

Total Quality Management in Construction

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Abstract

The primary purpose of TQM is to provide excellence in customer satisfaction through continuous improvements of products and processes by the total involvement and dedication of each individual who is in any way a part of that product/process. It is a structured approach to improvement. If correctly applied, it will assist a construction company in improving its performance. Unfortunately the Construction industry has lagged behind other industries in implementing TQM. The main reason for that has been the perception that TQM is for manufacturing only. One aspect of TQM that has frustrated the construction industry the most has been "measurement". The main aim of this work was to produce a measurement model - with tools and methodologies for the recognition and measurement of construction processes for continuous improvement and client satisfaction. Analysis of questionnaire survey indicates that the major obstacle to implement a TQM program is changing the behaviour and attitude, lack of expertise/resources in TQM, lack of employee commitment/understanding, lack of education and training to drive the improvement process.

The Client Satisfaction Index, the Cause and Effect Diagram and the Improvement Index were developed to find out the major sources of client satisfaction and dissatisfaction in the construction industry. The outcomes of this survey show that customer satisfaction can be greatly raised by improving construction underestimation, project management, coordination, pattern changes by clients and change orders from procurement department. For the local construction industry, this project has the potential to demonstrate tangible benefits of using TQM in their organizations.

Key Words: Total Quality Management (TQM), Client Satisfaction, Continuous Improvement.

1. INTRODUCTION

For the last few decades Total Quality Management (TQM) techniques have been used extensively and beneficially in the area of manufacturing and industrial engineering to control the process and prevent defects before they happen. TQM focuses on the quality of management systems, not the management of quality, on continuous improvement of processes in order to improve every

feature of an organization. The implementation of TQM is fundamentally a process of culture change.

ISO 8402:1994 ISO Definitions defines quality as the degree of excellence in a competitive sense, such as reliability, serviceability, maintainability or even individual characteristics. Quality systems refer to the organizational structure, procedures, processes and resources needed to implement quality management. Quality assurance is the planned and systematic activities implemented within quality system and demonstrated, as needed, to provide adequate confidence that an entity will fulfil requirements for quality. ISO 9000 - 2004 defines quality control as the operative technique and activity; for example, providing a means to control and measure the characteristics of a material, structure, component, or system that are used to fulfil requirements for quality. Quality management refers to all activities of overall management functions, especially top management, leadership, that determine quality policy objectives and responsibilities for all members of the organization. Total quality management is the management approach of an organization, which concentrates on quality based on the participation of its members and aims at long-term success through satisfaction and benefits to all members of the organization and society (ISO 8402:1994 ISO Definitions and Griffin 1990). Abu et al. (2011) in this study TQM process is considered as a modern system in the field of quality, after quality assurance, quality control and ISO in the Construction sector.

Evolution

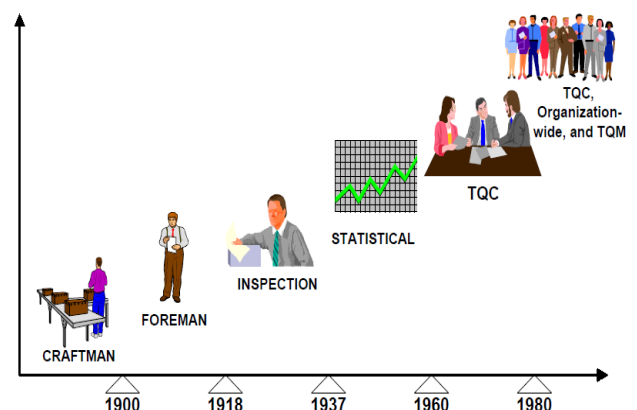


Figure 1: Quality Control Evolution (Source: Feigenbaum (1991))

1.2 Quality Improvement Techniques

Total Quality Management mainly demands a process of continued improvement aimed at reducing variability. An organization wishing to support and develop such a process needs to use quality management tools and techniques. It is prudent to start with the more simple tools and techniques: Check-sheet, Check list, Histogram, Pareto Diagram, Cause-and- Effect Diagram (Fishbone Diagram), Scatter Chart and Flowchart.

Check Sheet

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

Checklist

Checklist is used to tell the user if there is a certain thing, which must be checked. As such, it can be used in the auditing of quality assurance and to follow the steps in a particular process.

Histogram

Histogram provides a graphical representation of the individual measured values in a data set according to the frequency of occurrence. It helps to visualize the distribution of data and there are several forms, which should be recognized, and in this way they reveal the amount of variation within a process.

Pareto Analysis

It is a technique employed to prioritize the problems so that attention is initially focused on those, having the greatest effect. As a generalized rule for considering solutions to problems, Pareto analysis aims to identify the critical 20% of causes and to solve them as a priority.

