

# The Use of Total Quality Management (TQM) Principles for Construction Projects in Nigerian Tertiary Institution

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## Abstract

The construction industry, as the backbone and a parameter for measuring the growth and development of any nation, is tedious and expensive. There is therefore need to properly manage constructions for high quality delivery. Total quality management (TQM), is basically a way of thinking about the concept, visualization and achievement of goals to ensure good quality and productivity. It is a management philosophy which has been widely implemented in the manufacturing and other services industries, and has been recently brought into the construction sector. As a new concept in the construction industry, some few articles and studies attempted to bring the benefits of this philosophy to the construction industry. The objective of this research is therefore to point out the latest studies which focused on improving the quality in construction project through implementing TQM in construction industry, its importance and suitable applications in the different phases in Nigerian tertiary institution. The paper concludes by laying apt emphasis on the great potentials of quality improvement on construction project using the TQM model, in tertiary institutions where it supposed to be more practiced. It also recommends that construction professionals within the institution should be well trained in the application of TQM principles and that management should not unduly emphasise cost at the expense of quality of a project.

**Keywords:** Total quality management (TQM), Construction industry, Quality Control; Quality Assurance and TQM implementation.

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## I. Introduction

Long before now, Total Quality Management (TQM) was considered as a management tool in the manufacturing and service industries where it was extensively used. But in the construction industry, it is being considered as an effective tool only in recent times [1]. The manufacturing industry first established Total Quality Management (TQM) concepts, first applied in Japan and in recent years used in the United States, which have improved productivity, reduced product cost and enhanced product reliability [2]. TQM is a concept in which organizations, processes and people are interwoven in the correct format so that right things are done rightly at the correct time. TQM gives emphasis on innovation and adaptation of new technology to improve quality [3]. These conceptions are also appropriate to the construction industry. Apparently, TQM is an exertion that involves all organisations in the industry to improve performance. It permeates every aspect of a company and makes quality a strategic objective [4]. TQM is attained through an integrated effort among workforces at all levels to maximise customer satisfaction by continuously improving performance. Consequently [5] ascertain that TQM focuses on process improvement, teamwork, customer and supplier involvement and training and education with the effort to realise customer satisfaction, cost effectiveness, defect-free project and provides the culture and environment important for innovation and for technology advancement. [4], asserts that the fundamental principles that a structure must be fit for purpose and use, material and construction and at reasonable proportion and scale. In fact, the attainment of acceptable levels of quality in the construction industry has long been a problem. Great disbursements of money, time and resources (human and material), are wasted yearly due to inefficient or non-existent quality management processes [1], [5] and it is against this aforesaid statement that this research was carried out to answer the fundamental research question:

- What is the relationship between Total Quality Management and qualitative construction project delivery;

### I.1 AIM AND OBJECTIVES

The main aim of this research is to highlight Total Quality Management principles in the construction industry, that enhance the qualitative delivery of a project at the right time and as the cheaper absolute cost.

This can be achieved through the following objectives:-

- To conduct literature review of the philosophy behind the concept of TQM.
- To establish how quality can be assured through quality control model of TQM.
- To succinctly highlight the factors that affect the total quality of a project.
- To conclude and make appropriate recommendations to stakeholders

## **II. Material (Literature Review)**

### **II.1 DEFINITION OF QUALITY**

Quality according to [5], can be referred to as meeting the legal, aesthetic and functional requirements of a construction project. Requirements may either be simple or complex, or be stated in terms of a detailed description of what is to be achieved or end result required. However it is expressed, quality is attained if the stated requirements are satisfactory, and if the completed project fit in to the requirements. Some design professionals believe that quality is measured by the aesthetics of the facilities they design.[6]also justified this traditional definition of quality as based on such issues as how well a structure blends into its environments, a structure's psychological impacts on its occupants, such as the ability of a landscaping design to match the theme of adjacent buildings, and the use of new design concepts that capture common imaginations. Quality can also be defined from the perspective of function, by how closely the project fit in to its requirements [7]. By this definition, a high quality project can be termed as ease in understanding drawings, economics of construction, ease of maintenance, ease of operation, level of conflict in drawings and specifications and energy efficiency.

In the construction industry, quality can be referred to as meeting the requirements of the designer, constructor and regulatory agencies as well as the client. According to [7], quality can be characterized as follows.

