THE EFFECT OF TOTAL QUALITY MANAGEMENT ON CONSTRUCTION PROJECT PERFORMANCE

CASE STUDY: CONSTRUCTION FIRMS IN YEMEN

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Abstract

This study empirically examines the extent to which Total Quality Management (TQM) and project performance are correlated and the effects of TQM on project performance. In this study, a TQM framework is developed according to a comprehensive literature review. This framework demonstrates the relationship between TQM and construction project performance through examining the effects of nine TQM constructs on three element levels of project performance. The proposed model and hypotheses were tested by using data collected from Yemen construction firms. The survey covered 40 companies chosen from construction sector (30% of sample size). 29 questionnaires were returned. The response rate was 72.5%, normal for such research). The results of this aforementioned model support the proposed hypothesis (TQM has positive effects on teamwork satisfaction, quality of construction project implementation, client satisfaction, and construction project performance. Finally, this research culminates with TQM process for improving construction project performance, a discussion and the general conclusions are extracted in the light of the survey findings. The results finding are expected to provide useful information for future research directions especially as an indicator for the development of a suitable TQM framework for the construction firms.

Keywords: TQM framework, TQM constructs, project performance, construction in Yemen.

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1. Introduction

TQM is a philosophy with a system science point of view that focuses on continuous improvement within the organization so as to provide superior value to customers. The current generation of TQM concepts is based on the quality theory and approaches suggested by [12, 14, & 17]. The central theme of TQM stresses three principles, i.e. customer satisfaction, employee involvement, and process improvement. The rationale for conducting this research is the need to examine the effect of TQM in construction project performance and make TQM process to use it to improve construction project performance in Yemen, in identifying these effects as have been indicated in the literature in this area. A number of empirical studies reported the positive effects of applying the TQM paradigm in construction firms. Some researchers have examined the implementation of total quality management (TQM) and its positive impacts on organization performance [21, 29, & 30]. Equally, many empirical studies examine the effect of TQM in construction firms [1, 13, 23, 26, 27& 29].

What is the TQM process needed to improve construction project performance? So far there is no published research that answers this question. This study investigates this issue using data from construction firms in Yemen. Using empirical data collected from Yemen construction firms; this study aims to examine the effect of TQM on the performance of the construction project. It seeks to assist contractors in identifying the positive effects for the implementation of TQM and presenting aspects of TQM. More attention will be given to investigate the following: (1) To propose an effect framework (model) for TQM on construction project performance. (2) To examine possible steps for restructuring an organization for TQM.

The key research questions addressed in this study are (1) what is the effect of TQM on: Employee satisfaction, Quality of Construction project implementation, Client satisfaction, Construction Project performance? (2)What is the type of TQM model effect on Yemen construction firms? (3)What is the TQM process needed to improve construction project performance? This paper is organized as follows. Section 1 presents a
literature review and the conceptual model. Section 2 research methodology. Data analysis and discussion are provided in Section 3. Section 4 provides conclusions and finally, section 5 provides reverences.

1.1 Literature review and research model

Firms have arrived at the conclusion that effective TQM implementation can improve their competitive abilities and provide strategic advantages in the marketplace [5]. Several researchers also reported that TQM implementation has led to improvements in quality, productivity, and competitiveness in only 20-30% of the firms that have implemented it [9]. A study conducted by [25] indicated that a 90% improvement rate in employee relations, operating procedures, customer satisfaction, and financial performance is achieved due to TQM implementation. Some researchers have examined the implementation of total quality management (TQM) and its positive impacts on organization performance [20, 27 & 30]. In the research by Low [23] outlined the following basic framework for implementing TQM in construction firms namely: customer feedback system, continuous improvement, encourage teamwork, reduce number of suppliers, process management and improvement through productivity study, effective communication system, top management, review organizational culture, produce training plans, establish monitoring process.

The paper by Ahmed [1] pointed out how construction professionals implement TQM and its tools in their projects in the different stages (design and construction). From the results and conclusions from each case study included in this paper, it’s clearly now that TQM is not a fad and how much benefits that TQM can bring to your construction business (Improve business quality, increase customer satisfaction, reduce cost, save time and much more). The reason that the construction industry has arrived late to TQM is that the construction professionals unaware of the TQM principles and techniques. To bring these benefits to the construction industry, more efforts must be made to spread the culture of TQM among the construction professionals and TQM courses must be in the engineering under graduated programs.