Cause and Effect Diagram

Cause and Effect Diagram or Fishbone diagram is useful in breaking down the major causes of a particular problem. The shape of the diagram looks like the skeleton of a fish. This is because a process often has a multitude of tasks footing into it, any one of which may be a cause. If a problem occurs, it will have an effect on the process, so it will be necessary to consider the whole multitude of tasks when searching for a solution.

Scatter Diagram

The relationship of two variables can be plotted in the scatter diagrams. They are easy to complete and obviously linear pattern reveals a strong correlation.

Flowcharts

Flow chart is used to provide a diagrammatic picture using a set of symbols. They are used to show all the steps or stages in a process project or sequence of events. A flowchart assists in documenting and describing a process so that it can be examined and improved. Analysing the data collected on a flowchart can help to uncover irregularities and potential problem points.

2. OBJECTIVE

- To identify the level of effectiveness in implementing managerial practices of TQM in the construction industry.
- Determine the processes ("what to measure") that are most suitable and appropriate for measurement during the construction project life-cycle.
- Develop a model ("how to measure") for the measurement and evaluation of the quality performances of the construction processes identified in (2) above as a tool for continuous improvement.

3. RESEARCH METHODOLOGY

The data for this research was collected through the use of four questionnaires targeting contractors and clients in the Bangalore (1) To identify the level of effectiveness in implementing managerial practices of TQM in the construction industry; (2) determine the areas or phases of construction with which the clients are dissatisfied, (3) use TQM tools to identify the major sub causes of client dissatisfaction areas and (4) finally develop an Improvement Index to determine the areas that need improvement.

Since no accurate information regarding the extent of TQM usage in the local construction industry was available, as a **first objective** of this research project, the applicants (contractors and subcontractors) were asked to identify the level of effectiveness in implementing managerial practices of TQM in their business. Questionnaires were developed to elicit information about quality management practices in their businesses. The questionnaire was divided into six parts namely: their knowledge of TQM, their perception of quality, the data acquisition methods used by them, the degree of training provided to their employees towards TQM, and the obstacles faced by them in implementing TQM in their businesses.

To achieve the **second objective**, a questionnaire called the Client Satisfaction Index was developed and was given to several clients and owners to get their feedback on the areas of dissatisfaction by conducting personal interviews with them. The questionnaire was divided into four parts namely: administrative, project management and engineering, construction and logistical. Each area had several activities, which were obtained from various technical papers, journals and existing projects. The clients were asked to identify the activities with which they are most dissatisfied. After reviewing their feedbacks, the major areas of client dissatisfaction were identified.

The **third objective** was achieved by developing a questionnaire using a TQM tool called the Fishbone Diagram or the Cause-and-Effect Diagram, was sent to several contractors and subcontractors to identify the important sub causes. A rating scheme of not important to very important was used to achieve this purpose.

The **fourth objective** of this research project was to identify the areas, which need a lot of improvement in order to achieve total quality in all the areas of construction life cycle. For this purpose a fourth questionnaire called the Improvement Index was developed and distributed to the same clients and owners who were interviewed for the questionnaire 2 (Client Satisfaction Index). The questionnaire was divided into five parts or areas of client dissatisfaction, which were identified from the second questionnaire. Under each area the most important sub causes that were obtained from the third questionnaire were highlighted. The clients were asked to identify the areas that need a lot of improvement. A rating scheme from a lot of improvement to no improvement was used for this purpose. The areas that need a lot of improvement are identified. The premise is that when those areas or phases are improved then we can attain continuous improvement in the construction industry. This process is repeated until all the areas are improved and our goal of total quality management is achieved.

4. RESULTS AND DISCUSSIONS

Phase 1: The following tables are the results gathered from Questionnaire # 1 - To identify the level of effectiveness in implementing managerial practices of TQM in the Construction Industry, which is composed of 36 questions and divided in six sections as follows:

- Knowledge of TQM
- Your perception of Quality
- Data acquisition method
- Quality in your organization
- Training
- Others

4.1 Knowledge of TQM

The analysis of this section tells us that the majority of the contractors perceive quality as a competitive advantage next to elimination of defects. They feel that that product / service quality is very important for them in gaining customers satisfaction because it ultimately translates to higher profits for them. They feel that customer satisfaction is their main goal. Interestingly however, when they were asked to rank in the order of importance the following attributes: Quality, Safety, Time, Cost and Scope; they ranked scope and cost as the important considerations followed by Timeliness, Safety and Quality.

4.3 Data Acquisition methods

The results of this section show that the majority of the companies do collect data to measure the performance of operations and the way they solve problems is assigning an individual to solve them. On the other hand, 52% of the companies have a system for gathering customer suggestions but just 28% measure customer satisfaction through questionnaire surveys. 20% gather customer suggestions by the number of complaints or other methods. In most of the cases the suppliers and the

subcontractor are rated (52%) and when defects in services are identified, they are required to pay for or correct them.

