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RESEARCH ARTICLE

The Correlation between Total Quality Management with Engineer Performance

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ABSTRACT

Total Quality Management (TQM) has become, in the span of a few years, a new modern management philosophy focused on a complete shift in mindsets and practices at all levels of the organization. Thus, TQM is very important for overall performance. Every organization, whether public or private, must adopt TQM. The role of this management approach in improving workforce performance is well established. Through statistical analysis, we have shown that there is a strong correlation between the implementation of TQM and the performance of engineers. Indeed, TQM proves to be an essential tool for enhancing workforce productivity within organizations. Total Quality Management (TQM) seems to play an important role in improving the individual productivity of engineers.

1. INTRODUCTION

Although Total Quality Management (TQM) is a relatively old concept, its first appearance, according to Stuelpnagel (1993), dates back to 1929 with the work My Life and Work by Ford and Crowther. The first adoption of this approach in Japan dates to 1949. However, the term "Total Quality Management" was used for the first time in 1985 by the Japanese Naval Air Systems Command (Bemowski, 1992).

Undoubtedly, the concept of Total Quality Management (TQM) has continued, since the 1990s, notably with the works of Feigenbaum, Ishikawa, Deming, Juran, and Crosby (cited by Osayawe Ehigie & McAndrew, 2005), to attract the attention of specialists and researchers in the field of business and organizations. Indeed, as a new management approach, TQM is considered an innovative channel towards enhancing the competitiveness of a company's products in a highly competitive market (Sadikoglu & Olcay, 2014). Naturally, TQM is rooted in a valuable philosophy of comprehensive management with a global approach aimed at the long term, deploying resources to achieve clear objectives (Thunyachairat et al., 2024).

According to (Hashmi, 2007), the concept of Total Quality Management refers to a management philosophy that focuses on improving all organizational functions of the company and understanding customer needs. Thus, it is a comprehensive approach aimed at implementing organizational change focused on quality improvement. All areas of the company are affected by this change; that is why we speak of total quality. This corresponds to Feigenbaum's view (Feigenbaum, 1951), according to which all departments of an organization are responsible for quality improvement.

It is clear that the culture of implementing Total Quality Management entities within companies has the direct goal of improving the outputs of the various departments. In other words, total quality is achieved through the performance of the different components and individuals within the company.

Thus, employees play a significant role in the success of TQM strategies (Christoforidis & Anastasiadou, 2024).

As we mentioned earlier, the success of quality management is largely tied to the contribution of human capital in the TQM process. Indeed, it is difficult to imagine total quality within companies without the full involvement of their employees. In the case of industrial companies, engineers play a central role in TQM (Zairi, 1991). Whether it is adapting products to market and customer needs, validating prototypes, conducting validity tests on samples, or supervising other members of the production chain, all these responsibilities fall to engineers.

According to Zairi (1991), there is a positive link between engineers and total quality management (TQM). As an approach that aims to integrate dynamic change throughout the organization, TQM should contribute to improving the engineering profession. According to this author, the engineering profession has evolved significantly to become central to all other professions within organizations.

The performance of engineers within companies is therefore essential to the overall performance of the company. For Juran (1995), quality management is not limited to identifying and eliminating variations, but involves meeting customer needs – focusing the entire company on them. Studying the relationship between TQM and engineers' performance seems constructive and helps better justify the increasingly frequent implementation of services dedicated to TQM in many industrial companies.

TQM, through its innovative vision, positively influences the skills of engineers (Zairi, 1991). Thus, by positioning themselves at the center of the organization, engineers also become managers, allowing them to gain more experience and expertise. Additionally, in terms of external organizational output, they contribute to improving products and, consequently, to customer satisfaction.

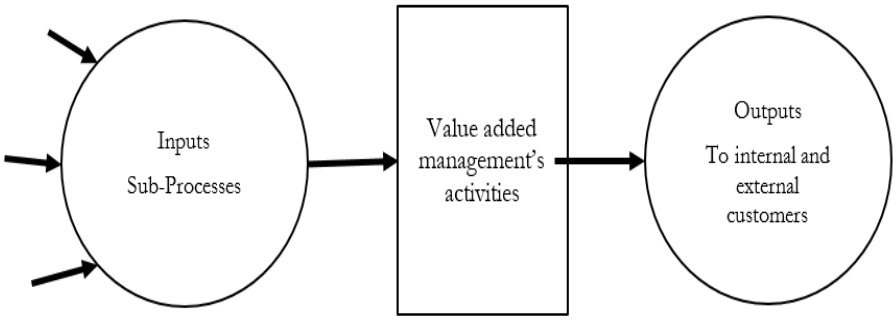

Figure 1: Value added

Source: (Zairi, 1991).

