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Study on Key Determinants for TQM Adoption in Construction Practices: An Indian Perspective

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Abstract: The purpose of this paper is to explore the factors that influence the implementation of TQM practices in the construction industry. The study was conducted in Tamil Nadu from June 2015 to January 2016. The researchers used a random sample approach to collect data from participants. A questionnaire-based approach was chosen to collect information from participants. Statistical tools such as Cronbach's Alpha, exploratory factor analysis, multiple regression, correlation, standard deviation, and coefficient variation were employed in the study. Nine crucial dimensions of TQM implementation were identified: customer-oriented factors, organizational culture factors, internal communication factors, supplier-related factors, employee participation factors, employee development factors, employee training factors, availability of equipment factors, and process improvement factors. TQM implementation is influenced by a number of factors, including but not limited to customer-oriented factors; organizational culture factors; employee participation factors; employee development factors; availability of equipment factors; and process improvement factors. The study found that TQM implementation is driven by customer-oriented factors. Among engineers and project managers, the focus on customer-oriented factors was the highest. The results of this study can be used to inform policy makers, helping them create effective TQM policies in the construction industry.

Keywords: Dimensions, Statistical analysis, Implementation, Total Quality Management

1. Introduction

In the current fiercely competitive business landscape, any successful enterprise continues to prioritize the pursuit of quality above all else. Careful planning and efficient management techniques for these goods and services are necessary to meet this objective. This holds true for both the domestic market and the overall economic growth of a country. There is a strong demand for providing clients with high-quality goods and services, particularly in the

construction industry. Consequently, the building sector is the backbone of any nation, making a substantial contribution to the infrastructure and overall growth of the nation.

Nonetheless, the construction sector faces issues common to developing nations, including low productivity, a lack of standards, and poor-quality products. According to quality management is essential to managing construction projects successfully [1].

Ensuring that a product or service continually meets or exceeds customer expectations is the fundamental focus of quality management. It is a business management strategy designed to maximize organizational benefits by continuously improving processes, labour, services, goods, and the environment. Because quality management is a management-centric endeavour, attaining quality management requires complete and active engagement from every member of the company, guided by the management team [2].

One important management strategy for consistently raising the caliber of products is total quality management, or TQM. Quality inspection (QI), followed by quality control (QC), quality assurance (QA), and finally total quality management (TQM) is the current state of quality management [3].

The economic and performance success of any firm is impacted by the effective implementation of Total Quality Management (TQM). Numerous advantages and enhancements result from this implementation: decreased costs, decreased production time, decreased goods damaged in transit, improved customer perceptions, decreased defects and errors, minimized waste, increased sales and productivity, higher profits, expanded market share, improved relationships with suppliers, increased employee and customer satisfaction, and consistency [4-7].

2. Literature review

Numerous studies that shed light on the variables influencing the implementation of Total Quality Management (TQM) and its connection to organizational performance are included in the literature on TQM.

Identified 54 obstacles hindering successful TQM implementation. These obstacles include ineffective TQM packages, inappropriate implementation methods, and unsupportive environments, emphasizing the need for managers to address these barriers for TQM programs to positively impact organizational performance [2].

A conducted a study focusing on the critical success factors for TQM implementation in the construction industry, particularly in the Gaza Strip. Continuous improvement emerged as the most crucial factor among the 7 identified critical success factors, comprising 38 sub-factors, emphasizing its significance for successful TQM implementation [8].

Highlighted the importance of leadership competencies in implementing TQM, emphasizing that while management commitment and leadership are crucial, there lacks consensus on specific leadership competencies necessary for successful TQM implementation. Leadership's role extends beyond formal power, creating an environment conducive to change through interpersonal relationships and influence [9].

Chapman & Al-Khawaldeh (2002) researched the relationship between TQM implementation and labour productivity [10]. The study revealed that companies with high levels of TQM implementation exhibited significantly higher labour productivity compared to those with lower levels of TQM implementation. Regression analysis indicated a positive linear relationship between TQM and labour productivity, with a more pronounced effect in organizations with ISO 9000 certification.

Zakuan et al. (2012) emphasized the significance of training in boosting employees' efforts towards improvement [11].

Identified critical factors and performance measures of TQM, likening TQM implementation to constructing a house. Top management commitment served as the foundational element, followed by employee training, quality measurement, process management, and customer involvement, forming the pillars of successful TQM implementation.

