) per cent of the accessible population is enough. Ndege (2004) indicates that 30 is the minimum number of cases to be used for a study. As such, a sample size of 30 was used in this study. A sample size of 30 firms is more than 10% of the registered architectural firms in Kenya.

To be able to capture a variety of practising architectural firms (ranging from solo practices to larger firms with more than five (5) architects), and building projects in Nairobi, a visit to the Nairobi City Council development control office was made to obtain a list of all the projects submitted and approved for building from January, 2008 to present. This was to provide current projects which are possibly being built or soon to be built. The compilation effectively eliminated government projects which do not go through the local authority for approvals. Private projects are envisioned to be more subject to quality measures and controls as the clients are more defined rather than public/government projects whose clientele/ end user is more diverse and many a times ambiguous.

A list of all the firms was compiled from and a check was undertaken to ensure that the sample chosen had offices in the Nairobi CBD and nearby suburbs for ease of accessibility due to limitation of time and finances. From a list of 49 valid firms, the names were individually folded up into a box and 30 names were randomly picked therein and used for the purposes of the survey.

Purposive sampling was used to select one firm for the purposes of key informant interviews. The selection was based on accessibility of the Firms' Principal and historical data on projects undertaken as a measure of the architects' experience. This was primarily from a list of top architectural performers in the industry as indicated by the Architectural Association of Kenya annual awards. The selected architect has over thirty years of professional experience with architectural academic qualifications to post-graduate level. He is also a fellow member of the AAK, the highest level of membership accorded to members of the building profession who have contributed to the growth of the industry. As a practising architect, he has undertaken a wide range of projects in several countries in Africa.

Through this key informant, one of the willing multiple-clients and engineer of projects being undertaken was sourced and used for further key informant interviews. The selected Client had undertaken four (4) building projects -3 commercial units and a residential building-over the past ten years. The selected engineer has practiced for 15 years with nearly 20 major (projects worth over 200 Million Kshs) building projects undertaken, ongoing or stalled. The range of buildings undertaken was ranging from residential to commercial and public buildings. The input of the key informants was to provide further information, validate and fill any perceived gaps in information obtained through the questionnaires.

3.1.3 Variables

3.1.3.1 Independent Variables

An independent variable is defined as a variable that a researcher manipulates in order to determine its effects or influence on another variable (Mugenda and Mugenda, 2003). The categories of this variables are chosen by the researcher independently of the measurement taken in the project and normally prior to it (Francis, 1979).

In this study, experience of architects, number of variations, cost fluctuation and design adequacy were viewed as the independent variables.

3.1.3.2 Dependent Variables

A dependent variable attempts to indicate the total influence arising from the effects of the independent variable (Mugenda and Mugenda, 2003). Their results are presumed to depend upon differences in the independent variable. The variation in them is seen as being related to, caused by, or in some way influenced by differences in the independent variable (Francis, 1979).

In this study, customer satisfaction, aesthetic appeal, cost and duration of project were viewed as dependent variables.

3.2 Data collection

3.2.1 Survey instruments

The survey instruments used to collect data were questionnaires and interviews.

The structured questionnaires were administered to architects in the various firms. A rating scale was mostly used to measure the perceptions, attitudes and values associated with quality since the measures of quality are considered to be more subjective (Griffith, 1990). The questionnaires were pretested in an architectural firm to verify the appropriateness and clarity of the questions and items in the list. The questionnaires sought to;

a) Profile the architectural firms in terms of the number of personnel, identify who is mainly involved in design decisions and identify the projects mainly undertaken by the firm,
b) Explore the understanding of quality as a concept and design quality and its perceived contribution to overall building quality
c) Investigate and identify which quality management systems are utilized at the design stage
d) Identify the factors that contribute to poor design quality
e) Explore the perceived barriers to implementation of quality management systems at the design stage,
f) Identify how often training in quality is undertaken by designers.

The interviews were conducted for an in-depth understanding through the use of an interview schedule.

3.2.2 Procedure of data collection

A visit was made to each of the selected firms and the questionnaires delivered for self-administration. The target architects were primarily the Principals or a senior architect who would give a response which can be termed as the firms' stand. A period of a week was given to the respondents to give them adequate time for consultation and response. Collection of the same was done thereafter. An evaluation of the collected questionnaires was done to check for adequacy and responsiveness.

Based on insights and missing links from the preliminary data received, the key informant interviews were conducted. The key informants were supplied with the interview schedule at least a day beforehand when seeking out the time for the interview. A time period of at least 45 minutes with each respondent was sought to ensure adequate time to cover the interview schedule exhaustively.

3.3 Data analysis

Data was analysed using simple spread sheets and presented in charts and figures. Percentages and arithmetic means were used to show the proportion of the samples that has a particular attribute of the variables being measured.

3.4 Data presentation

The data analysed is presented through the use of simple pie charts indicating the proportional allocation of the various percentages and arithmetic means as obtained from the analysis.

A descriptive account is given for the data realized from the interviews in prose.

CHAPTER 4

DATA ANALYSIS AND PRESENTATION

4.0 Introduction

This chapter presents the results of the data collected and further discusses the findings. The study sought to investigate the extent of awareness of quality management techniques, the extent to which these and other quality management techniques are utilized at the design stages of construction. It further attempted to identify what factors affect quality management at the design stage of construction.

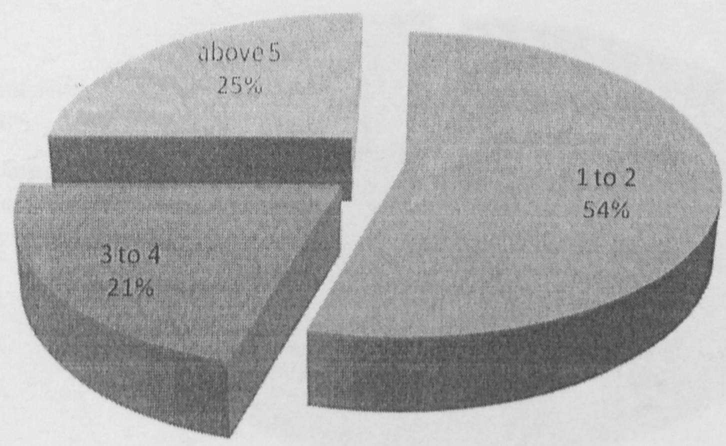
Thirty (30) firms were selected for the purpose of this study. Out of the thirty questionnaires that were distributed and administered, five (5) were not returned due to non-availability of the principal architect and/or lack of a suitable substitute in the targeted firm. During the process of data processing which involved data validation, editing, coding, classification and tabulation, one (1) additional questionnaire lacked completeness and was therefore not deemed fit for analysis. This provided 24 questionnaires for evaluation and analysis giving a cumulative response rate of 80%.

One (1) architect, one (1) client and one (1) engineer were also selected as key informants and subjected to in-depth interviews

4.1 Profile of Respondents

Out of the firms sampled, 54% had 1-2 architects in the firm. This is in comparison to 21% of the firms having 3-4 architects and only 25% having more than 5 architects. Figure 4.1 which gives an indication of the profile of the architectural firms in Kenya indicates that the majority of architectural firms are run by at most a partnership of 2 architects.