The study by Rizwan [26] aims at analyzing the significance and willingness of contracting firms regarding implementation of (TQM) to
Pakistani construction industry. After analysis and statistical sorting of data were based on extensive industry surveys via questionnaires and one-to-one interviews with key contractors of the existing market. The current practices infer the average attitude of the contractors towards the importance of adopting TQM. The aspects that were targeted such as quality in the organization employee training, and organizational culture, seem to be slightly appreciable. Also partnering is known by almost everyone in the industry but they show a low response in this regard. Lacking of having a concise and exact definition of quality was also observed. The fragmented nature of the industry is a big hurdle in TQM application. Lack of education is also one of the reasons why TQM would fail. In addition, corruption, negligence and irresponsibility are also critical issues. Contractors are apprehensive in adopting TQM philosophy as they have a myopic view and are unable to realize its long term benefit. Implementing TQM requires a major organizational change that would transform the culture, process, strategic priorities and belief of an organization. Apart from commitment top management must educate its employees on the need of TQM so that it will help to reduce the amount of work for employees if they no longer need to attend the customer complaints and defect problems. In the research by [23] outlined the following basic framework for implementing TQM in construction firms namely: customer feedback system, continuous improvement, encourage teamwork, reduce number of suppliers, process management and improvement through productivity study, effective communication system, top management, review organizational culture, produce training plans and establish monitoring process.

In the paper by [9] indicated the importance of TQM implementation followed by continuous improvement, top management role, customer focus, and teamwork; and effort commitment is the most factor of organizational commitment.

Bhimaraya pointed the first outlines the imperatives of quality and its initiatives in the construction industry. Based on the comprehensive analysis and examination of existing TQM frameworks and literature, the paper proposes the 10 critical success factors (CSFs) of TQM for construction industry, namely, top management commitment, quality culture, strategic quality management design quality management, process management,
supplier quality management, education and training, empowerment and involvement, information and analysis, and customer satisfaction.

The research model in this study consists of 12 elements divided into two parts. The first part, TQM elements which contains the following elements (top management commitment, supplier quality management, construction project design, participation, recognition & reward, empowerment & involvement, design change, education & training, client focus). The second part contains: (client satisfaction, employee satisfaction, quality of project implementation & finishing). In this model there are four new elements two in first part; (construction project design and design change) and two in second part; (client satisfaction and quality of project implementation). See figure 2.

1.2 Research framework and hypotheses

The research model in this study consist of 12 elements divided into two part, TQM elements (top management commitment, supplier quality management, construction project design, participation, recognition & reward, empowerment & involvement, design change, education & training, client focus) and project performance (client satisfaction, employee satisfaction, quality of project implementation & finishing). See figure (1) below. In recent years, much research has been conducted on the effects of TQM implementation on project performance. Many researchers, in one way or other, have argued that it has positive effects on client satisfaction, quality of construction project performance, employee satisfaction, and project performance. [1, 23, 26, 30].

In order to achieve the objectives of this study the following hypotheses were developed:

TQM has an effect on client satisfaction
TQM has an effect on employee satisfaction
TQM has an effect on quality of construction implementation
TQM has an effect on project performance
2. Research Methodology