These studies collectively underscore the multifaceted nature of TQM implementation, emphasizing the pivotal role of leadership, continuous improvement, training, and various critical factors in achieving successful TQM outcomes and enhanced organizational performance.

3. Project Research Model

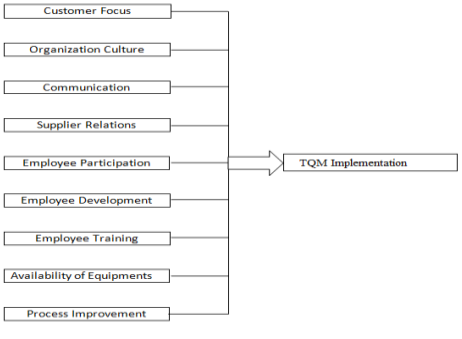

Figure 1. Schematic of proposed research model.

This study is approached with the following proposed research model as shown in the Figure 1.

3.1. Objectives

This study was confined to the following objectives:

1. To evaluate Total Quality Management's (TQM) effects on the building sector. This entails investigating the ways in which the use of Total Quality Management (TQM) procedures impacts a range of factors, including output quality, customer satisfaction, productivity, efficiency, and overall project performance.

2. To gauge how various dimensions and TQM implementation relate to one another. To successfully implement TQM principles in construction practices, this objective entails assessing the relationships or connections between a variety of factors, including leadership commitment, employee training, customer focus, process improvement, and other pertinent TQM dimensions.

3. To pinpoint the precise elements that affect how Total Quality Management is applied in the building sector. This goal is to identify and comprehend the critical components or variables that have a major influence on the effective application of TQM principles, particularly in the context of building projects.

3.2 Project hypothesis

H0: There is no significant impact on customer focus on TQM implementation.

H1: There is significant impact on customer focus on TQM implementation.

H2: There is no significant impact on Organization Culture on TQM implementation.

H3: There is significant impact on Organization Culture on TQM implementation.

H4: There is no significant impact on Communication on TQM implementation.

H5: There is significant impact on Communication on TQM implementation.

H6: There is no significant impact on Supplier Relations on TQM implementation.

H7: There is significant impact on Supplier Relations on TQM implementation.

H8: There is no significant impact on Employee Participation on TQM implementation.

H9: There is significant impact on Employee Participation on TQM implementation.

H10: There is no significant impact on Employee Development on TQM implementation.

H11: There is significant impact on Employee Development on TQM implementation.

H12: There is no significant impact on Employee Training on TQM implementation.

H13: There is significant impact on Employee Training on TQM implementation.

H14: There is no significant impact on Availability of equipment on TQM implementation.

H15: There is significant impact on Availability of Equipment on TQM implementation.

H16: There is no significant impact on Process Improvement on TQM implementation.

H17: There is significant impact on Process Improvement on TQM implementation.

3.3. Scope

The scope of the study is limited to site supervisors, site engineers, and managers involved in construction projects specifically within Tamil Nadu. The purpose of the study is to compile information, viewpoints, and insights from these roles in Tamil Nadu's construction industry. In the context of building projects in the Tamil Nadu region, the study aims to comprehend the experiences, obstacles, attitudes, and contributions of site supervisors, site engineers, and managers toward the adoption of Total Quality Management (TQM) concepts.

3.4. Period of the study

This study was conducted during the period of June 2015 to January 2016.

3.5. Data collection method

A questionnaire was used as the major data gathering tool in this investigation. The questionnaire was divided into three sections: the first part asked questions about the respondents' demographics; the second part contained variables about TQM implementation in the construction industry; and the third part contained variables about TQM implementation specifically.

3.6. Construct Development

To develop the constructs, previous works by researchers such as Oruma et al., (2014), Mosadeghrad (2014), Altayeb & Alhasanat (2014), Das et al., (2011), Motwani (2001), Bhat & Rajashekhar (2009) were referred to, with modifications made to suit the present study's requirements [2, 8, 9, 13, 14].

3.7. Descriptive statistics

Descriptive statistics were used to analyze the demographic profile of the respondents, considering factors like experience level, organization type, and types of construction projects. Out of 230 surveys distributed, 129 valid questionnaires were collected, resulting in a response rate of 42%. Most respondents had 24% experience, were male (129), from private sectors (89.9%), and engaged in residential projects (48.1%).