- Meeting the requirements of the client as to functional adequacy, completion ontime and within budget, lifecycle costs, its operation and maintenance.
- Meeting the requirements of the designer as to provision of well-defined scope of work; budget to construct and use a qualified, trained and experienced personnel; budget to acquire sufficient field information before design; provisions for timely decisions by client and design professional; and contract to perform required work at a fair fee with sufficient time allowance.

### **II.2 QUALITY ASSURANCE AND QUALITY CONTROL**

According to the Manual of Professional Practice for Quality in the Constructed Project, in [7], "Quality Assurance" (QA) is referred to as a program covering all activities required to provide quality in the work to meet the project requirements. QA includes establishing project related policies, procedures, guidelines, standards, training, and system required producing quality. The designer and constructor are obliged for developing an appropriate program for each project. In fact, QA as postulated by [2], offers protection against quality problems through early warnings of trouble ahead. Such early warnings play a significant role in preventing both internal and external problems.

On the other hand Quality Control (QC) is defined by [8], as the specific implementation of the QA program and related activities. Effective QC minimise the possibility of mistakes, changes and omissions, which in turn result in less disagreement and disputes. He further noted that one way to give more attention to quality control is the development of a project quality control plan. To justify this statement, testing and inspection requirements are distributed throughout the contract specifications. To develop an organisation plan, the testing and inspection requirements can be lumped into a new division of the specifications. This will define quality control and provide an organised location in which all quality control issues are acknowledged by the bidders [9]. As a part of a quality control plan, the manner in which the construction manager will apply quality control procedures should be ascertained to the bidders. This will permit them to assign suitable costs to the testing procedures [8]. [10], however observed that the terms quality assurance (QA) and quality control (QC) are often used interchangeably. [9], further revealed that since quality control is a part of quality assurance, maintaining a clear difference between them is difficult but vital. Quality assurance is all planned and systematic actions needed to provide sufficient confidence that a building, system or component will perform satisfactorily and conform to project requirements [11].

On the other hand, quality control is a set of specific procedures involved in the quality assurance process. These procedures include planning, coordinating, developing, scheduling, checking and reviewing, the work. The quality control function is closest to the product in that numerous activities and techniques are used to monitor the process and to pursue the removal of sources that may lead to substandard quality performance [10]. Therefore, developing and monitoring the activities within the quality assurance program in the construction phase as suggested by [11] are the responsibility of either the designer or the construction management organisation or project team (such institutions) which depends on the project delivery system in use.

### **II.3 FACTORS AFFECTING QUALITY IN NIGERIAN CONSTRUCTION INDUSTRY**

[10], noted that establishing the project requirements for quality begins at project inception. A careful balance between the client's requirements of the project costs and schedule, materials of construction, desired operating characteristics and so on with the designer need for sufficient time and budget to meet those requirements during the design process is vital.[8], noted that clients should balance their requirements against economic considerations and against chance of failure and designer is obliged to protect public health and safety in the context of the completed project. The constructor is responsible for the means, methods, techniques, sequences, and procedures of construction, as well as safety precautions and programs during the construction process. Indeed, project requirements are the main factors that define quality in the process of construction[10], [12].The process of construction can be broken down into three main phases, namely, the planning and design phase,the construction phase, and the maintenance and operation phase [7]. However, [12] described the factors that may affect quality in each phase of the construction process as follows:

#### **II.3.1 Management Commitment and Leadership**

The success of a TQM program first of all depends on management practices. TQM is a culture and philosophy that must permeate an organisation as the method of management. It can succeed only when the management establishes TQM as a top priority. In fact, this commitment must be joined with a thorough understanding of TQM. Only if supported by this commitment and understanding, can management lead the institution toward the realisation of higher quality in its undertakings.According to[13], in this style of management, the emphasis is on the organisational chart and the key control points within the organisation structure. Examples are where directors of planning or works may be given certain goals as target. They, in turn, set goals and impose controls on each of their subordinates. In construction terms, cost, schedule, and possibly quality goals are established for each project where their subordinates are rewarded on the basis of meeting these goals.This method, according to [13], has been somewhat successfulbecause it is simple, logical, and consistent. Once it acknowledges that there is a problem, the second step for management is to develop a clear understanding of the underlying principles and elements of TQM. [4], further suggested that Management should then demonstrates its commitment to quality through action. Apparently, without this understanding, management's action will most likely contradict TQM requirements, confirming the doubts of the labour force and dooming their effort to failure[14], [15].