Fig. 4.1 Number of architects/ firm



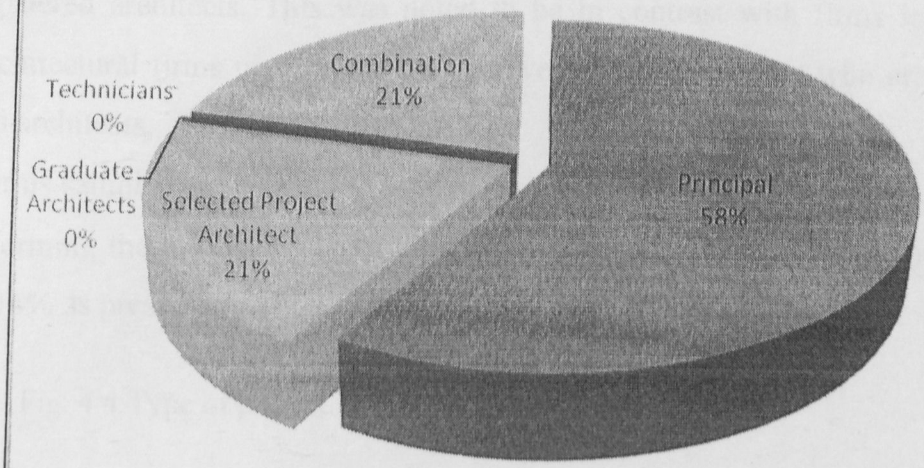
Source: Field Survey, 2009

In order to broadly assess the qualifications and experience of the persons undertaking the main design decisions in architectural firms, an examination was made to ascertain the persons mandated to make major design decisions. 'Lead designer' was operationalised by the researcher to mean a registered architect mandated to make major design decisions in a particular project.

In a majority of the firms (58%), the lead design aspects were undertaken by the Principal architect rather than any other architect .For the rest of the firms, 21% appointed a particular architect as the project architect and these decisions were made by the same person. A further 21% utilized a combination of the principal and selected architects together undertaking major design decisions. Figure 4.2 gives the details regarding who makes design decisions.

It was therefore deduced that the main responsibility for design quality for a majority of the architectural firms is vested in a single individual-the lead designer. When another architect is appointed to undertake the lead designer role either separately or in conjunction with others, accountability and hence design quality is more assured as there is involvement of more than one participant.

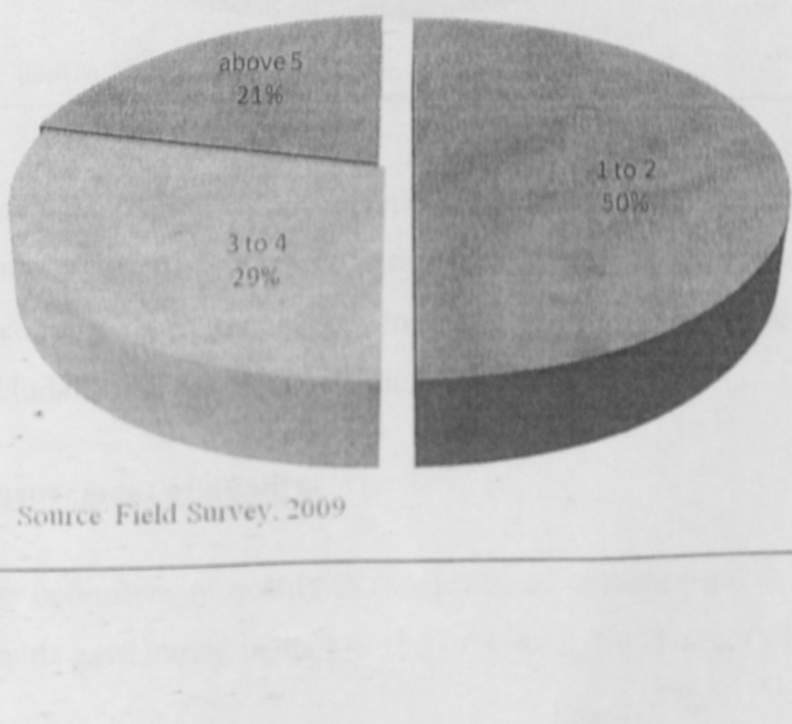
Fig. 4.2 Lead Designer



Source Field Survey, 2009

Graduate architects and technicians were indicated to play no part in major design decisions. The firms selected had at least one technician. Figure 4.3 gives the details regarding the number of technicians in the firms.

Fig. 4.3 Number of Technicians/ firm

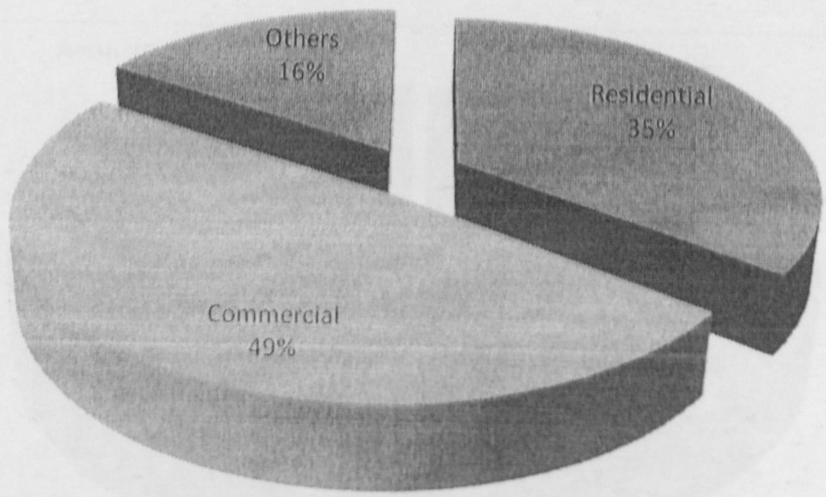


Source Field Survey, 2009

This profiling of firms was further probed into during the key informant interviews where it was indicated that most firms in Kenya are generally small in terms of the lead architects (Principals) with most having only one principal and on average one or two other registered architects. This was noted to be in contrast with firms internationally where architectural firms usually are led by several directors under who are many other registered architects.

The firms sampled were found to undertake a wide range of projects with commercial projects forming the bulk of projects undertaken at 49%, residential projects at 35% and others at 16% as presented in Figure 4.4.

Fig. 4.4 Type of project



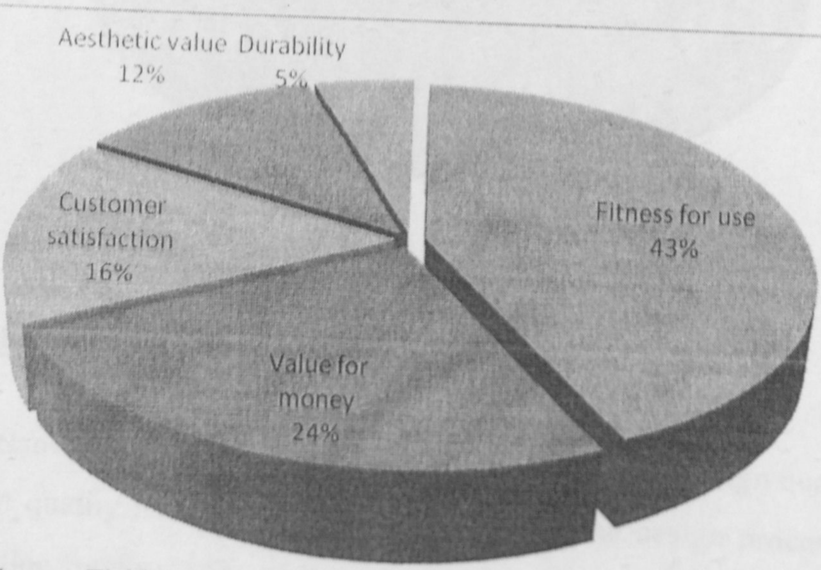
Source: Field Survey, 2009

In this study, commercial projects are operationalised to mean projects such as offices, private academic institutions, shopping and entertainment facilities outlets and any other development not commissioned by the government/ public project. The category of 'others' broadly included government and public projects.