3.8. Sampling Method

In the absence of a sampling frame, the district headquarters' builders' associations were contacted as part of the sampling procedure. Based on data from the association, some of the construction projects were selected randomly, and respondents were mailed with the questionnaire. Only 129 legitimate questionnaires were received from the respondents despite several attempts, resulting in a 42% response rate

3.9. Pilot study

Prior to administering the questionnaire, a pilot study was conducted to validate the questionnaire, and modifications were made based on feedback received from construction engineers, supervisors, and managers.

3.10. Content validity of questionnaire

For content validity, a committee comprising TQM experts and academicians reviewed the questionnaire, incorporating necessary changes based on their suggestions.

3.11. Analysis and discuss

3.11.1. Reliability statistics

Coefficient alpha scores were calculated to assess the reliability of the PubhosQual scale. The alpha values for various dimensions related to TQM implementation were found to be well above the recommended criterion of 0.863 by Nunnally (1978), indicating high reliability for the scale used in the study as given Table 1.

Table 1. Reliability Statistics

Cronbach's Alpha	N of Items
.863	28

3.11.2. Determinants for a successful Total Quality Management implementation

Factor analysis was employed to identify overarching determinants influencing the success of Total Quality Management (TQM) implementation. The Kaiser-Meyer-Olkin measure of sampling adequacy yielded a satisfactory value (KMO 0.764), indicating the dataset's suitability for factor analysis as shown in Table 2. Additionally, Bartlett's Sphericity test resulted in a highly significant level of .000, confirming the appropriateness of the variables for factor analysis. Thus, all the prerequisites for conducting factor analysis were met. The extraction technique utilized was principal components, and the rotation method employed was varimax.

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.764
Bartlett's Test of Sphericity	Approx. Chi-Square	1070.635
	Df	378
	Sig.	.000

Table 3. Determinants that precede quality management practices in the construction sector.

	Loadings	Initial Eigen values	Variance explained	Percent of variance	Cumulative Percent
Customer Focus					
Continuously assessing& improving administrative programs	0.711	6.317	22.562	11.147	11.147
To meet customer needs expectations	0.603				
Timely response to customer quality	0.656				
Customer needs in developing services	0.468				
Long-term relationship with suppliers	0.610				
Organization Culture					
Your organisation has a flexible culture	0.655	2.098	7.492	8.100	19.247

Organisation has a quality mission & policy	0.699				
Top management provides leadership	0.688				
Continuously improving process for quality services	0.711				
Communication					
Well-developed internal communication	0.686	1.696	6.058	7.634	26.881
Free flow of quality management between departments	0.532				
Organisational culture encourages to company policy and law	0.497				
Supplier Relations					
Feedback on performance of product &	0.542	1.618	5.780	6.830	33.710
Regular inspection and reviewing of work	0.654				
Critical resources required in implementing quality	0.719				
Timely supply of material to site	0.480				
Employee Participation					
Employee's idea on quality	0.729	1.502	5.365	6.519	40.229
Supplied material fulfil required standards	0.703				
Top management participation in all levels of QM	0.640				
Organisational culture on control	0.660				
Employee Development					
Timely information about quality needs	0.702	1.201	4.289	6.252	46.481

Employees participation in decision making	0.573				
Employee Training					
Well-developed equipments used	0.762	1.189	4.247	5.927	52.409
Right person for right job	0.621				
Availability of Equipments					
Assessment of supplier on quality	0.579	1.105	3.947	5.609	58.017
Employees in are frequently trained on TQM	0.747				
Process Improvement					
Periodical updating of equipment	0.494	1.014	3.621	5.344	63.362
Top management committed to quality	0.691				

Initially all the 28 variables were used. After rejecting those items that have insufficient loadings, we deduced to nine factors. The identified factors explain percent of total variance. The factors are named as follows (Table No 3)

1. Customer Focus
2. Organization Culture
3. Communication
4. Supplier Relations
5. Employee Participation
6. Employee Development
7. Employee Training
8. Availability of Equipments
9. Process Improvement

3.11.3. Impact of various factors on TQM implementation

Multiple regression analysis was used to investigate further. The examination of nine aspects such as factors connected to the customer, organizational factors, supplier-related

factors, internal communication considerations, employer participation factors, employee development factors, employee training factors, equipment availability factors, and factors related to process improvement was performed to identify the motivating factors for the implementation of TQM. Further to test the set of null hypotheses a proposed multiple regression models has been used. (Table 4 and Table 5).

