

## TOTAL QUALITY MANAGEMENT ADOPTION BY PROCESS ENGINEERING DESIGN FIRMS IN SOUTH AFRICA

L. NJENGE

University of Johannesburg, Faculty of Engineering and Built Environment  
University of Johannesburg, Gauteng, South Africa  
[mrsnjenge@gmail.com](mailto:mrsnjenge@gmail.com)

ANDRE VERMEULEN

University of Johannesburg, Faculty of Engineering and Built Environment  
University of Johannesburg, Gauteng, South Africa  
[avermeulen@uj.ac.za](mailto:avermeulen@uj.ac.za)

JHC PRETORIUS

University of Johannesburg, Faculty of Engineering and Built Environment  
University of Johannesburg, Gauteng, South Africa  
[jhcpretorius@uj.ac.za](mailto:jhcpretorius@uj.ac.za)

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### ABSTRACT

The study investigates the effects of Total Quality Management (TQM) implementation on process engineering design firms. Secondly, the study investigates the extent of TQM adoption by South African process engineering design firms. Lastly, the study investigates the perceived importance of TQM principles. The study reveals that 70% of the firms which participated in the survey have formally adopted TQM while 30% have not. Although the firms which have not formally adopted TQM are implementing TQM principles, they have not been able to implement the principles as well as the firms which have formally adopted TQM. It also reveals that TQM implementation improves employee satisfaction, customer satisfaction, and financial performance while providing a vision that channels the entire organisation towards improvements in product quality and customer-related performances.

**Key Words:** Total Quality Management (TQM), Improvements, Product Quality, Performance

### INTRODUCTION

Process engineering design firms are operating in a competitive, global business environment where outsourcing of process engineering design services from other countries is not an uncommon practice [1]. Design is the most imperative phase in terms of product quality. An error in the design phase is amplified in the manufacturing phase and may only be detected in the inspection and testing phases [2]. Although the design phase is the most critical, quality consciousness is required in all stages of the product life cycle, with the commitment from management level to the junior levels in an organisation. The holistic approach is the fundamental nature of a Total Quality Management approach to engineering design [3].

TQM is defined as a management philosophy, driven by top management with employee participation, which encompasses all facets of an organisation with the aim of producing products and services which meet the customer's needs. There are various quality management techniques that are available, such as the lean enterprise system, six sigma and business process reengineering [4]. However, Burke [5] argues that TQM integrates all quality management features.

TQM was adopted by project-based organisations in the 1990s in response to increasing global competition [5]. Increasing product quality creates a competitive advantage while allowing firms to charge higher prices as a result of product differentiation [6]. Hollins [2] states that quality starts with designers.

## RESEARCH QUESTIONS

- i. What is the effect of TQM on the performance of process engineering design firms?

The question is answered with a literature study.

- ii. To what extent has TQM been adopted by South African process engineering firms?

The question is answered with the use of a questionnaire survey.

- iii. What is the perceived importance of TQM principles in process engineering design?

The question is answered with the use of a questionnaire survey.

## VALUE OF THE STUDY

The study adds value in the following manner:

- i. Promotes an understanding on effects of TQM adoption on the performance of process engineering design firms;
- ii. Promotes an understanding of the extent of TQM adoption by process engineering design firms in South Africa;
- iii. Promotes an understanding of the TQM principles which process engineering design firms in South Africa consider important;

## METHODOLOGY

A questionnaire survey was chosen as a research method because it allows the researcher to quantify the findings [7]. The limitation of a questionnaire with set questions is that the respondent is restricted to exploring only the issues presented in the questions and has no freedom to move outside the boundary of the questions to explore other themes, thereby restricting in-depth analysis. The limitations, however, may be overcome by a well-established questionnaire [8]. The questionnaire type which was selected was a self-administered questionnaire instead of an interviewer-administered questionnaire.