#### **II.3.2 Teamwork**

Quality teams as ascertained by [12], provides the organisation with the structured environment needed for successful implementation and continuous applicationof the TQM process. Quality training is conducted and the continuous improvement process is performed through a well-planned team structure.The ultimate goal of the team approach is to get the stakeholders, including contractors, designers, vendors, subcontractors, and the client involved with the TQM process. At our institution level, teams composed of individuals from various departments who are needed to implement TQM throughoutthe construction project. Extent of teamwork of parties participating in the design phase as observed by [16]was found to be the most significant factorthat affects quality. This shows that teamwork amongparties such as electrical, civilengineers, architects, builders and client is essential to reach thequality goals for design.

#### **II.4 Cost of Quality**

The cost of quality is considered by both[17]and [18]to be the key tool for measuring quality. In their approach, it was used to monitor the effectiveness of the TQM process, select quality improvement on projects, and provide cost justification to doubters. Cost of quality has received increasing attention in lately. It is effective in its intended purpose of raising awareness about quality and communicating to management the benefits of TQM in terms of Naira.A quality cost as noted by [19], [20]consists of the cost of prevention, the cost of appraisal, and the cost of deviation. Prevention costs are those resulting from activities used to avoid deviations or errors, while appraisal costs consist of costs incurred from activities used to determine whether a product, process, or service conforms to established requirements [20]

The cost of design or constructability reviews, as well as the cost of modifying work procedures to adhere to quality standards might be considered prevention costs, while inspection is an example of an appraisal cost. Meanwhile, deviation costs are those resulting from not meeting the requirements. Some deviation costs are incurred on the project site due to scrap, rework, re-inspection, supplier error, failure analysis, price reduction due to nonconformity. [21], stressed on other deviation costs are incurred once the client takes possession of the constructed facility. These include costs for adjustment of complaints, repair costs, costs for

handling and replacing rejected material, workmanship or equipment costs for correcting errors, and litigation costs.

In the construction industry, contractors and sub-contractors are selected by clients on a competitive basis. Even though the bid is considered to be the main criterion of selection, especially private client like our institution also consider the contractors' safety record, technical support, equipment capabilities, and especially reputation regarding the quality of the work performed[20]. Contractors or sub-contractors with a reputation for poor quality are not likely to be awarded any projects in the existing competitive marketplace[19]. It therefore pays for contractors and the sub-contractors to invest in measures to attain high work quality in order to maximise chances of winning contracts.

## **II.5 Quality of Codes and Standards**

According to [7], the key purpose of codes and standards are to protect the public's health and safety. Compliance with codes and standards should be an issue addressed early in the design phase. [9] further emphasises that the designer must be knowledgeable about the provisions of codes and standards before starting the design process because the building codes directly control the minimum standards of many components of a building project, and are responsible for much of the finished product quality. [6] also stressed that quality design begins with sound scientific and engineering principles and must satisfy the criteria of applicable codes and standards, but also the client's project requirements. Codes and standards refer to the minimum criteria. Client (our institution) however, may have particular requirements and apart from the quality control developed by our institution, the following British, European and international standards will have to be observed in any construction work which includes:

- BS 4778, Quality vocabulary.
- BS EN ISO 9000 series, Quality management & Quality assurance standard.
- BS 5750, guide to quality management.
- BS 5360, Reliability of system equipment & component.
- ISO 10007, Quality management, guideline for configuration management.

## **II.6 Quality of Drawings and Specifications**

Drawings and specifications are the two sets of documents given to the constructor or sub-contractor to provide them with 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 gathered into a final project. [14], noted that the final product of design work is a set of contract documents (drawings and specifications) to guide the physical construction of the project. There are often inconsistencies between the drawing and specifications [2] that is why it is critical that drawings be clear, concise, and uniform [7].

## **II.7 Constructability of Design**

Constructability is one of the key factors that affect the quality of design. According to in [7], the designer must consider the requirements of the Builder. The project must be constructible by those retained to carry out the project. Like codes, constructability and construction techniques vary in different geographical areas, especially in restricted environments. In fact, designer must clearly and sufficiently communicate the design intent to the Builder. This is done primarily with the contract documents, with both plans and specifications as [7], stressed that the quality design must extend throughout the construction phase of the project.

