An Overview of Total Quality Management (TQM) practice in Construction Sector

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Abstract. In construction sector TQM can be termed as a philosophy which guides construction professionals on the proper execution of construction projects in terms of quality. The aim of this paper is to discuss on quality management practice in construction sector. This paper evaluated five previous researches and the findings were discussed to find a conclusion of TQM practise in construction sector. The study found that TQM had been successfully practice in construction sector at Saudi Arabia, India, US and South Africa. Application of Artificial Neural Network (ANN) help to improve the implementation of TQM in construction sector. In conclusion, quality management practices will give better control of processes in construction sector.

1. Introduction

These guidelines, ineffectiveness in industrial atmosphere has improved considerably and, as a direct concern, the search for different procedures and organization practices to achieve better performance in all processes have been a major concern for organizations involved in setting its global market presence [1]. In order to survive with progressively more powerful competition, industrialized companies have been repeatedly trying to expand their operations with specific needs [2].

TQM is termed a philosophy involving all organization in an industry toward making some improvement in term of performance. It including all aspect of a business that can results a quality of objective [3]. TQM in construction firm is a distinct eye that needs to be given utmost seriousness in any construction project. During preceding years construction industry has faced critiqued for its deprived manufacture and output compare to other businesses [4].

According to Erande & Pimplikar [5], TQM covers all activities of integrating all procedures, measures, structures and products to achieve excellence in the project. The level of improvement, establish in construction industry by clients is that, it's projects excited within stipulated time, of the budget and, free defects with, efficient, safe and by worthwhile companies [6].

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The aim of this paper is to overview whether the implementation of TQM in construction industry can prove effective in wining considerable market share, increased company reputation, achieving customer delight which is one step ahead of customer satisfaction. As stated by Christopher [7] implementing TQM in construction industry time and cost overrun could be reduced, employee satisfaction could be achieved, continuous improvement and most important the sustained growth of an organization.

2. Methodology

To achieve aim of the paper, literature review of previous studies on TQM in construction industry was listed and summarized. The results of the studies were discussed and compared.

3. Application of TQM in construction sector

Table 1 shows summary and contributions of previous researches on TQM to construction sector. It shows six previous researches that applied TQM in construction industry. Details on the research were discussed in sub topics below.

Table 1. Summary TQM application in construction sector.

Author/Year	Title	Purpose	Findings
Faihan et al. [9]	Relationship Between Total quality Management Practices and Contractors Competitiveness	Purpose was to ascertain correlation among TQ management tradition as well as contractors competitiveness	Examine the correlations among diverse total quality management traditions with competitiveness
Jha and Chockalingam [10]	Prediction quality performance using artificial neural network, with evidence from Indian construction project.	The purpose was to allow construction project team members to comprehend the factors that must closely observe complete projects with an anticipated quality and to predict quality performance of a project.	Investigates answers and conclusions, and factors including, project manager's competence, observing and response of project participant, good direction between project participant and availability of taught resources significantly affects quality performance criterion.
Erande and Pimplikar [5]	TQM in Indian construction industry	Is for transforming customer needs into proper technical requirements for each stage of process development.	Study is conducted in quest of finding solutions for TQM implementation in construction industry
Harrington et al. [8]	Applying total TQM to the construction industry	Purpose explained quality and output problems with progress opportunities sighted in construction industry.	It concludes to show lack of good research to improve approaches in construction work as an undesirable profession, also determines a slow change from quality control (QC) to total quality management (TQM).

Joubert et al. [2]	The implementation of total quality management system profit South African construction companies.	Purpose was to explore reasons for poor quality South African construction industry and if implementation of a TQM system will improve the situation.	Workers in South Africa construction industry do not have adequate training to deliver the anticipated results

3.1. Relationship among TQM Practices and Contractors Competitiveness within Saudi Arabia.
Al-Fedaghi and Faihan [9] stated that TQM indicate mainly on approaching constant operational achievements using service of client's contentment. The study had identify relationship regarding TQM traditions and contractor's competitiveness in construction industry within Saudi Arabia. Inquiry in the research conducted ranked regression examine dealings among different total quality management practices. The factors examined includes TQM traditions, quality culture and competitiveness.

Table 2. Reliability analysis of total quality management practices factors.