2.1 Research Instruments

The primary research instrument for this study is a literature review. The literature review identified what the concept of TQM is. Thus the first research question, “What is the concept of TQM?” was answered. Similarly, the literature review on all aspects of construction project performance identified what is important for measuring organization construction project performance. Thus, the second research question, “What is construction project performance within TQM?” was answered. The second research instrument is a questionnaire survey. A questionnaire survey can be used only when the objective of the study is clear and not complex [30]. In the area of TQM, much research has been conducted using questionnaire...
surveys to collect information [1, 5, 16, 20 & 30]. All of these researchers developed their questionnaire for data collection, and their questionnaire different from each other. After study all these questionnaire, it was determined that none fully met the requirement of this research. Therefore, it was necessary to develop a new research questionnaire. Based on there questionnaire survey and the concepts theoretical of TQM effect, and the 9 TQM affection constructs, questionnaire for this study were developed. Generally, questionnaires were used to obtain a large database of TQM with a low level of details. In this study, Based on the existing theories, deduces hypotheses from it, and proceeds to test these hypotheses. The questionnaire survey was used to obtain information about TQM affection and construction project performance from a wide range of Yemen construction firms. So the third research question-“What are the effects of TQM on: Construction project teamwork, Construction project product quality, Client satisfaction, Construction Project performance (In Yemen construction firm)" and four question "what is the type of TQM model effect on Yemen construction firms?" were answer by using questionnaire surveys.

2.2 Survey Sample.

Construction firms in Sana'a city were selected for investigation due to the city’s position as one of the most important city in Yemen; it’s the capital of Yemen, as well as for reasons of practicality and convenience perceived by the author. The type of samples and the number of firms were determined on the basis of meeting the information requirements for the research. In this research, all of the investigated firms were from Sana'a city, where there were more than 200 construction firms. Most of construction firms were found in Sana'a city Thus the samples from Sana'a city were enough for this research purpose. Although the selected samples were limited to construction firms in the Sana'a city, it was assumed that the samples from Sana'a city might represent the whole situation of construction firms in Yemen. Therefore, the research results might be generalized to all construction firms in Yemen. The ministry of public work and road provide the author with a firm name list. In Yemen, there were 219 construction firms classified in to 6 classes (class 1 to 6). There are 134 construction firms from classes (1 to 3) and a sample study was chosen from this classes. A sample of 40 construction firm was normally selected from the list
(30% of sample size). After the 40 firms were randomly selected, deliver 40 questionnaires by hand to the firms selected. Finally 29 questionnaires were return. The response rate was 72.5%, normal for such research. Of the 40 construction firms, they classified as follow: - 12 were first class, 10 were second class, and 7 were third class.

2.3 Measurement Evaluation

Table (1) below lists Cranach's alpha for different TQM effects scales. This table shows that the reliability coefficients ranged from 0.8985 to 0.9440, indicating that some scales were more reliable than others. Accordingly, the instrument developed for measuring TQM effects constructs was judged to be reliable.

<table>
<thead>
<tr>
<th>Scale address</th>
<th>NO. Of items</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Top management commitment and leadership</td>
<td>10</td>
<td>.8985</td>
</tr>
<tr>
<td>2 Employee empowerment and involvement</td>
<td>9</td>
<td>.9063</td>
</tr>
<tr>
<td>3 Employee participation and teamwork</td>
<td>11</td>
<td>.9078</td>
</tr>
<tr>
<td>4 Recognition and reward</td>
<td>12</td>
<td>.9046</td>
</tr>
<tr>
<td>5 Education and training</td>
<td>11</td>
<td>.9121</td>
</tr>
<tr>
<td>6 Change of construction design</td>
<td>6</td>
<td>.9440</td>
</tr>
<tr>
<td>7 Supplier quality management</td>
<td>11</td>
<td>.9121</td>
</tr>
<tr>
<td>8 Construction project design</td>
<td>9</td>
<td>.9069</td>
</tr>
<tr>
<td>9 Client focus</td>
<td>6</td>
<td>.9072</td>
</tr>
</tbody>
</table>

2.4 Descriptive analysis and Statistical Testing

Be described in this section, view and analyze the answers vocabulary of the study sample, where the discharge answers contained lists of resolution in the statements of the stomach, and the development marks corresponding to the opinion referred to by the respondent or interviewee in the questionnaire (study tool), according to a scale (Likert) gradually quintet, which allows five options for respondent in answer to paragraphs of resolution associated with the variables of study and of (b application of total quality management in construction companies - a case study
"construction companies in Yemen") so determines Category one answer for each paragraph of between 5 alternatives are available, namely, (strongly agree - agree - natural - I do not agree - strongly disagree) and to reverse those answers in the form of account numbers easily treated statistically, given her values, respectively(5.4.3.2.1). For the purpose of interpretation and discuss the results of statistical analysis of data collected, will be relying on that over the arithmetic mean of the response of the respondents, compared with a range of cells to likert scale (the length of cells of the scale) as a measurement standards upon which to assess the responses of the subjects that will be calculated in the following way: Upper and lower limits for the cell scale to be determined calculates the range (5-1 = 4) and then dividing by the number of cells of the scale for the length of the cell proper (4/5 = 0.80), is then add this value to the lowest value in the scale, which is equal to (1) to determine the upper limit for the first cell, and thus became the standard length of the cells as follows: Measure taken in the interpretation of responses of respondents to the paragraphs of resolution