This article seeks to empirically study the nature of the relationship between TQM and engineers' performance. In other words, we will seek to determine whether there is a correlation between Total Quality Management (TQM) and the performance of engineers.To achieve this, we will first present the chosen methodology, then present the results obtained, and finally discuss these results.

2. METHODOLOGY

2.1 Method

The approach was quantitative and made use of data collection methods in the form of questionnaires. The subjects in this study were 78 respondents, including managers and engineers. The research instrument is TQM with four aspects which include continuous training, customer satisfaction, continuous improvement/sustainable quality improvement, managers' skills. Engineer performance with two aspects which include project quality, and respecting deadlines. The sample was determined using the calculation formula of Isacc and Michael. The data were analyzed quantitatively using canonical correlation analysis (CCA). canonical correlation analysis was used to do a quantitative examination of the data.

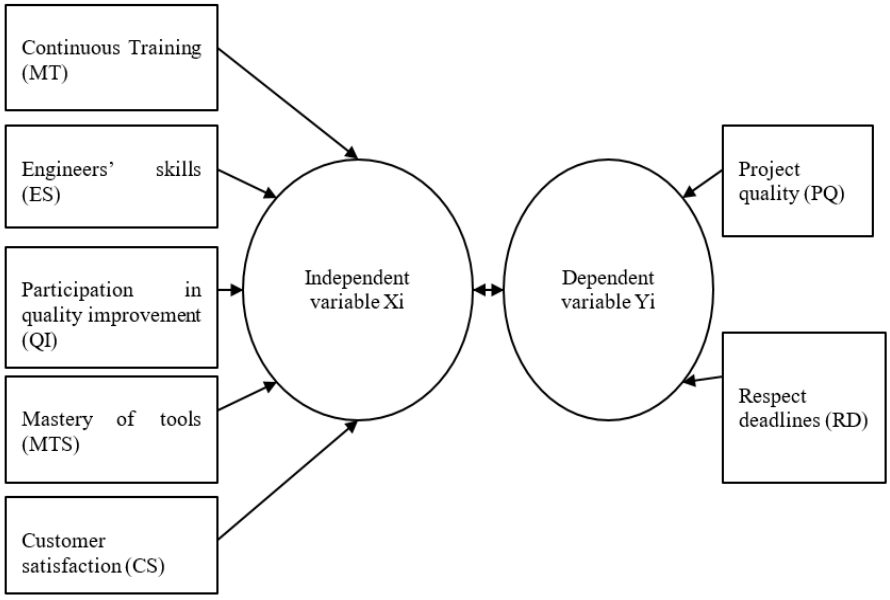

Figure 1: Proposed model

Source: author

2.2 Item of the questionnaire

Table 1: Items

Item N°	variable block	item	Measure
1	TQM	continuous training (CT)	Number of continuous training sessions per year
2	TQM	Engineers' skills (ES)	Number of years of study
3	TQM	Participation in quality improvement (QI)	Number of proposals for quality improvement submitted
4	TQM	Mastery of tools (MT)	Number of software programs mastered
5	TQM	Customer satisfaction (CS)	Number of projects completed by the same client within a year
6	EP	Project quality (PQ)	Number of complaints received
7	EP	Respect deadlines (RD)	Number of projects completed on time

Source: Author

2.3 The administration

After preparing the questions for the questionnaire and, of course, validating it, we visited 17 companies active in the industrial sector that employ engineers. Only 14 companies agreed to respond to our questionnaire, which we directed to the department responsible for quality management and oversight, presenting it to the person in charge of project monitoring. By utilizing the engineers' monitoring sheets, we obtained the sought-after responses.

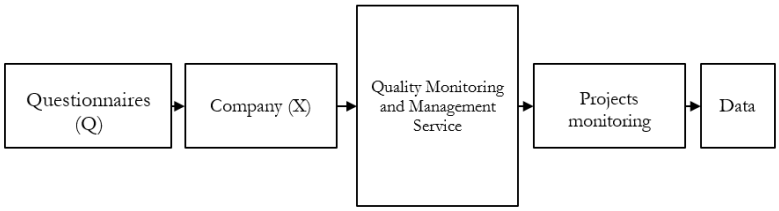

Figure 3: Questionnaire circuit

Source: Author

3. RESULT AND DISCUSSION

3.1 Validation and reliability

This questionnaire was validated by experts. The reliability analysis was conducted using Cronbach's alpha. For the majority of specialists, if this index is greater than 0.6, the reliability of the instrument is accepted. In our case, the results of the index are as follows:

Cronbach's alpha is well above 0.6, with a value of 0.840, and Cronbach's alpha based on standardized items is equal to 0.797. Therefore, the reliability of the instrument is confirmed.