Variable	Factors	No.of objects Before reliability	No.of objects after reliability	Alpha earlier reliability	Alfa later reliability	General reliability
Total quality management practices (TQMP)	ET	4	4	0.930	0.930	0.855
	CF	6	4	0.566	0.851	
	IA	6	4	0.637	0.854	
	CI	3	3	0.806	0.806	
	PM	6	4	0.591	0.831	
	ER	8	7	0.669	0.759	
	TMC	6	4	0.388	0.951	
	MS	4	4	0.953	0.953	
Total	8	43		4		

The TQMP flexible contained eight aspects namely Customer Focus (CF), Education and Training (ET), Continuous Improvement (CI), Information and Analysis (IA), Employee Relation (ER), Top Management Commitment (TMC), Process Management (PM) and Management Supplier (MS). In the positions of TQMP, the results of the tests are shown in the table 2. It is realised that all items for Continues Improvement (CI), Education Training (ET) and Management of Supplier (MS) are included. Though, item CF5, CF6, IA5, IA6, PM5, PM6, ER8, TMC5 and TM6 are not included because it makes the construct unreliable. Result shows that all factors are reliable with Alfa value more than 0.7 and the overall reliability value of 0.855 respectively. Then, factor analysis was run in study using Principal Component Analysis (PCA).

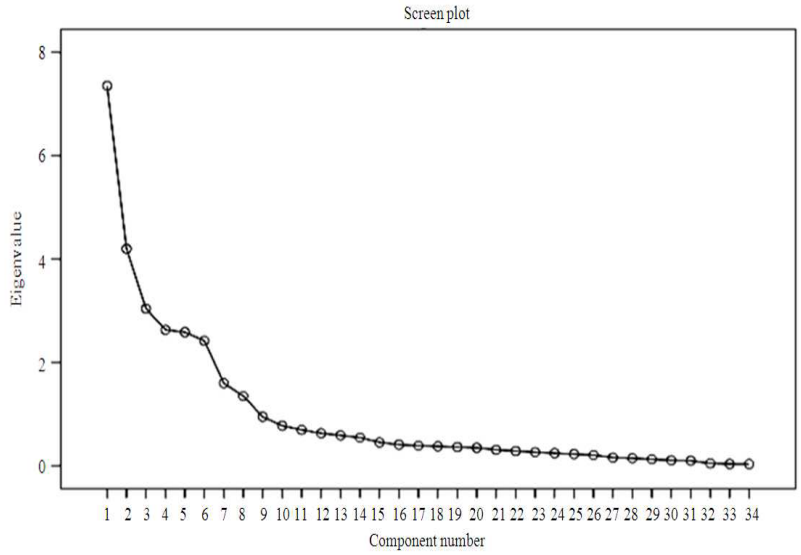


Figure 1. Screen plot of quality management practices

Figure 1 reveals the results where screen plot declines steeply downward from one factor to seven factors before it gradually becomes a nearly horizontal line.

Table 3. Summary of relationship of variables.

		Competitiveness practices	Total quality management practices	Quality culture
Competitiveness	Pearson correlation	1000	0,412	0.353
	Sig. (2-tailed)		0.000	0.000
	N	388.000	388.00	388.000
Total quality management practices	Pearson correlation	0.412**	1.000	0.762**
	Sig. (2-tailed)	0.000		0.000
	N	388.000	388.000	388.000
Quality culture	Pearson correlation	0.353**	0.762**	1.000
	Sig. (2-tailed)	0.000	0.000	
	N	388.000	388.000	388.000

Table 3. Correlation analysis is term as statistical method accepted in defining the influences with approach taken by linear link among double diverse variables. It's obvious, TQMP is linked to competitiveness. The relationship constant standards among the two was found to be 0.412, which can be called positive modest relationship at the given levels whereby ($p<0.01$). As an important positive relationship exist, consequently, comes a support for the hypothesis.

3.2. Prediction of quality performance using ANN

Jha & Chockalingam [10] investigate factors which must closely be observed to complete projects with a desired quality and forecast quality performance during the progress of a project. Quality is one of the main concerns of clients in construction projects. The research talks about an addition in the former research in which 55 project performance aspects were analysed according to experienced idea and literature survey which after investigation 20 factors were achieved (11 success and nine failure).

The results shows factors as project manager's competence, good direction between project members and opportunity of trained resources greatly alter quality achievement principle. However, outcome of the second phase sampling survey was used to establish the quality performance prediction model according to artificial neural networks (ANN). Therefore, best prediction model was found to be 5-5-1 which was 5 neurons in input layer, 5 neurons in hidden layer and 1 neurons in output layer. The model was developed using feed forward neural network based on back propagation algorithm. Validation result showed that the model was in very good performance with mean absolute percentage deviation (MAPD) of 8.044%.