![Table (2): The correlation the length of cells](image)

The researcher used center hypothesis for the study (3) is calculated from the following formula: \( U = (1+2+ 3+ 4+ 5) / 5 = 15/5 = 3 \)

Include resolution 102 items distributed in two parts the first part on the nine themes (leadership and commitment of top management - with a quality management - design construction projects - teamwork and participation of team work - recognition and reward - the mandate and the link for users - change the design of construction projects - Education and Training - Focus on customers), while the second part contains four axes (client satisfaction - quality of project implementation - construction teamwork satisfaction - performance of the project).
2.5 Model Testing

The hypothesized theoretical model consists of 9 TQM effects constructs and four construction project performance constructs, and includes 16 hypotheses that will be tested. The 9 TQM effects constructs are treated as directly observed or measured variables, which are independent. The values of each construct can be calculated by summing the scores of each item in that construct. Q1, Q2, Q9 are used to represent the 9 independent variables. There are four dependent variables: construction teamwork satisfaction, quality of construction project implementation, client satisfaction, and construction project performance. There are three items to measure construction teamwork satisfaction, seven items to measure quality of construction project implementation, two items to measure customer satisfaction, and five items to measure construction project performance. The four dependent variables can be represented as Y1, Y2, Y3, and Y4, respectively. see figure (2)
Figure (2): Testing the Theoretical Model of TQM effects Constructs and construction project Performance

Hypothesis was confirmed
Hypothesis was not confirmed
3. Data Analysis and Discussion

The researcher presented the results of the questionnaire analysis in bar chart and tables (graphs specified as per the questionnaire). see table (3).

Table (3): Data analysis of TQM elements

<table>
<thead>
<tr>
<th>Q. No</th>
<th>items</th>
<th>No</th>
<th>mean</th>
<th>Normative deviation</th>
<th>t-value</th>
<th>Degree of freedom</th>
<th>Sig.</th>
<th>Degree of accept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Top management commitment</td>
<td>29</td>
<td>2.8759</td>
<td>.6881</td>
<td>22.494</td>
<td>28</td>
<td>.000</td>
<td>Natural</td>
</tr>
<tr>
<td>2</td>
<td>Supplier quality management</td>
<td>29</td>
<td>2.9937</td>
<td>.4256</td>
<td>37.875</td>
<td>28</td>
<td>.000</td>
<td>Natural</td>
</tr>
<tr>
<td>3</td>
<td>Construction project design</td>
<td>29</td>
<td>3.4559</td>
<td>.4846</td>
<td>6.594</td>
<td>28</td>
<td>.000</td>
<td>agree</td>
</tr>
<tr>
<td>4</td>
<td>Employee Participation</td>
<td>29</td>
<td>3.0065</td>
<td>.5431</td>
<td>.063</td>
<td>28</td>
<td>.950</td>
<td>Nature</td>
</tr>
<tr>
<td>5</td>
<td>Recognition &amp; reward</td>
<td>29</td>
<td>3.0201</td>
<td>.7710</td>
<td>.140</td>
<td>28</td>
<td>.889</td>
<td>Nature</td>
</tr>
<tr>
<td>6</td>
<td>Empowerment &amp; involvement</td>
<td>29</td>
<td>2.8889</td>
<td>.5665</td>
<td>-1.056</td>
<td>28</td>
<td>.300</td>
<td>Nature</td>
</tr>
<tr>
<td>7</td>
<td>Project Design change</td>
<td>29</td>
<td>3.5000</td>
<td>.3908</td>
<td>6.889</td>
<td>28</td>
<td>.000</td>
<td>Agree</td>
</tr>
<tr>
<td>8</td>
<td>Education &amp; training</td>
<td>29</td>
<td>2.443</td>
<td>.6724</td>
<td>-4.419</td>
<td>28</td>
<td>.000</td>
<td>Disagree</td>
</tr>
<tr>
<td>9</td>
<td>Client focus</td>
<td>29</td>
<td>2.9598</td>
<td>.5953</td>
<td>-.364</td>
<td>28</td>
<td>.719</td>
<td>Nature</td>
</tr>
<tr>
<td>10</td>
<td>Client satisfied</td>
<td>29</td>
<td>3.4655</td>
<td>.7784</td>
<td>3.221</td>
<td>28</td>
<td>.000</td>
<td>Satisfied</td>
</tr>
<tr>
<td>11</td>
<td>Employee satisfied</td>
<td>29</td>
<td>4.5977</td>
<td>.4119</td>
<td>20.887</td>
<td>28</td>
<td>.000</td>
<td>Nature</td>
</tr>
<tr>
<td>12</td>
<td>Quality of construction project Implementation</td>
<td>29</td>
<td>3.0246</td>
<td>.4371</td>
<td>.303</td>
<td>28</td>
<td>.764</td>
<td>Nature</td>
</tr>
</tbody>
</table>