The questionnaire was comprised of sections. Section 1 was to gather general information about the organisation, namely the quality initiatives which the organisation had adopted and other quality assurance systems for which the organisation was certified. Section 2 gathered the perceived importance of TQM principles. Questions were grouped into nine (9) categories. The questions under each category were developed using the checklists of the Deming Prize [9], the EFQM Excellence Model [10] and a survey used by a quality research group at the University of Birmingham [11]. The questionnaire used a five-point Likert scale, which is an appropriate scale for measuring attitudes [7]. Section 2 of the questionnaire was grouped into two categories, namely "importance" and "adoption". The nine principles in the questionnaire are discussed as follow:

### **PRINCIPLE 1: POLICIES AND STRATEGIES**

One of the principles of TQM is the establishment of policies and strategies which guide the organisation in quality control policies, targets, strategic goals and plans of action. The category gave the researchers insight on the extent to which the organisation had developed and communicated quality policies and strategies in terms of:

- i. Management developed a quality and/or quality control policy
- ii. Policy clearly states quality targets and quality measures
- iii. Policy has a clear relationship to long- and short-term company strategic goals
- iv. There is a clear communication plan for the policy
- v. There is a clear roadmap on how the quality policy will be turned into action

### **PRINCIPLE 2: MANAGEMENT COMMITMENT**

The category aimed to establish whether or not management created a quality culture, supported quality improvement projects, established communication about quality with employees, led by example and became key drivers to quality improvement. The following critical factors in terms of management commitment were analysed:

- i. Management builds a quality culture
- ii. Management is a role-model for the quality culture in the organisation
- iii. Management motivates and supports efforts towards quality improvement
- iv. Communication about quality between management and employees is established
- v. Management is the key driver to quality improvement

### **PRINCIPLE 3: EMPLOYEE EMPOWERMENT**

This assessment was done to establish whether or not employees were empowered with quality-related aspects of their function. It also established whether the well-being of employees was prioritised in terms of:

- i. Employees are equipped with quality-related knowledge
- ii. Employees are trained for job-related skills
- iii. An appraisal system based on quality performance is established
- iv. There are initiatives to establish employee well-being and satisfaction
- v. Employees are empowered to suggest quality improvement programs

#### **PRINCIPLE 4: CUSTOMER INVOLVEMENT**

The aim of the category was to determine if the organisation had clear methods of communicating with the client in order to establish the client's requirements and expectations in terms of:

- i. The organisation has a clear method of determining the requirements of the client
- ii. The organisation has a clear method of communicating with the client

#### **PRINCIPLE 5: SUPPLIER QUALITY MANAGEMENT**

This category attempted to determine whether or not supplier quality was verified by use of supplier databases with approved suppliers, continuous audit of suppliers and selection of suppliers by quality standards instead of price in terms of:

- i. There is a supplier database with approved suppliers
- ii. Suppliers are audited and evaluated regularly
- iii. Suppliers are provided with standardised, relevant data when ordering
- iv. Long-term partnerships are built with suppliers
- v. Suppliers are selected not on price but on quality aspects

#### **PRINCIPLE 6: QUALITY SYSTEMS AND PROCESSES**

The category attempted to establish whether or not systems were in place to ensure quality, and whether the systems were customer-focused and were reviewed and improved regularly in terms of:

- i. The organisation has systems and processes in place to ensure quality
- ii. The organisation's quality systems are proactive instead of reactive
- iii. Quality systems and processes are continuously reviewed and improved
- iv. Quality inspections, evaluation and audits are done regularly
- v. The quality systems and processes are focussed on meeting the client's needs

#### **PRINCIPLE 7: RESOURCE AND INFORMATION MANAGEMENT**

The section intended to establish whether or not management was willing to allocate financial resources towards quality improvement and if quality information was collected and communicated throughout the organisation in terms of:

- i. Management is willing to provide financial resources for quality improvement
- ii. Quality information is collected and communicated throughout the organisation

#### **PRINCIPLE 8: MEASUREMENT AND FEEDBACK**

The section aimed to determine whether or not a customer feedback system was established, customer satisfaction levels measured, monitored and improved in terms of:

- i. A customer feedback system has been established

- ii. Customer satisfaction levels are measured and monitored

#### **PRINCIPLE 9: CONTINUOUS IMPROVEMENT**

The category aimed to determine if continuous improvement measures such as quality steering committees, quality improvement projects and quality improvement ideas were established. There is a quality steering committee that monitors and improves quality