Table 4. Hypothesis model

	Dependent variable	TQM implementation
		Customer oriented factors
		Organizational cultural factors
		Internal communication factors
		supplier related factors
		Employer participation factors
		Employee development factors
		Employee training factors
		Availability of equipment factors
Research model	Independent variables	Process improvement factors

$$y = a+\beta1x1+ \beta2x2+ \beta3x3+ \beta4x4+ \beta5x5+ \beta5x5+ \beta6x6+ \beta7x7+ \beta8x8+ \beta9x9 + e$$

Where y is the overall TQM implementation and

a = constant,

x1,=Mean score on Customer oriented factors,x2=Mean score on Organizational factors x3=Mean score on Internal communication factors,x4=Mean score on supplier related factors,x5=Mean score on Employer participation factors,x6=Mean score on Employee development factors,x7=Mean score on Employee training factors,x8=Mean score on Availability of equipment factors,x9=Mean score on Process improvement factors.

β1 to β9 = slope coefficients of all the above factors.

e = error rate.

Table 5. Multiple Regression Analysis Results

S. No	TQM Factors	Unstandardized Coefficients		Standardized Coefficients β	T value	sig	Collinearity Statistics	
		Beta	SE				Tolerance	VIF

	Constant	.536	.255		2.100	.038		
F1	Customer oriented factors	.092	.039	.156	2.371	.019	.632	1.583
F2	Organizational cultural factors	.158	.041	.262	3.831	.000	.586	1.707
F3	Internal communication factors	.055	.037	.092	1.503	.136	.736	1.359
F4	supplier related factors	.036	.047	.048	.768	.444	.691	1.448
F5	Employer participation factors	.088	.042	.127	2.088	.039	.744	1.345
F6	Employee development factors	.152	.036	.281	4.221	.000	.616	1.624
F7	Employee training factors	.032	.035	.053	.915	.362	.801	1.249
F8	Availability of equipment factors	.108	.042	.146	2.555	.012	.839	1.192
R2								.675
Adjusted R2								.650
Significance								0.000

Before applying regression analysis, it was imperative to check the existence of multicollinearity among the independent variables before proceeding to the results of regression analysis. Multicollinearity problem was verified by average Variance Inflation Factors (VIF).

Table 6. Anova Results

Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.780	9	1.753	27.458	.000
	7.599	119	.064		

	23.379	128			

Table 6 shows the Anova results by using the sources of variation. In terms of the relationship between TQM implementation and perception factors the adjusted R2=.650 was statistically significant. TQM implementation-oriented dimension examined showed that employee development factors were effective influencing the TQM implementation (β=.281, t= 4.221, P<=0.00). The organizational cultural factors were also has influencing on TQM implementation (β=.262, t=3.831, P<=0.00). Followed by process improvement factors (β=.157, t=2.750, P<=0.00), availability of equipment factors (β= .146, t= 2.555, P<=0.00), customer-oriented factors (β=.156, t= 2.371, P<=0.00), employee factors (β=.127, t=2.088, P<=0.00) were effective influence on TQM implementation. Other dimensions like internal communication factors, supplier relationship factors, employee training factors do not have any influence on TQM implementation.

Table 7. Interco-relation among the TQM constructs

TQM factors	COF	OCF	IC	SRF	EPF	EDF	TF	AEF	PIF	TI
Customer oriented factors (COF)	1	.381**	.346**	.315**	.346**	.500**	.313**	.226**	.279**	.580**
Organizational cultural factors (OCF)		1	.448**	.488**	.405**	.445**	.263**	.121	.173	.621**
Internal communication factors (IC)			1	.307**	.246**	.314**	.278**	.158	.214*	.468**
supplier related factors (SRF)				1	.328**	.389**	.298**	.042	.171	.453**
Employer participation factors (EPF)					1	.386**	.152	-.046	.091	.449**
Employee development factors (EDF)						1	.308**	.027	.209*	.625**
Employee training factors (ETF)							1	.208*	.226*	.382**
Availability of equipment factors (AEF)								1	.291**	.288**

Process improvement factors (PIF)									1	.398**
Total Quality Management implementation (TI)										1