4.2 Measurement of quality

From the various definitions of quality in construction as pointed out in the literature review, the respondents gave varied understanding of quality, for instance, fitness for use was the most weighted definition at 43% , value for money was weighted at 24%, customer satisfaction at 16 %, aesthetic value at 12% and durability of the built product at 5%. This was emphasised by the key informant that "even if a building is of the highest aesthetic appeal and very durable, unless it satisfies its basic function as defined by the clients' needs, it remains of very low overall quality." Fitness for use was further defined by the key informants (architect and engineer) as meeting the demand for structural soundness and buildability especially as pertains to the inclusion of other consultants. Quality measurement is graphically represented in figure 4.5. Despite the weighting of customer satisfaction at 16%, further study through the key informant revealed that customer satisfaction from the point of the client remains to be critical and of priority.

Fig. 4.5 Measurement of quality



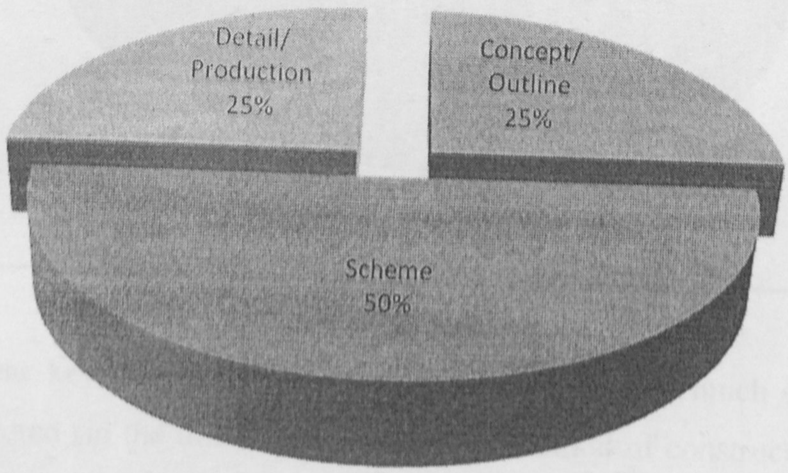
Source: Field Survey, 2009

All the respondents affirmed the need for quality in the built product and during the design stage of construction. The use of QMS was further extrapolated over the 3 main stages of the design process, namely

a) concept/outline stage
b) scheme design stage and
c) detail/ production stage

The scheme design stage was weighted by the 50% of the respondents as most critical stage for the application of quality management systems followed equally by detail/production stage and concept/outline stages at 25% importance as presented in figure 4.6.

Fig. 4.6 Priority stage for quality



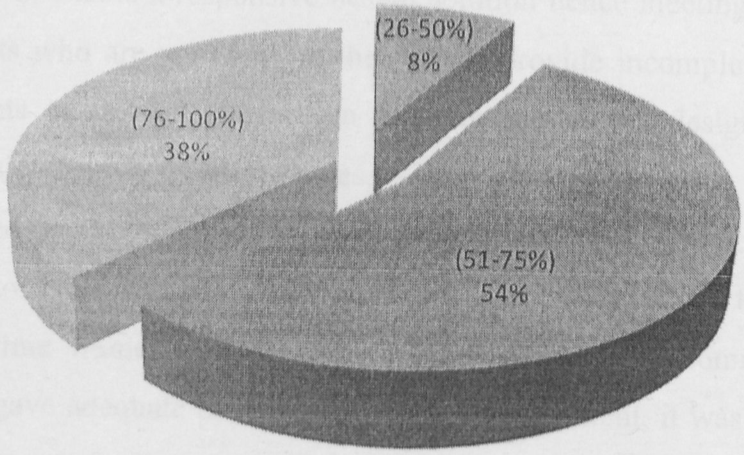
Source: Field Survey. 2009

4.3 Design Quality

The study deemed it necessary to ascertain the importance of design quality as a result of application of quality management techniques during the design process. In terms of the overall building quality, 54% of the respondents felt that design quality contributes between 51-75% to the overall building quality, 38% felt that this contribution is between 76-100%, and only 8% indicated that the design quality contributed less than 50% to the overall building quality. Design quality therefore plays a vital role in the overall building quality as 92% of the respondents indicated that its contribution is over 50% as presented in figure 4.7.

The key informants-consultants and the client indicated that design quality is measured through the responsiveness of the space provided for a particular use. Hence, the contribution of design quality to overall building quality is critical for ensuring customer satisfaction which is a key concept in TQM.

Fig. 4.7 Contribution of design quality to overall building quality



Source: Field Survey, 2009

According to the key informant (architect), this contribution is much so because the architect is considered (in the traditional procurement method of construction) to be the lead consultant and their involvement in the entire building process sets the standard for the particular standard of quality to be adhered to all through the building process. This was reiterated by the client key informant who pegged the responsibility for design quality on the architect as the head of the design team. Nevertheles, it was indicated that despite the application of and adhernace to quality standards in the design, effort had to be put during the building phase to ensure adherance and conformance.

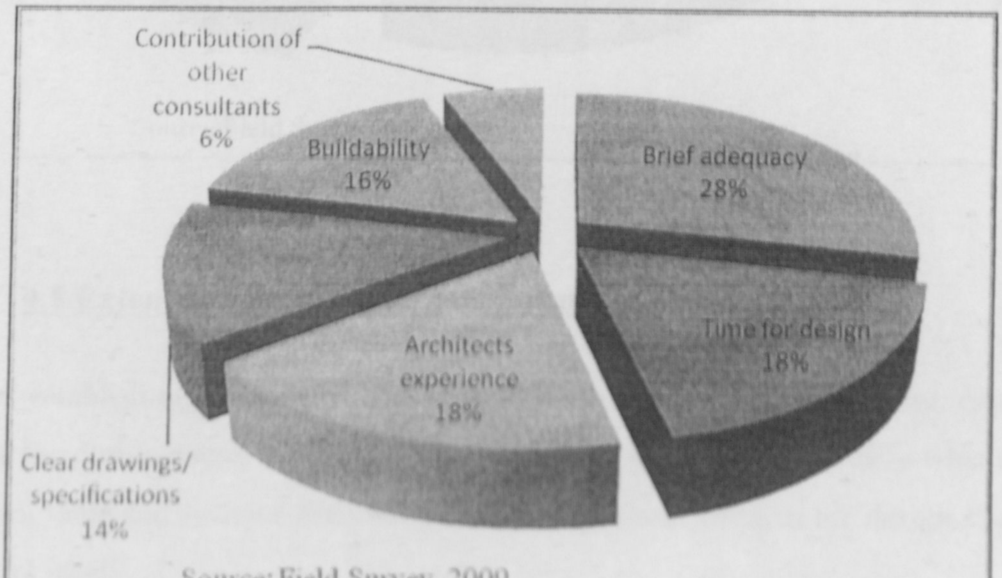
4.4 Factors affecting design quality

An investigation of the factors that contribute to design quality was undertaken to form the basis for understanding the application of quality management systems. This aimed at achieving one main objective of the study-to determine the extent of understanding of qualitý management systems and the extent to which the quality systems are utilized during the design process.