The questionnaire finding revealed that top management commitment & leadership has positive effect on employee satisfaction (p<0.05).
The mean response for the questionnaire survey was (2.8) that means the top management lack the knowledge of the concept of TQM. The reason for this in the flowing: - most of construction firm are private company and the top management is Owner Company and there is not a great deal of learning and does not have any experience. Also the results show that the top management has great effect on employee satisfaction. According to the results of interviews, leadership is the third most important factor affecting employee satisfaction.

The questionnaire finding revealed that supplier quality management has positive effect on client satisfaction (p<0.05). There is long-term cooperative relation with supplier but this relation does not based on product quality. It based on low price. Most of company deal by debt with supplier so the result will be poor product quality. Suppliers that can produce high quality products always require buyers to pay immediately. The interviewed firms did not have sufficient money for immediate payment. So for these firms it was not necessary for them to participate in supplier quality management if suppliers could provide high quality products. The mean response for the questionnaire survey explains that where the mean was (2.9). The absence of state control will have a maximum effect in the absence of availability of quality product and limited purchasing power of many of the client.

The questionnaire finding revealed that project design has positive effect on quality of project implementation (p<0.05). The mean response for the questionnaire survey was (3.5) that Means Company paid much attention to produce quality design, and that comes through reviewing project design before construction at side and make preliminary project design. The most common important component for producing quality project is the coordination and participation among the various departments in project development. This gives an indication that company focuses on client, and trying to produce quality project.

The total mean for the scale 4 employee participation was (3.5) equal the assumed mean (3). This questionnaire survey data provided no significant statistical support for the hypothesis that participation &
teamwork have a positive effect on employee satisfaction. The following points explain that:

1. Employee participation in their respective firms was actually “forceful” and not based on the free will of the employees.
2. Decisions made individually by the top management only
3. In most companies owner of the company is its director, and Most of the employee recommendations and views are ignored.

The total mean for the scale 5 recognition & reward participation was (3) equal the assumed mean (3). The questionnaire finding revealed that recognition & reward have positive effect on employee satisfaction (p<0.05). In construction industry in Yemen we need to implementation the policy of recognition and reward. This policy includes for example public recognition, salary increasing, promotion, bonus, non-monetary rewards (non-material rewards). Questionnaire survey response shows that reward and recognition is absence because the following: - Focus on Individual performance, related evaluation, Reward practices.

The total mean for the scale 6 empowerment & involvement was (2.8) less of the assumed mean (3). The questionnaire finding revealed that empowerment & involvement has positive effect on employee satisfaction (p<0.05).