3.3 TQM programs in India construction sector

Erande and Pimplikar [5] shows transforming customer needs into proper technical requirements for each stage of process development in construction industry. The study was conducted in quest of finding solutions for TQM implementation in construction industry in the figures below.

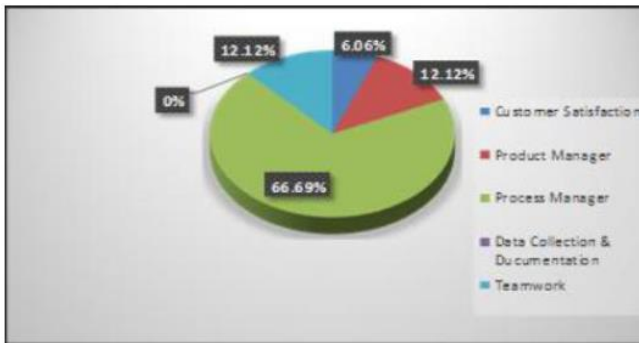


Figure 2. Percentage of training in TQM.

Figure 2 shows the percentage of training in TQM for questionnaire was sent to 100 people of 20 different construction firm and 25 respondents. The result shows the process in management holds a key position as far as training is concerned with 69.69% compare to product management with 12.17%, customer satisfaction with 12.12%, and teamwork with 6.06%, data collection and documentation 0% but the rest factors are on neglected side, which are also important for successful completion of project.

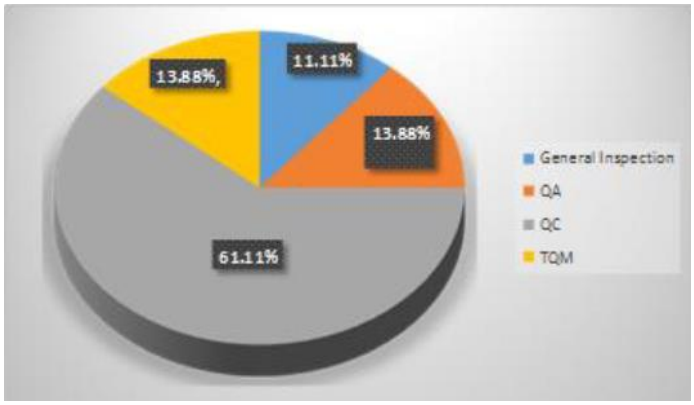


Figure 3. Quality improvement programme.

Figure 3 shows the quality improvement programme which only 13.88% of respondents implement TQM on their project. This means construction industry shareholders on a very large scale are not aware of TQM and benefits to the construction industry. Therefore construction industry needs attitude to change by increasing benefits of TQM adoption in the industry.

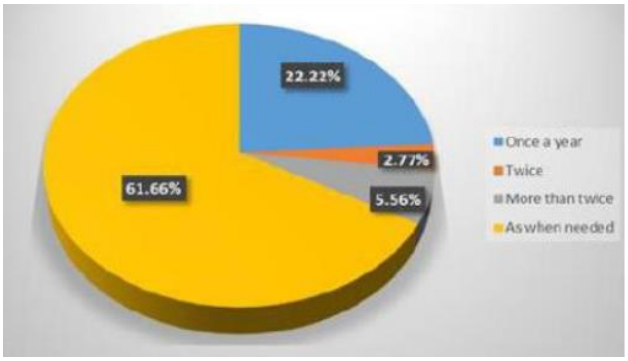


Figure 4. Frequency of training.

Figure 4 discussed on frequency of training analysis was confirmed even knowing that training is a motivating factor for successful project. The result shows; Once in a year 22.22%, twice 2.77%, more than twice 5.56%, as and when needed 61.66%, it happened because one quarter of shareholders in the construction industry do not take training on regular basis which is necessary to be replaced with regular training programs to be planned.

3.4. Applying total TQM in construction sector

Harrington et al. [8] describes TQM in broad and basics of the TQM that can be useful to the construction industry. TQM concept been addressed in this paper is about member, disciplined, and organized approach to improve process in construction sector. In addition, the TQM elements to succeed in the implementation of quality management in this study include the following components; (1) Leadership and management commitment; (2) Training; (3) Communication; (4) Teamwork; (5) Customer satisfaction; (6) TQM and measurement; (7) Continuous improvement; (8) Process improvement; (9) Focus on employee; and (10) Supplier involvement.

3.5. Implementation of TQM in South African construction sector

Jourbert et al. [2] shows that quality management in South African construction sector has been below average which was an evident in the reports of poor project performance. In order to become more competitive, a company needs to be extra proactive. One way to achieve this is by improving the quality of the company's product.