Figure 4.8 presents the weighting given to the various factors by the respondents. Adequacy of the design brief weighted at 28% was deemed as the most critical factor contributing to design quality. This was attributed to the clients' vital role at the initial design stages in providing concrete and adequate information on the needs to be answered by the built product to enable a responsive design solution hence meeting the functional need. Further, clients who are not clear on their needs provide incomplete briefs hence creating impediments to design formulation and control of the design process and consequently the design quality as it progresses.

The time allocated for the design and the architects' experience were both weighted at 18%. The time factor, just like brief adequacy was also attributed to the client as a component of the time frame given between commissioning and commencement of building. If a client gave adequate time for the design development, it was argued by the respondents that the opportunity for an appropriate design quality was much better than when the time available for design was limited. The experience of an architect was also explained as important in terms of the availability of relevant skills to meet the demands especially of new technologies and stringent client demands.

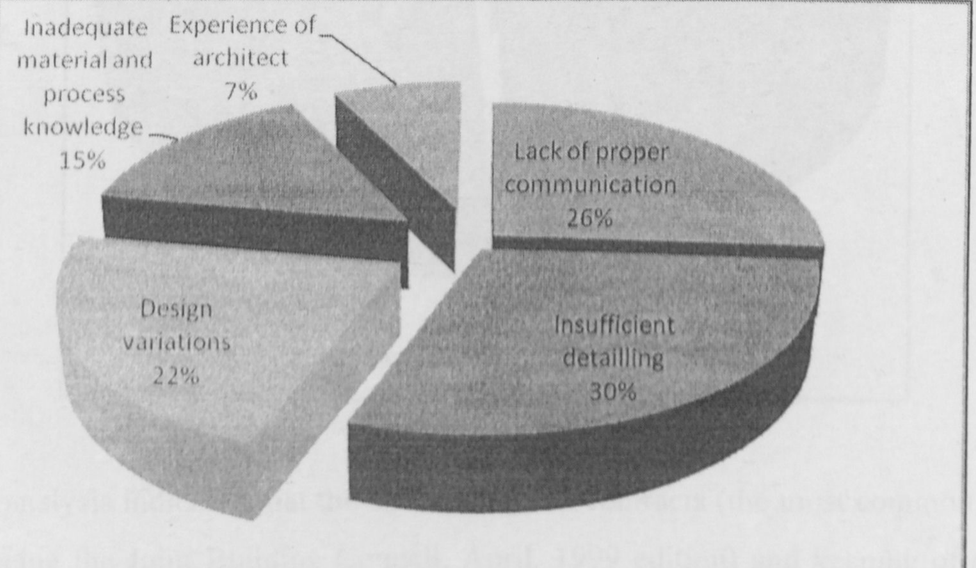
Fig. 4.8 Factors contributing to design quality



Source: Field Survey, 2009

The study revealed that there are various factors that would contribute to low building design. These are presented in figure 4.9. Insufficient detailing of drawings from the architects was weighted at 30%, representing the highest contributor to low design quality, lack of proper communication (between client and architects) at 26%, design variations, which was also attributed to varying client demands at 22%, inadequate material and process knowledge by the architects at 15% and the architects experience at 7%. Inadequate material and process knowledge by the architect was found out to be a major factor by the client as it acts as an impediment to the achievement of the clients expectations especially when the client is very specific on his/her demands.

Fig. 4.9 Factors contributing to low design quality



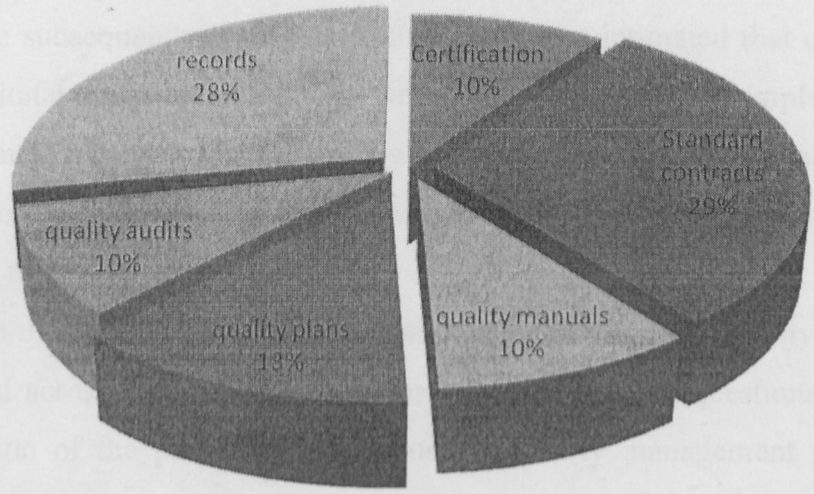
Source:Field Survey, 2009

4.5 Extent of use of quality management techniques

Besides establishing the extent of awareness and understanding of quality, QMS and their use at the design stage, the second objective of the study was to identify what quality management tools and systems are used among architectural firms at the design stage and how they are used.

All respondents asserted that they have management systems to ensure design quality. On further examination of what particular quality management systems are used, 29% of the respondents indicated that they use the standard contracts as their main quality management system, keeping of records at 28% and quality plans, quality audits and certification as at 13%, 10% and 10% of the firms respectively as presented in figure 4.10.

Fig. 4.10 Use of quality management tools/systems



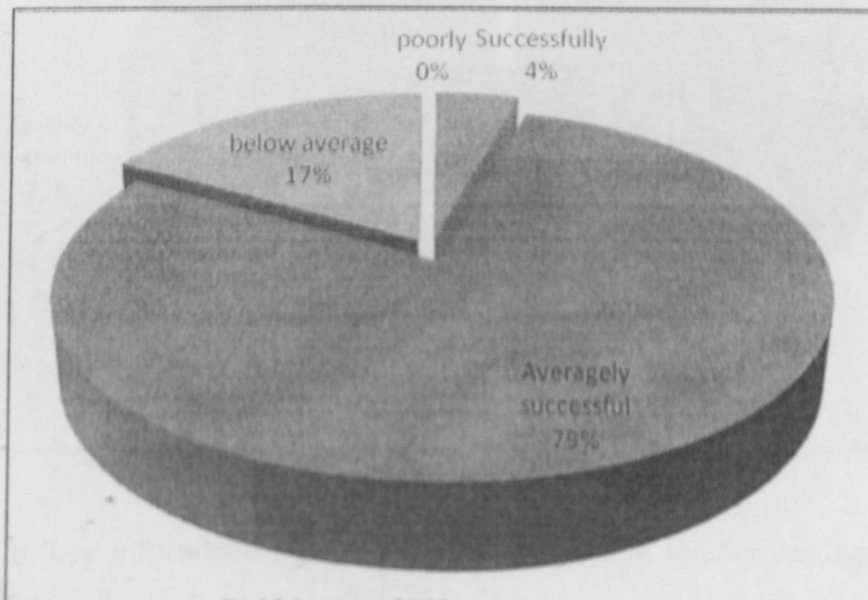
Source: Field Survey, 2009

Further analysis indicated that the use of standard contracts (the most commonly used in Kenya being the Joint Building Council, April, 1999 edition) and keeping of records was more of a default quality management system rather than a proactive means of ensuring quality of the design process. Architects are required to keep the contract and contract documents (which include the drawings) for at least 6 years after the project completion. This therefore becomes a legal requirement rather than a system that a particular firm chooses to put in place. Further, records such as drawings are invaluable as a source of reference material for similar projects in the future for the architectural firm. It was pointed out that the standard contract is signed between the contractor and the client and as such is more of a quality management tool at the building stage rather than at the design stage as this takes place after the procurement of a contractor which in the traditional system comes after the design stage. Therefore, the implication is that the contracts' main purpose is ensuring the contractors compliance which is verified through inspection.