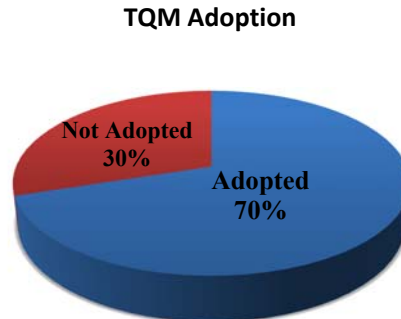
- i. Employees are encouraged to give quality improvement ideas
- ii. Employees are recognised for contributing ideas for quality improvement
- iii. Quality improvement is monitored and communicated throughout the organisation

#### **RELIABILITY OF RESEARCH QUESTIONNAIRE**

The Cronbach's alpha coefficient was calculated independently for the importance items and the adoption items. The importance items indicated a Cronbach's Alpha coefficient  $\alpha = 0.925$ , while adoption items indicated  $\alpha = 0.942$ . Both the coefficients are  $\Rightarrow 0.9$ , indicating a high internal consistency. The implication is that the items measure the same underlying principle and are reliable and valid.

#### **RESULTS**

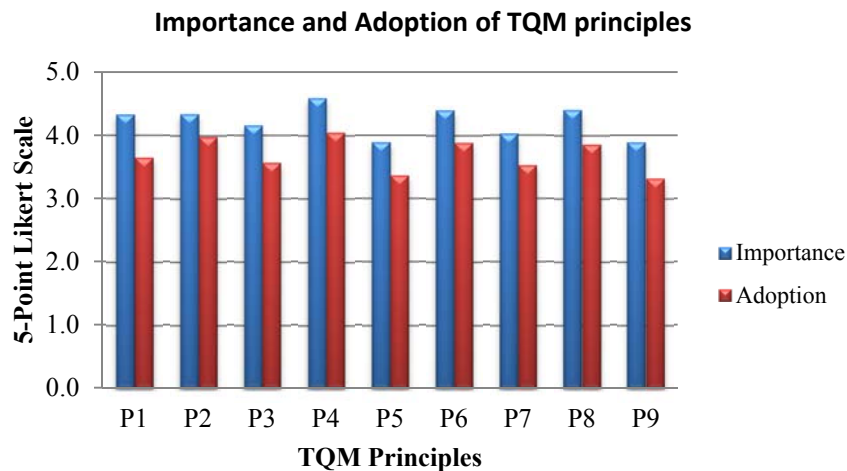
##### **TQM Adoption**



*Figure: TQM adoption by process engineering design firms in South Africa*

Of the firms which participated in the survey, 70% have formally adopted TQM while 30% have not. Of the 70% that have adopted TQM, 57% have done so in the year 2013, less than 10 months prior to the study. Eighty five per cent of the organisations that have adopted TQM are ISO9001 certified. The 30% which have not adopted TQM stated that they are unlikely to do so in 12 months from the date of the study. An adoption rate of 70% indicates an above-average TQM adoption by process engineering design firms in South Africa. An ISO9001 certification of 85% indicates that South African process engineering design firms are conforming to international quality standards.

## IMPORTANCE AND ADOPTION OF TQM PRINCIPLES



*Figure: Importance and Adoption of TQM principles*

The importance of the principles ranges from 78% to 92% (“important” to “very important”). The most important principle is perceived to be Customer Involvement (P4), while Continuous Improvement (P9) and Supplier Quality Management (P5) are perceived to be the least important. The data suggests that the design firms adhere to the theory that quality is defined by the customer, promoting customer involvement as a priority [12]. Continuous Improvement and Supplier Quality Management being the least important principle suggests that firms find the least value in creating and maintaining supplier databases, selecting suppliers with quality aspects instead of price, and creating long-term partnerships with suppliers, while improving quality continuously. The data suggests that South African process engineering design firms consider cost to be a more important constraint than quality when choosing suppliers. It also suggests that quality steering committees and quality improvements are not considered a priority in South African process engineering design.

The adoption of the principles ranges from 66% to 80% (moderate to high). Customer Involvement (P4) and Management Commitment (P2) are the most highly adopted, while Supplier Quality Management (P5) and Continuous Improvement (P9) are the least adopted. The trend indicates that satisfying the customer is the most important aspect of quality, as suggested by literature [12]. High adoption of Management Commitment indicates that South African process engineering design firms are making an effort to implement TQM. Supplier Quality Management and Continuous Improvement are the least adopted. This is according to the author’s expectations due to their low importance rating.