According to [7], the project design team should include builders and engineers with practical experience. Most organisations have these professionals on management. [23], stressed that the quality assurance standards are designed for contractual and assessments purposes and are ISO 9001, ISO 9002, and ISO 9003. The quality management standard is ISO 9004 and is designed to provide guidance for organisations developing and implementing quality systems [22]. ISO standards as noted by [6] and [23] are directed towards improving an organisation's production processes. Consequently, the best way of viewing ISO is that the emphasis in the ISO registration is on the management of process quality. This is not meant to reduce the role of ISO in a TQM system. The ISO standards provide an excellent beginning point for an organisation starting a TQM program and indeed our institution can imbibe this culture into the system [6].

## **II.8 DIFFERENCE BETWEEN TRADITIONAL MANAGEMENT AND TQM**

The main differences between TQM and the traditional management system, as highlighted by [3], are as follows:

- I. TQM is a process oriented approach as against the traditional result oriented approach.

- II. In TQM quality, flexibility and services are dominant objectives in place of cost, technical efficiency and partial productivity.
  - III. Traditional management proposes hierarchical and vertical organizational structure whereas in TQM, a flatter organizational structure is adopted.
  - IV. TQM views customer as the most dominant resource.
  - V. TQM takes into account that profits follow quality and not the other way round.
- A leader in a TQM set up requires the following skills – commitment, collaboration, continuity, conversation and conscience.

## **II.9 LIMITATIONS OF TQM**

It must be clearly understood that by adopting TQM in a company, according to [3], results cannot be achieved instantaneously as it needs time to adapt to the set up and environment.[4], also maintained that the implementation TQM requires an organizational change that would modify the culture, priorities, processes and beliefs of an organization.[1], further advised top management to get involved and then try to inculcate a sense of importance of the system among the employees. By training, teamwork and timely feedback no doubt the full benefits can be achieved by the implementation of Total Quality Management in Construction companies.

## **III. Conclusion**

There is great potential for quality improvement in the construction industry, especially in institutions where it supposed to be in practice. In today's competitive world, the term 'quality' and its concepts are significant for the construction industry and organisations. There is neither much time nor resources to waste as reworks and delays are not acceptable. As it is in the construction industry, institutions should focus on process quality. It is clear that TQM and its principles do apply to the nature of construction project which are carried out within the institution. Indeed, it is a useful tool to avoid and mitigate problems and to improve quality performances on projects and also principles that management may use to achieve effective cost control, quality control, and schedule control, among others. Many civil and construction Corporations in country have applied the Quality Management successfully and got more profits and reduced lost time and cost for reworks and for our institution is to reduce cost, time and rework. The management may with this research recognise the importance of the Quality Management and use it to identify, assess, prevent and manage all breakdowns and risks to construction projects, damage to existing structures and good working environment and also use quality improvement programs to establish actions for achieving the objectives and targets, in line with the policy commitment of continuous improvement within the system. Apparently, TQM philosophy of teamwork and co-operation should be adopted not to generate confrontation and conflict.

## **IV. Recommendations**

This research indicates that future strategies and potential developments should base on the TQM findings. The management and construction project leaders should consider the following points in developing the quality systems within the institution developmental project scheme:

- Management commitment to quality and continuous quality improvement is very important in each phase of the construction process. Management must participate in the implementation process and be fully committed to it if TQM is to succeed.
- Construction professionals should be aware of the importance of quality training in Engineering, Architecture and Construction Management as well as Building /Civil Engineering students who eventually become the industry's future leaders must be instructed in the basics of quality management.
- Teamwork is necessary to allow each individual to get the assistance required to be successful individually, and collectively as a team. The whole construction is project oriented; to improved quality performance must be project-related and must include the whole project team. Manufacturer, subcontractors, main contractor, vendors, designers, construction officers and above all, the client (Institution representatives) must be involved in the process.
- Drawings and specifications received from the designer 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 very important that drawings and specifications be clear, concise, and uniform. The project must be constructible by those retained to execute the project. Designer must be familiar with construction materials and techniques that constructors will be using in the project.

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