The key informants (architect and engineer) further indicated that certification provided a means of ensuring the other quality management systems- quality manuals, plans and audits are at least in place before certification is issued. With only 10% percent of the respondents having attained certification, it is clear that this and the other systems of quality management i.e. quality manuals, plans and audits (at 10, 13 and 10% respectively) are subsequently hardly used. Further, it was intimated that certification is more of a fashionable aspect rather than one to ensure the actual implementation of quality management systems. For the firms where the use of quality manuals, plans and audits were indicated to be used, an attempt in futility was made to obtain a copy of such documents from them.

A question to the architects on their opinion on how successfully quality management systems are used across the architectural firms was posed in the questionnaire and this gave an indication of the perception to the use of quality management practices and systems. Figure 4.11 shows that about 79% of the respondents indicated that they considered that quality management systems have been averagely successfully integrated into the design process in architectural firms.

Fig. 4.11 Success rate of use of quality management systems



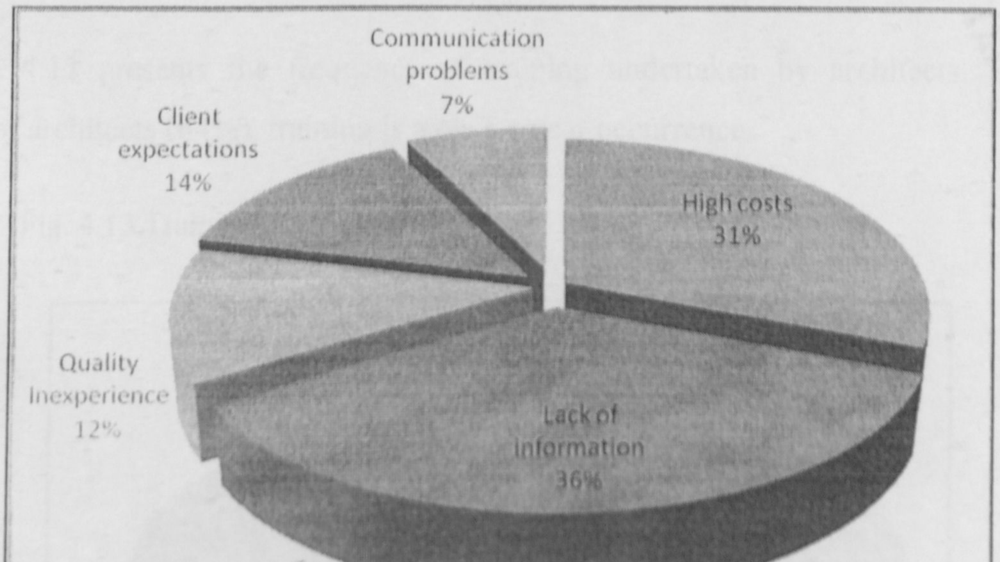
Source: Field Survey, 2009

This gave a majority view of the success of QMS implementation during the design process. The study revealed that the quality management systems are apparently viewed as successful due to;

a) Competent contractors who are able to undertake quality building work despite design weaknesses
b) Lack of knowledge on other means of quality management systems at the design stage, hence this success of the use of QMS at the design stage is limited to the use of standard contracts and keeping of records as indicated in figure 4.10

The use of quality management systems during the design process is limited due to lack of information (on QMS) according to 36% of the respondents and high costs (of implementing QMS) by 31% of the respondents as presented in Figure 4.12.

Fig. 4.12 Barriers to quality improvement



Source: Field Survey, 2009

According to key informants, most of the other means of quality management which could be applied at the design stage were virtually new in the industry, hence unknown and further more required some form of training either as management courses or through other specialised courses.

High costs were deemed by the key informant to be critical in two main areas;

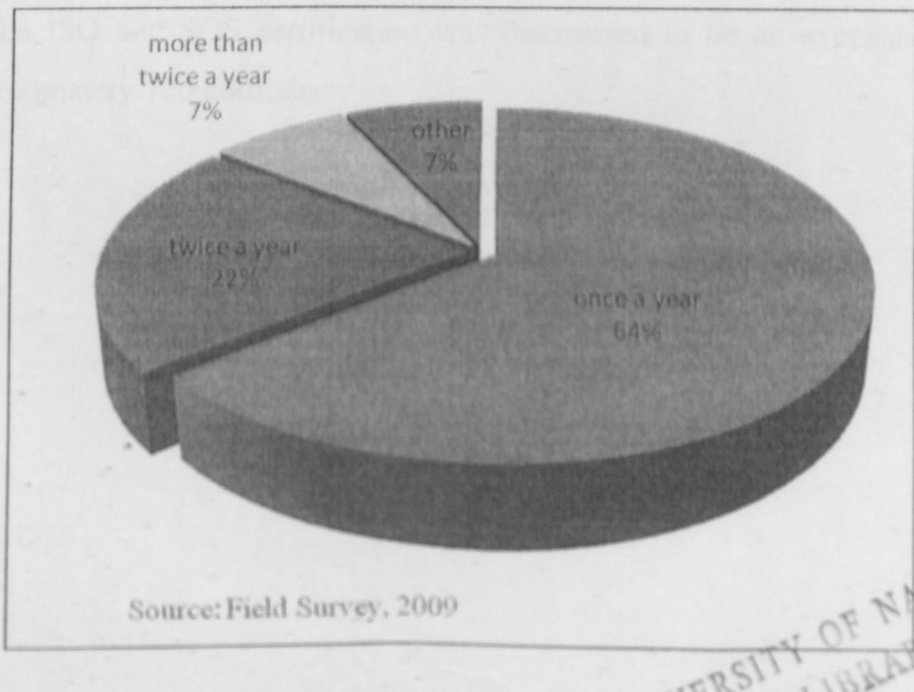
a) Training of personnel

b) Certification with relevant quality bodies.

Relevant training which locally is mainly in the form of Continuous Professional Development (CPD) courses conducted mainly by the Architectural Association of Kenya (AAK) and the Institute of Quantity Surveyors of Kenya (IQSK) in conjunction with the Board of Registration of Architects and Quantity Surveyors (BORAQS) has seen a gradual increase in attendance fees over the years. This cost is seen as prohibitive to architects since the CPD courses are conducted severally in a given calendar year. Furthermore, for more project specific training in modern building practices, building typologies and/or material technology, one may have to consider attending training out of the country. For example, one key informant (architect) had recently attended a training conference on high rise buildings in Dubai and it cost him 170,000 Kshs for the training package alone excluding air fare and accommodation. This is out of the reach of many architects.

Figure 4.13 presents the frequency of training undertaken by architects. For the majority of architects (64%), training is a once a year occurrence.