It is evident from Figure 6-2 that there is a gap between the perceived importance and adoption of the TQM principles. The mean score for importance is 4.2 (84%) while the mean score for adoption is 3.7 (74%). Although Customer Involvement is perceived to be the most important principle, there is a 12% gap between the importance (92%) and the implementation (80%). The data suggests that the policies and strategies of the organisations have not achieved full implementation of TQM. This is evident in the implementation of Policies and Strategies being 72%. The results indicate that the organisations have room for improvement in the implementation of Policies and Strategies in order to fully implement TQM.

## **CONCLUSION**

The research has three aims. Firstly, the research aims to investigate the effects of TQM adoption on the performance of process engineering design firms. Secondly, the research aims to investigate the extent of TQM adoption by South African process engineering design firms. Lastly, the research aims to investigate the perceived importance of TQM principles.

### **RESEARCH QUESTION 1**

*What is the effect of TQM on the performance of process engineering design firms?*

The author was unable to find studies relating specifically to process engineering design firms. As a result, a literature study was done for engineering firms in general. The survey indicates that TQM adoption has a favourable effect on engineering firms. The study reveals that TQM implementation improves employee satisfaction, customer satisfaction, and financial performance, while providing a vision that channels the entire organisation towards improvements in product quality and customer-related performances. The author concludes that TQM implementation has a positive effect on organisational performance. The author recommends the implementation of TQM by process engineering design.

### **RESEARCH QUESTION 2**

*To what extent has TQM been adopted by South African process engineering firms?*

The study reveals that 70% of the firms which participated in the survey have formally adopted TQM while 30% have not. Of the 70% that have adopted TQM, 57% have done so in the year 2013, less than 10 months prior to the study. Eighty five per cent of the organisations that have adopted TQM are ISO9001 certified. An adoption rate of 70% indicates an above-average adoption of TQM by South African process engineering design firms. An ISO9001 certification of 85% indicates a high conformance to international quality standards by South African process engineering design firms.

The adoption of the TQM principles ranges from 66% to 80% (moderate to high). Customer Involvement and Management Commitment are the most highly adopted, while Supplier Quality Management and Continuous Improvement are the least adopted. Although firms who have not formally implemented TQM have adopted TQM principles, they have not been as successful as the firms who have formally adopted TQM. The mean adoption score for firms which have adopted TQM is 77%, compared to 63% for firms which have not adopted TQM.

The author concludes that South African process engineering firms aspire to meet international quality standards and are implementing TQM and ISO9001. Formal implementation of TQM allows organisations to implement TQM principles more successfully compared to firms which attempt to adopt the principles of TQM without having TQM policies and procedures in place. The author recommends that firms which endeavour to adopt TQM principles start with formally implementing TQM.

### RESEARCH QUESTION 3

*What is the perceived importance of TQM principles in process engineering design?*

The survey reveals that the perceived importance of the TQM principles ranges from 78% to 92% ("important" to "very important"). The most important principle is perceived to be Customer Involvement, while Continuous Improvement and Supplier Quality Management are perceived to be the least important. The firms who have formally adopted TQM find more value in TQM principles than the firms who have not formally implemented TQM. The perceived importance by the firms which have adopted TQM is 4.33 (86%), while the firms which have not formally implemented TQM have a mean score of 4.0 (80%).

It is evident from the data that there is a gap between the perceived importance and adoption of the TQM principles. The mean score for importance is 4.2 (84%) while the mean score for adoption is 3.7 (74%). The implementation of Policies and Strategies is 72%. The data suggests that the policies and strategies of the organisation have not achieved full implementation of TQM and have room for improvement. The author concludes that there is value in implementing TQM in process engineering design.

### RECOMMENDATIONS

A study can be applied to investigate the inter-relationship between TQM implementation and performance in South African process engineering design firms. A crucial part of the study will also investigate how process engineering design firms measure performance, which includes performance indicators, performance reporting and performance evaluation. A qualitative and quantitative research study can be done to determine what effect each TQM principle has on the performance indicators. The study will reveal how performance is measured and monitored in the TQM context, and the effects of TQM implementation in process engineering design in South Africa.

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