4.3 Quality in their organization

From this section, although only about 50% of the contractors surveyed had a clear definition of quality in their organizations, 86% are aware of the importance of quality. The majority of the respondents said that they do not have a formal. Quality Improvement Program (QIP) in place. Those that do, however, have the full support of their top management. Also, they use a mix of Quality Control, TQM and ISO 9000 principles in their QIP. Demanding customers, CEO commitment and competitive pressures were identified as the key reasons for implementing the quality improvement programs. Main objectives of the QIP are employee involvement followed by increasing productivity and cost reduction. 40% of the contractors felt that the quality of their products and services improved after implementing such a program.

4.4 Training

32% of the companies provide some to no training to their employees. Only 24% said that they provide formal training in TQM or other quality improvement philosophies. 44% of the contractors said that their managerial/supervisory staff have undergone quality improvement training. The number is even lower for non-managerial positions (29%). Training programs mostly emphasize customer satisfaction as a primary goal followed by teamwork and communication.

4.5 Others

The following shows the obstacles in the implementation of Total Quality Management Program most important to least important based on the data gathered.

- Changing behaviour and attitude.
- Lack of expertise/resources in TQM
- Lack of employee commitment/understanding
- Lack of education and training to drive the improvement process
- Schedule and cost treated as the main priorities
- Emphasis on short-term objects
- Tendency to cure symptom rather than getting to the root cause of a problem

Phase 2:

A second questionnaire focusing on the customer was created to identify the processes for improvement. It was called "Client Satisfaction Index" (Annexure B). A client survey is an invaluable aid in determining how well a construction company is doing in meeting customer's expectations. The real value of the survey was that it identified areas for improvement. The customer satisfaction index is the measurement of a company's overall performance in the eyes of its customers.

Client Satisfaction Index: This questionnaire was prepared after analysing the results of the first questionnaire and reference from books. The questionnaire was divided in four sections:

Administrative, Project Management and Engineering, Logistical and Construction. A rating scheme was used ranging from strongly satisfied to strongly dissatisfied.

Under the administrative section clients are dissatisfied with attention to client priorities (27.27%), and adequacy of planning (27.27%). Under the Project Management and Engineering section, the clients are dissatisfied with scheduling (36.36%). Under logistical problems, the clients are dissatisfied with adequacy of delivery (18.18%). Under construction related problems, the clients were mainly dissatisfied with adequacy of processing change orders (33.33%).

Cause and Effect Diagram: Based on the client satisfaction index, five sets of questionnaires using the Cause and Effect Diagram were developed to investigate the problems related to client dissatisfaction. They are:

1. Poor planning
2. Lack of attention to client priorities
3. Poor scheduling
4. Inadequate change orders processing
5. Poor delivery schedule and methods

Poor Planning

- Quality of Material
- Manage Change Orders
- Cash Flow Analysis
- Construction Underestimation
- Quality of Workmanship
- Damage to Equipment

Lack of Attention to Client Priorities

- Cost Control
- Quality Control
- Contractor-Subcontractor Coordination
- Conformance to Specifications
- Training of Personnel

Poor Scheduling

- Incomplete Design
- Site Condition Supervision
- Project Management Coordination
- Network Model Selection

Processing Change Orders

- Errors in Construction Design
- Defective Material/Equipment
- Weather Delays
- Design Changes by Clients

Poor Delivery

- Change Orders from Procurement Department
- Ambiguity in Methods
- Availability of Materials/Equipment's

Phase 3:

A total of five interviews were conducted with the same owners and clients who were interviewed for the Client Satisfaction Index and this was called Importance Index. This questionnaire was divided into five areas which were previously identified as areas of client dissatisfaction: Administrative - Poor Planning and Lack of Attention to

Client Priorities; Project Management and Engineering - Poor Scheduling; Construction - Processing Change Order and Logistical- Poor Delivery. A rating scheme was used from "A lot of improvement" to "No improvement".

From the results, we can determine that the clients' satisfaction level will increase with the improvement of the following processes.

- Construction Underestimation
- Cost Control
- Conformance to specifications
- Incomplete Design
- Project Management Coordination
- Design Changes by Clients, and
- Change Orders from Procurement Department

5. CONCLUSIONS and RECOMMENDATIONS

- The majority of the contractors agreed that TQM is a philosophy used to improve cost estimating and warranty claims. This shows their lack of knowledge about the TQM and the potential benefits in implementing this program in their organizations.
- The majority of the contractors perceive quality as a competitive advantage and the product/service quality is very important in order gain customers satisfaction to increase profit.
- The methods and techniques for implementing Total Quality Management program in the Construction Industry are still to be developed. The basic problem attributes to lack of expertise or resources for implementing quality improvement programs.
- Customer satisfaction can be greatly enhanced by improving construction underestimation, conformance to specifications, project management coordination, design changes by clients and change orders from the procurement department.
- The key to understand is that the client is now a moving target, their expectations and requirements are constantly changing. To keep up with their ever hanging goals, the contractors need to have in place a system of identifying, measuring and continuously improving their tangible and intangible products and services.

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