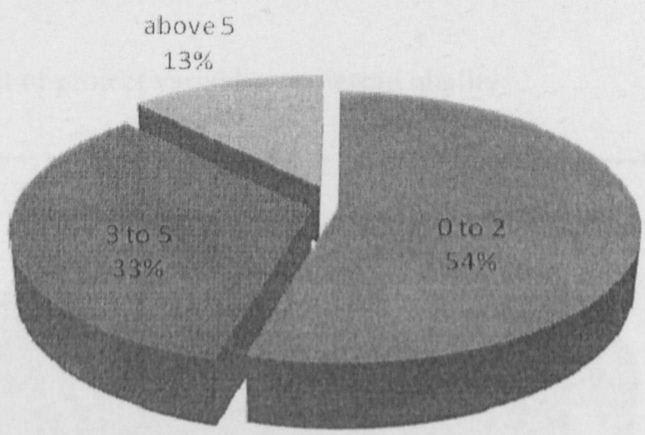
Fig. 4.13 Training frequency



Source: Field Survey, 2009

On the number of personnel who had undertaken any training in quality management systems, 54% of the respondent firms indicated that they had at least two personnel in the firm who had undergone some form of quality management training as shown in figure 4.14.

Fig. 4.14 Number of personnel trained in quality management



Source: Field Survey, 2009

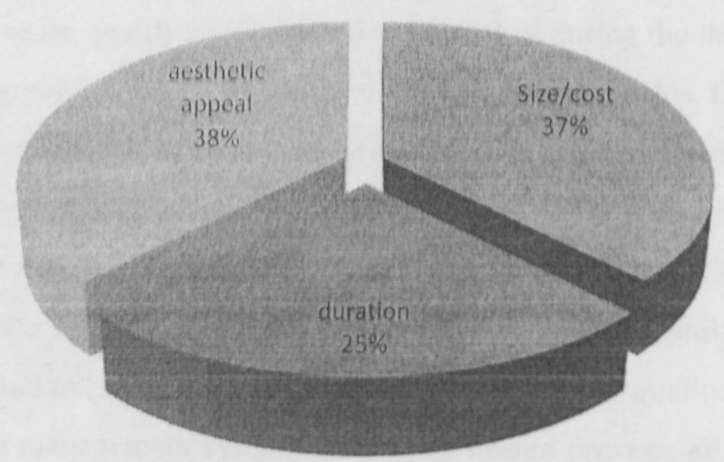
On the aspect of quality certification, seeking accreditation through two local bodies who grant the ISO and SGS certification was discovered to be an expensive exercise costing approximately 700,000Kshs.

4.6 Factors affecting use of quality management techniques

The third objective of the study was to identify the factors that affect quality management during the design process.

All the respondents indicated that quality systems are applicable in the design of all projects regardless of their size, location and type. Nevertheless, certain selected project variables were found to have some measure of effect on the design quality as presented in Figure 4.15 below.

Fig. 4.15 Effect of project variables on design quality



Source: Field Survey, 2009

The demand by the particular project for aesthetic appeal was weighted as the more critical effect to design quality at 38% closely followed by the size/cost of the project (37%). Aesthetic appeal was also discovered to be critical in particular building types which have a higher demand for aesthetic beauty as an overriding function e.g. monumental buildings. Further to this, the budget stipulated for the particular project played a critical role in determining the design quality input especially as pertains to specifications and finishes.

4.7 Summary

The data collected and analysed profiled the architectural firms so as to understand the general firm sizes, assess the qualifications and experience of the persons who undertake design decisions in the firms and the types of projects mainly undertaken.54% of architectural firms sampled have 1-2 architects, 21% have between 3 and 4 architects while 25% have more than 5 architects. The design decisions were undertaken by the principal in 58% and by appointed project architects in 21% of the firms. These were all registered architects.

An examination of the understanding of quality as a concept was obtained with 43% choosing fitness for use as the main definition of quality. Quality was further assessed in terms of the areas where quality is considered to be critical during the design process. The scheme design stage was deemed most critical at 50%. Further to this, the contribution of design quality to overall building quality was analysed with 92% of the respondents indicating that design quality contributes more than 50% to the overall building quality. Design quality was found to be affected by mainly brief adequacy (28%), time allocated for the design process (18%) and the architects experience (18%) while detailing by the architects was deemed to be the highest contributor to low design quality (30%).

In use of quality management systems during the design process, all respondent firms indicated the use of at least one tool/ system with the majority utilizing basic and mandatory tools-standard contracts and record keeping. Other quality management systems-quality plans, audits and certification were found to be minimally used. This is despite the assertion by 79% of the respondents that the use of quality management systems is averagely successful.

Barriers to quality improvement during the design process were found to be mainly due to lack of information(36%) and high cost of implementing quality systems(31%). This was further determined by the trainings undertaken by architects in a given year-64% attended one training and 54% of firms had a maximum of two persons trained in quality management.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the conclusions and recommendations made from the analysis of data collected for this research. This is in line with the objectives of this study as previously indicated.

5.1 Overview of the study

This study was based on a sample of architectural firms in Nairobi who were subjected to questionnaires as the primary means of obtaining data. Further information was sourced from key informants who included an architect, a client and an engineer to give further in-depth insights and information where gaps or contradictions were found out from the data collected through the questionnaires.

5.2 Conclusions

Design plays an important role in the final achievement of desired quality, thus the need for designers (architects) to be aware of the need for QMS and its implementation (Dindi, 2004). This is backed up by the study in terms of the data collected and the unanimous agreement that design plays a major role in the overall building quality.

The objectives of the study were;

1. To investigate the application of quality management systems at the design phase of construction as a means of achieving Total Quality Management.
2. To investigate how quality management techniques are utilized at the design stage of construction
3. To identify the factors that affect quality management at the design stage in the local construction industry.

4. To come up with recommendations and strategies for quality management implementation at the design stage for overall building quality.

The conclusions of the study based on the findings and the objectives are;

5.2.1 Awareness of quality

From the statistics and data collected, it can be deduced that quality as a concept is generally understood amongst architects. This reiterated the connotation that quality has been well understood as a concept since time immemorial but its interpretation remains a challenge in differing scenarios, in this case the design process. Whilst all architects acknowledged the importance of quality in the eventual built product and more so alluded to quality during the building stage, quality in the design process elicited vague answers leading to the conclusion that the application of quality at the design stage still remains unclear, misunderstood or virtually unknown.

5.2.1 Awareness of quality management systems

Awareness of the quality management systems was found to be quite high but it was restricted to standard contract documents and keeping of records alone. This was attributed to;

i. the common use of the Joint Building Council, April 1999 edition conditions of contract in the local construction industry as the default contract document between the contractor and the client

ii. keeping of project records (as a condition of the same contract named above or as a means of future reference by the architectural firm) in the form of drawings and project documents (e.g bills of quantities and project communication documents).

The awareness of the use of certification, quality plans, manuals and audits as quality management systems were found to be minimal. Certification was pointed out to be perceived more as a fashionable aspect in increasing marketability and giving an edge over the competition rather than a quality management system.

5.2.2 Extent of use of quality management systems and techniques at the design stage of construction

Similarly, the application of quality management systems was found out to be still rudimental and restricted to standard contracts and record keeping which is deemed as default and relegates quality management systems to the 1st stage of quality management evolution- Inspection. This gave an indication that the quality management systems currently in use in the local construction industry are those that mainly relegate the responsibility of quality of the built product to mainly the contractor rather than a process involving all players in the building process, from the design team to the building team. Other suggested quality management systems were found to be not clearly understood and hence not applied. Where there was an understanding of the same, there was no evidence to back the same as attempts to obtain such documents for any current or past projects were futile.