The study indicate that more research is needed concerning quality management in the construction industry to assist in relieving other problems that deluge the South African construction industry such as poor performance, safety, cost, time, and poor traditional practices.

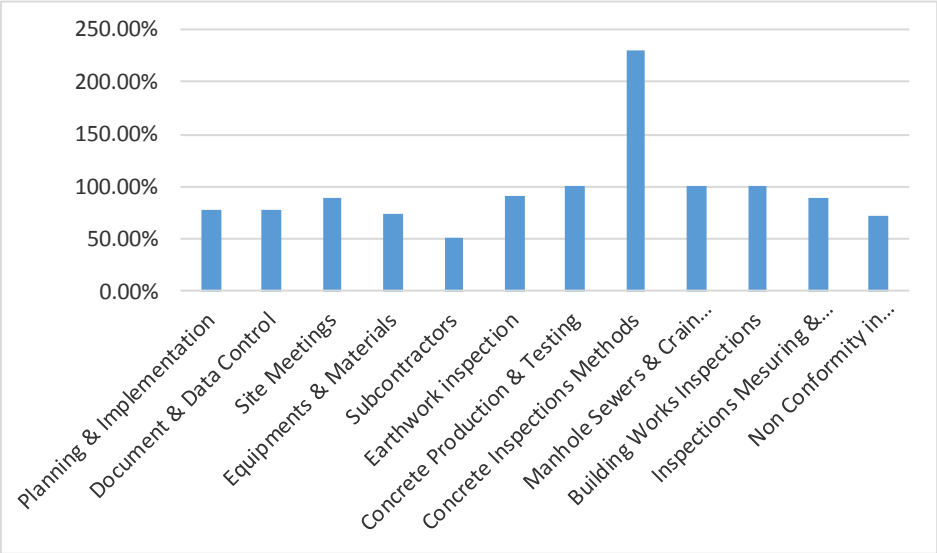


Figure 5. Audit results.

Figure 5 shows audit results on quality management fundamental business imperative for construction companies in South Africa. The graphical sketch of an audit conducted by the main contractor indicated the highest score was in concrete inspections and the lowest score was from sub-contractor performance.

The client was updated regularly on the performance of the project, through agents and project reports. The existence of a designed system for recording and correcting non-conformances boosted the client's confidence in the contractor's ability to control the risk of poor quality.

Table 4. Audit results.

Assessment	Percentage (%)
Non-compliance to system and processes	70 %
Partial compliance to system and processes	100 %
Compliance - room to improve	150 %

Table 4 audit result indicate non-compliance with 70%, boosted the client's confidence in the contractor's ability to manage the risk of poor quality to system and processes. Partial compliance to system and processes with 100% Employees were sent on training courses to improve their knowledge and management skills. Compliance - room to improve with 150%.

Therefore, one of the shortage identified was that the staff did not fully understand the impact of quality management. This was overcome by showing the employees a record of their non-conformances and how much they had cost the company and it was presented to them how a collaborative effort between themselves and the quality department would not only reduce non-conformances but would lead to improved performance in terms of quality of work and delivery time.

5. Results and discussion

Quality management is achieve through training, good communication and customer satisfaction in construction sector. Factors examined includes TQM performance, excellence philosophy and competiveness. ANN Application in construction engineering shows a significant benefits that makes it a powerful and practical tool for solving problems in the field of construction engineering and expected to be applicable in future. TQM programs using ANN in India shows that the processes in management holds an important position as far as training is concern. Proper usage of quality construction elements shows that, one of the lacking identified was staff do not understand the impact

of TQM on a project and therefore did not see the real value of the system. It was however, overcome by showing the employees records of their non-conformance and how much it cost the company.

The quality of construction projects in South Africa has been below equality. The outcome of the study using an experimental study of middle- line managers in the US and Taiwan dealt with supply chain competencies and resulted in achieving quality management effects on organisational performance. Indian construction companies faced tremendous amount of competition from their counterparts across the globe. Indian companies need to show huge competitiveness from conception to completion.

The study also identify the relationship between total quality management practices and contractor's competitiveness in construction industry in Saudi Arabia showed repeated training to staff, good communication with customer satisfaction is a parameter leading to good and quality management practice to construction sector.

6. Conclusion

In conclusion, the outcome of the reviewed literature revealed that when quality management practices, quality culture and competitiveness are fully implemented there will be better control of processes in construction sector.

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