Decisions made individually by top management only, Most of the employee recommendations and views are ignored and In most companies owner of the company is its director

The questionnaire finding revealed that change design has negative effect on employee satisfaction (p<0.05). The mean response for the questionnaire survey was (3.5). That means change of design makes effect on employee reflected in low of employee production and employee interaction with work. Some of Yemen construction problem related to change design like project late finishing, decrease quality. It should be emphasized that special program for employee to deal with design change is very necessary.

The questionnaire showed revealed that education & training have positive effect on employee satisfaction (p<0.05). Employees had the
capacity to do their jobs better. But they need training and education to make use of this capacity. In Yemen construction firms the mean response for the questionnaire survey was (2.4) that is means education and training are lack in this firm. The reasons for this are: - Work in most companies relies on local materials, little profit and training need spending money and the company is not willing to do this, and Lack of financial resources. The questionnaire finding revealed that client focus has positive effect on employee satisfaction (p<0.05). The mean response for the questionnaire survey was 2.9 that mean there is some interest by company to focus on the clients. This interest shown in that is company provides warranty on our project implementation. Client focus needs to collect extensive complaints and conduct client satisfaction survey.

4. A framework of TQM

The framework of TQM was formulated on the basis of the theoretical model of TQM effects constructs and construction project performance. The combination of the elements of TQM and construction project performance was the framework of TQM, which is displayed in Figure (3).

![Figure (3): a framework of TQM effects](image-url)
5. Process of TQM Model Effect

This section provides processes of using the TQM effects model in practice. Figure (4): displays the primary processes of affects TQM, consisting of four steps.

- **Top management commitment**
- Form team to communicate TQM to whole firm
- Formulate plan for (training - education - reward - participation - monitoring - special program for change design)
- Employee external consultant (optional)
  - depends on firm's own resource

**Step 1**

**Plan**

**Step 2**

Implement formulate plan

**Step 3**

Observe and check results

**Step 4**

Investing & analyze results

**DO**

**Act**

**Check**

Figure (4): Total Quality Management Process for improve construction project performance.
6. Conclusion

From the data collection it can be shown that the concept of TQM in most Yemen construction firms is absence.

What is the effect of TQM on construction project performance? Data analysis for this study shows that the TOM has positive effects on construction teamwork satisfaction, quality of construction project implementation, client satisfaction and construction project implementation. So TQM can increase the performance of construction project by reduce time and cost and increase the quality of project implementation. These results assist contractors to identifying the positive effects for the implementation of TQM on project performance.

Top management commitment and leadership, empowerment & involvement, participation, recognition & reward, education & training, and change design has positive effect on employee satisfaction and top management commitment, employee participation and teamwork does not have positive effect on construction project performance. Supplier quality management has positive effect on client satisfaction. Design of construction project and client focus has positive effects on quality of construction project implementation. This result specified the type of TQM model effect on Yemen construction firms.

Data analysis show that, top management does not learn most of TQM concepts, low salary, incentives and training almost non-existent, poor quality of imported materials. These results assist author to identifying TQM process needed to improve construction project performance.

The more finding of this research are; project teamwork satisfaction has positive effects on client satisfaction and on construction project implementation and does not have positive effects on quality on construction project performance, quality of construction project implementation has positive effects on client satisfaction and construction project implementation, Client satisfaction does not have positive effect on construction project implementation.

Finally, validity and reliability of instruments measuring total quality management and performance of the project in this study that can be used by other researchers to measure the impact of the application of total quality management in construction projects.
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7. Recommendations

Some recommendations outlined in the existing literature may have been more appropriate to applied TQM. Based on the study of the Yemen construction case, the following recommendations can be emphasized for Yemen construction industry to improve construction project performance.

1) Allocating a percentage of the company's profits for training and education programs.
2) Establishing a team from inside or outside the company for training and education of employees and to work out special programs to deal with the requirements of design changes.
3) Devote at least 4 hours a month for education and training.
4) Making lists graded of rewards (for bonuses and incentives).
5) Give more freedom for employees to make decisions on their jobs and should be encouraged to propose solutions for problems which arise during work.
6) Adopt a policy of product quality for the formation of long-term relationships with suppliers.
7) Administration's choice should be done through efficient and effective mechanisms proposals.
8) Organize training course for top management in TQM concepts.
9) Top management must participate in quality management activities.

8. References


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