5.2.3 Factors affecting quality management at the design stages of construction

Various factors were identified as affecting the implementation of quality management systems at the design stage;

a) Lack of knowledge of quality management systems. This is attributed to lack of quality oriented training for the general building industry and also specifically to the separate specialities.

b) Lack of understanding of the application of quality management systems at the design stage. While there was found to be a general above average understanding of QMS at the building stage, application of quality management systems at design phase was at best rudimental and most often absent.

c) Existing procurement method- the use of the traditional system for building procurement was found to be a deterrent to the use of QMS as the procurement method separates not only the design participants but also the design team and the building team leading to fragmentation of the design process in itself and between the design and building process.

d) High costs- The apparent high charges associated with the process of certification were indicated to be prohibitive to the attainment of relevant certification of the existence of and adherence to QMS. With the majority of architectural firms having at most 2 architects, indicating small establishments, the apparent high costs may be a deterrent to the use of QMS in the architectural firms and consequently limit their use in the design process.

5.3 Recommendations

For successful integration of QMS into the entire building process, a look at the various participants has to be made so as to ensure the spirit of TQM which entails the involvement of all participants into the quality process and building of quality into rather than inspecting it in.

The recommendations of this study are;

5.3.1 Change in Quality culture

There is need for an industry-wide, and in particular amongst architects, change in attitude, style and culture so as to foster an environment conducive for the implementation of QMS at all stages of the construction process, not relegated to the building phase alone. This will place the responsibility of quality to not only the contractor, but to other participants and stakeholders of the building process,

5.3.2 Understanding of quality

It is vital for all participants of the building process and in particular the design team led by the architects to have a proper understanding of QMS and propagate its implementation at all stages of design,

5.3.3 QMS integration into construction stages

Quality management systems which include Quality plans, manuals and past quality audits of similar projects should be fully integrated into the entire construction process- from procurement to-building. This would necessitate the involvement of all parties into ensuring quality adherence in all stages and build in quality into all aspects of construction,

5.3.2 Training

There is dire need for training amongst architects on QMS to facilitate a proper understanding of both the systems currently in use and other possible systems which can facilitate QC during the design process.

5.4 Suggested areas for further research

a) The impact of implementation of QMS at the design stage of construction should be investigated and hopefully illustrate the positive effects of utilization of QMS,

b) The impact of implementation of QMS at the design stage under various procurement methods should be undertaken to gauge the effectiveness of QMS in different procurement systems,

c) QMS training models for architects and their effectiveness on implementation.

5.5 Limitations of the study

1. The study was limited geographically to the Nairobi area due to the time and financial provisions.
2. The study was limited to the design stage of the construction phase as the other stages- tender, building and post- building stages are considered to have been covered by previous research. As such, it further focussed on the architectural aspects of design as opposed to other designers involved in the construction industry e.g. Engineers, Interior designers and Landscape Architects. This was to enable an in-depth analysis of a particular discipline rather than a general overview of all the disciplines.
3. The study was limited to private projects as opposed to public/ government projects. Private projects are envisioned as being more subject to quality measures and controls as the clients are more defined rather than the public/ government projects whose clientele (end-user) is more diverse and many at times ambiguous.

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APPENDICES

1. Introduction letter
2. Questionnaire to Architects
3. Interview schedule for Architect
4. Interview schedule for Client
5. Interview schedule for Engineer

APPENDIX A: INTRODUCTION LETTER

UNIVERSITY OF NAIROBI

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION MANAGEMENT

P.O. Box 30197, 00100 Nairobi, KENYA, *Tel: No. +254-2-2724525/9 Fax: +254-2-2718548*

E-mail: *dept-recm@uonbi.ac.ke*

9th June, 2009

TO WHOM IT MAY CONCERN

RE: CHRISTOPHER MUTIE – B50/7501/2006

The above named is registered for the M.A. Construction Management Degree in this Department. The purpose of this letter therefore is to request you to kindly allow him access to any kind of material he may require from your organization to enable him complete his thesis successfully. The information given will be used for research purposes only.

His research topic is ***Quality Management in Construction: An Examination of Quality Management Systems at the Design Phase of Construction***.

Any assistance accorded to him will be highly appreciated.

Yours faithfully

CHAIRMAN
DEPARTMENT OF REAL ESTATE
AND CONSTRUCTION MANAGEMENT
UNIVERSITY OF NAIROBI

Dr. S.M. Masu
Ag. Chairman
Department of Real Estate and Construction Management

APPENDIX B: QUESTIONNAIRE TO ARCHITECTS

DECLARATION:

THE INFORMATION COLLECTED THROUGH THIS QUESTIONNAIRE SHALL BE TREATED AS CONFIDENTIAL.

Your assistance in completing this questionnaire will be highly appreciated.

INSTRUCTIONS;

Please tick (✓) against the appropriate answer and fill in the details where necessary.

Questionnaire No...........................

Date...

SECTION 1: INTRODUCTION

1. How many architects work in this firm?

   i. 1-2 ☐

   ii. 3-4 ☐

   iii. 5 and above ☐

2. How many technicians (design support staff) work in this firm?

   i. 1-2 ☐

   ii. 3-4 ☐

   iii. 5 and above ☐

3. Who in this firm is mainly involved in the design of the project?

   i. Firms' principal ☐

   ii. Selected Project architect ☐

   iii. Graduate architects ☐

   iv. Technicians ☐

   v. Combination of any of the above ☐

4. What criteria do you use in selecting the person to undertake the design work?

   ………………………………………………………………………………………………

5. What type of projects are you mainly involved in?

   i. Residential

   ii. Commercial

   iii. Others………………………………………………

SECTION 2: QUALITY AND QUALITY MANAGEMENT SYSTEMS

6. In your opinion, against a scale of 1-5 (where 1 is the lowest and 5 the highest), how do the following terms define quality?

TERM	1	2	3	4	5
Fitness for use					
Value for money					
Customer satisfaction					
Aesthetic value					
Durability					

7. Do you think that quality is important at the design stage of construction?

YES ☐ NO ☐

8. What in your opinion is **design quality**?

....

9. At what stage of the design process is design quality most critical?

i. Concept/Outline proposal stage ☐

ii. Scheme design stage ☐

iii. Detail/ production stage ☐

10. To what extent do you think that the design quality plays in the overall quality of the competed building?

PERCENTAGE (%)	
0-25	
26-50	
51-75	
76-100	

11. On a scale of 1-6 (where 1 is the minimum and 6 the maximum), what do you think contributes most to a quality design?

TERM	1	2	3	4	5	6
Brief adequacy						
Time for design						
Architects experience						
Clear drawings/ specifications						
Buildability						
Contribution of other consultants?						

12. To what extent in your opinion (on a scale of 1-5, where 1 is the minimum and 5 the maximum) do the following aspects contribute to low design quality?

TERM	1	2	3	4	5
Lack of proper communication					
Insufficient detailing					
Design variations					
Lack of detailed knowledge of building materials and processes					
Experience of architect					

13. How does your firm ensure quality of design?

....

....

....

14. A quality management system is defined as a management process that ensures that products and services are designed, developed, produced, delivered and supported to fully meet customers' expectations.

a) Does your firm have any management system to ensure design quality?