**=1% significant level, * =5% significant level

The correlation between TQM implementation criteria dimensions among employees was investigated using the Karl Pearson correlation coefficient along with its respective significance levels (* denotes a 5% significant level, while ** denotes a 1% significant level) given in Table 7. Notably, significant positive relationships were observed between customer-oriented factors and various other dimensions, including organizational cultural factors, internal communication factors, supplier-related factors, employer participation factors, employee development factors, employee training factors, availability of equipment factors, and process improvement factors. Regarding organizational cultural factors a significant positive relationship was identified with internal communication factors, supplier related factors, employer participation factors, employee development factors, employee training factors, availability of equipment factors and process improvement factors. Regarding internal communication factors a significant positive relationship is identified with supplier related factors, employer participation factors, employee development factors, employee training factors, availability of equipment factors and process improvement factors. Regarding supplier related factors the significant positive relationship is identified with employer participation factors, employee development factors, employee training factors, availability of equipment factors and process improvement factors. Regarding employer participation factors a significant positive relationship is identified with employee development factors, employee training factors, availability of equipment factors and process improvement factors. Regarding employee development factors also a significant positive relationship is identified with employee training factors, availability of equipment factors and process improvement factors. Regarding employee training factors a significant positive relationship is identified with availability of equipment factors and process improvement factors.

Table 8. Employee perception on various TQM factors

SI No	Factors	Mean score	Standard deviation	Coefficient of variation
1	Customer oriented factors	3.6163	.72149	.19951
2	Organizational cultural factors	3.5814	.70745	.19753
3	Internal communication	3.5840	.71204	.19867

	factors			
4	supplier related factors	3.7984	.57033	.15015
5	Employer participation factors	3.5097	.61349	.17479
6	Employee development factors	3.5543	.78869	.22189
7	Employee training factors	3.7674	.70447	.18699
8	Availability of equipment factors	3.9535	.57772	.14613
9	Process improvement factors	4.1705	.54664	.13107

3.11.4. General tendency of Employee perception on TQM implementation

As per the Table 8, among the nine dimensions, customer oriented factors had the highest mean score (3.6163) that was followed by organizational cultural factors (3.5814), internal communication factors (3.5840), supplier related factors (3.7984), employer participation factors (3.5097), employee development factors (3.5543), employee training factors (3.7674), availability of equipment factors (3.9535) and process improvement factors (4.1705).The mean score of the customer oriented factors was (3.6163) which indicated that TQM implementation depends on customer oriented factors.

3.11.5. Testing of Hypothesis

The results of the testing of the hypothesis in the context of TQM implementation criteria with nine dimensions are summarized in Table 9.

Table 9. Employee perception on various TQM factors

Hypothesis	**T value**	**B**	**Results**
Customer oriented factors will have no significant impact on TQM implementation	2.371	.156	Not supported
Organizational cultural factors will have no significant impact on TQM implementation	3.831	.262	Not supported
Internal communication factors will have no significant impact on TQM implementation	1.503	.092	supported
supplier related factors will have no significant impact on TQM implementation	.768	.048	supported

Employer participation factors will have no significant impact on TQM implementation	2.088	.127	Not supported
Employee development factors will have no significant impact on TQM implementation	4.221	.281	Not supported
Employee training factors will have no significant impact on TQM implementation will have no significant impact on TQM implementation	.915	.053	supported
Availability of equipment factors will have no significant impact on TQM implementation	2.555	.146	Not supported
Process improvement factors will have no significant impact on TQM implementation	2.750	.157	Not supported

4. Conclusion

The present investigation has identified nine noteworthy dimensions that are relevant to the implementation of Total Quality Management (TQM). These dimensions include those that are customer-oriented, organizational culture, internal communication, supplier-related, employer-related, employee development, employee training, equipment availability, and process improvement. Additionally, correlation analysis was performed to determine the links between these various variables. Customer-oriented factors, organizational culture factors, internal communication factors, supplier-related factors, employer participation factors, employee development factors, employee training factors, equipment availability factors, and process improvement factors were found to positively correlate with one another in the research. Additionally, the study highlighted that among engineers and project managers, customer-oriented factors emerged as a highly esteemed dimension. Despite diligent efforts to collect data, the researcher could only gather 129 responses, indicating a limitation. This study focused solely on nine independent variables, implying scope for future studies to incorporate a wider range of variables. Moreover, the study solely considered TQM Implementation as the dependent variable; future research could explore additional dependent variables such as organizational development, work efficiency, waste reduction, and accident reduction. The geographical scope of this study was confined to Tamil Nadu; however, future endeavours could expand to encompass the entire country of India. Comparative studies between supervisors and managers regarding TQM implementation practices could offer further insights. Furthermore, the study's findings could be extrapolated to other sectors like manufacturing and service industries for application and exploration.

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