Yes ☐ No ☐

b) If so, which one (or more) of the following tools/systems most closely represents the quality system/s used in your firm?

QUALITY SYSTEM/TOOL	
Quality Certification (ISO, SGS etc)	
Use of standard contracts	
Quality Manuals[12]	
Quality Plans[13]	
Quality Audits[14]	
Keeping of records	

c). What tools/ systems, in your opinion, are applicable at the following stages of design?

i. Concept/Outline proposal stage...

ii. Scheme design stage ....

[12] A quality **manual** is a document that provides an adequate description of the quality management system while serving as a permanent reference in the implementation and maintenance of that system.

[13] A quality **plan** is a document setting out the specific quality practices, resources and sequence of activitites relevant to a particular product, service, contract or project

[14] A quality **audit** is a systematic and independent examination to determine whether quality activities and related results comply with planned arrangement and whether these arrangements are implemented effectively and are suitable to achieve objectives

iii. Detail/ production stage ....

d) What other systems or tools can be used, in your opinion, to achieve design quality?

i. ....

ii. ....

iii. ....

d) Based on your experience and opinion, to what extent do you think quality is/has been integrated into the design process in architectural firms?

i. Successfully ☐

ii. Averagely successful ☐

iii. Below average ☐

iv. Poorly ☐

e) In your opinion and experience, how do you measure the customers' expectations and eventual satisfaction of a building design in line with the definition of a quality management system?..

....

15. On a scale of 1-5 (where 1 is the minimum and 5 the maximum), rank in order of merit the barriers to improving design quality.

i. High costs of quality systems ☐

ii. Lack of information ☐

iii. Inexperience in quality ☐

iv. Client expectations ☐

v. Communication problems ☐

vi. Others..

16. Are quality systems in your opinion applicable in the design of all projects regardless of their size, location and type?

Yes ☐ No ☐

17. If no, what factors influence the application of quality management systems in different project designs?

iv. ....

v. ....

vi. ....

vii. ....

viii. ....

18. It has been noted that training in quality systems is critical for all workers.

a) How many designers in this firm have undertaken any training in quality systems?

....

b) Is training a component of your calendar activities?

Yes ☐ No ☐

c) If yes, how often do you train designers in quality systems?

i. Once a year ☐

ii. Twice a year ☐

iii. More than twice a year ☐

iv. Other ☐

19. In your opinion, what is the effect of the size/cost of project, duration of project and aesthetic appeal on design quality?

	Major effect	Average effect	No effect
size/cost of project			
duration of project			
aesthetic appeal			

THANK YOU

APPENDIX C: INTERVIEW SCHEDULE TO SELECTED ARCHITECT

DECLARATION:

THE INFORMATION COLLECTED THROUGH THIS INTERVIEW SHALL BE TREATED AS CONFIDENTIAL.

Name of interviewer...

Respondents' name (Optional)..Date ....

1. What are your qualifications as pertains to Architecture?

i.

ii.

iii.

iv.

v.

2. How long have you practised?

....

3. How many building projects have you undertaken in the last 5 years?

Completed..

Ongoing ....

Stalled ....

4. How many projects in the following categories have you undertaken in the same duration?

Commercial.......................................

Residential...

Government.......................................

4. How have your services as an architect been procured?

....

5. Which method has yielded more projects than the rest?

....

6. Which of the following methods of procurement for construction have you utilized in your years of practise?

i. Traditional

ii. Design Build

iii. Management Contract

iv. Construction Management

v. Program/Project management

vi. Others

7. Have you had any repeat clients?

....

8. In your opinion, what is the general state of quality in construction in Kenya?

....

....

9. Do architects, in your opinion, have a role to play in the quality of the built environment?

....

10. To what extent do you think that the design plays on the quality of the entire building?

....

11. What in your opinion is design quality?

....

....

12. How in your opinion, do you think one can measure design quality, it being more subjective rather than objective?

....

13. What would then be the measures of design quality?

i. ....

ii. ....

iii. ....

iv. ....

v. ....

14. Who do you think is the best measurement of design quality?

i. Client

ii. Architect

iii. Engineers

iv. Contractor

v. Public

vi. Other

15. Based on your answer above, kindly explain why?

....

16. What problems have you encountered in quality management at the design stage?

....

17. What in your opinion is the contribution of other designers (structural and services engineers) to the overall design quality of a project?

....

....

18. What measures do you think can be used to ensure that design quality is met during design-

a) by the architects?

....

b) By other consultants?

....

19. What obstacles have you perceived/ do you perceive there to be in the implementation of quality management systems in architectural firms and in their use at the design stage?

i. ....

ii. ....

iii. ....

iv. ....

v. ....

THANK YOU

APPENDIX D: INTERVIEW SCHEDULE TO CLIENT

DECLARATION:

THE INFORMATION COLLECTED THROUGH THIS INTERVIEW SHALL BE TREATED AS CONFIDENTIAL.

Name of interviewer..

Respondents' name (Optional)..Date ....

1. How many building projects have you undertaken in the last 10 years?

....

2. What is your preferred method of procuring the services of an architect?

....

3. Why is the above method your preferred choice?

....

4. The client provides the brief to the architect. At what point do you ensure that the architect has all the information required?

....

5. How do you ascertain that all your requirements are met by the architect?

....

6. What is your understanding of the quality of buildings?

....

7. What qualities would you ascribe to a quality building?

i. ....

ii. ....

iii. ....

iv. ....

v. ....

8. What would you describe to be a quality design?

i. ....

ii. ....

iii. ....

iv. ....

v. ....

9. How do you ascertain the quality of the design?

....

10. Whose perception of design quality would you consider most valuable?

i. Client

ii. Architect

iii. Contractor

iv. Public

v. Other

11. Do you undertake the work of evaluation of the design personally or do you procure the services of another professional advisor?

....

12. What challenges, if any, have you encountered with quality during the design stage?

....

13. Who in your opinion is most responsible for quality of the completed building?

i. Client

ii. Architect

iii. Engineers

iv. Contractor

v. Other

THANK YOU

APPENDIX E: INTERVIEW SCHEDULE TO ENGINEER

DECLARATION:

THE INFORMATION COLLECTED THROUGH THIS INTERVIEW SHALL BE TREATED AS CONFIDENTIAL.

Name of interviewer...

Respondents' name (Optional)..Date ....

1. What are your qualifications as pertains to Engineering?

   i. ....

   ii. ....

   iii. ....

   iv. ....

   v. ....

2. How long have you practised?

....

3. How many building projects have you undertaken in the last 5 years?

   Completed...

   Ongoing ....

   Stalled ....

4. How many projects in the following categories have you undertaken in the same duration?

   Commercial...

   Residential..

Government.......................................

5. Do you work with particular architects or any?

....

6. What in your opinion is design quality?

....

7. How would you rate the design quality of an architect's work- (measures and/or characteristics of a quality design)?

....

....

8. What do you perceive to be the responsibility of the architect in ensuring quality at the design stage?

....

9. Who do you think is the best measurement of design quality?

i. Client

ii. Architect

iii. Engineers

iv. Contractor

v. Public

vi. Other

10. Based on your answer above, kindly explain why?

....

11. What problems (if any) have you encountered with architectural design quality?

....

12. What in your opinion is the contribution of other designers (structural and services engineers) to the overall design quality of a project?

....

....

13. What measures do you think can be used to ensure that design quality is met during design-

a) By the architects?

....

b) By other consultants?

....

THANK YOU