Table 2: Reliability test

Statistiques de fiabilité

Alpha de Cronbach	Alpha de Cronbach basé sur des éléments normalisés	Nombre d'éléments
,840	,797	7

Source: Spss

3.2 Prerequisite test

Normality, linearity, and multicollinearity tests made up the prerequisite analysis test for canonical correlation analysis. The data distribution is considered normal since the Kolmogorov-Smirnov(KV) test or the Shapiro-Wilk (SW) which was utilized for the normality test, yielded a result of P>0. When p>0.05 and the value of the F Fcount r table was present, the linearity test employed the F coefficient test with guidelines. In our study, the p-value is greater than 0.05 for all variables. Therefore, the basic assumptions are validated.

Table 3: Normality test

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CT	,046	78	,200*	,990	78	,814
ES	,084	78	,200*	,947	78	,003
QI	,060	78	,200*	,977	78	,159
MT	,072	78	,200*	,981	78	,305
CS	,080	78	,200*	,973	78	,096
PQ	,086	78	,200*	,978	78	,191
RD	,064	78	,200*	,990	78	,822

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Source: Spss

3.3 Descriptive analysis

The descriptive analysis of the sample shows that, the two aspects used in the study to evaluate the performance of engineers in their fields, namely the quality of projects measured by the number of

complaints received for delivered projects and the number of projects completed within the given deadlines, show a maximum of 3 complaints received and 9 projects completed on time (see the table below). This indicates that the number of complaints is low, while the number of projects completed on time is relatively modest. Similarly, with the exception of participation in quality improvement, all variables received relatively high scores.

Table 4: Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Project quality (PQ)	78	,0	3,0	,603	,7445
Respect deadlines (RD)	78	1,0	9,0	5,218	2,1053
continuous training (CT)	78	2,0	10,0	6,385	2,2111
Engineers' skills (ES)	78	2,0	8,0	4,462	1,7484
Participation in quality improvement (QI)	78	,0	4,0	1,679	1,2006
Mastery of tools (MT)	78	1,0	9,0	5,218	2,2018
Customer satisfaction (CS)	78	1,0	9,0	4,962	1,9702
Valid N (listwise)	78				

Source: Spss

3.4 Canonical correlation analysis (CCA)

Canonical Correlation Analysis (CCA) is a statistical method that examines the relationships between two sets of variables. In our case, the first set, called "engineer performance," consists of only two variables: project quality and meeting deadlines. The second set, which includes independent variables, is made up of five variables: continuous training, engineer skills, participation in quality improvement, mastery of tools, and client satisfaction. The results show a strong positive correlation between the two sets of variables. In other words, there is a positive relationship between TQM performance and engineer performance.

Within the first set, the correlation between the five variables and TQM is significantly positive. However, the relationship between engineer performance and project quality is relatively weak. In other words, the number of complaints received does not seem to impact engineer performance, unlike meeting the assigned deadlines. There is a strong positive correlation between engineer performance and meeting deadlines.

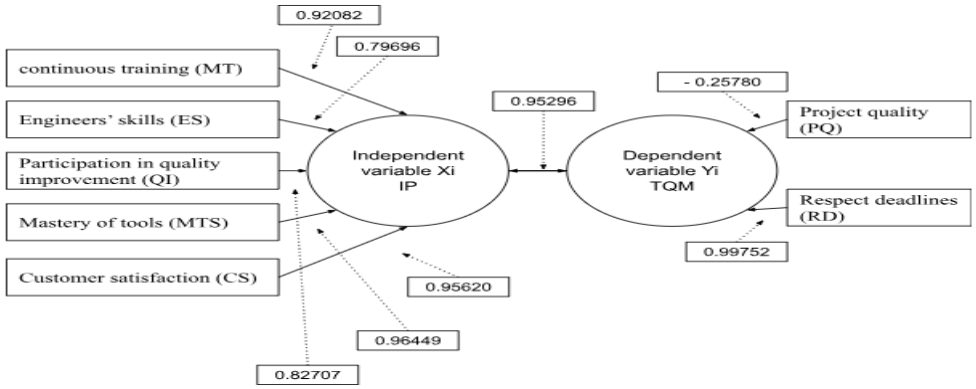

Figure 4: Canonicals correlations

Source: Author

In conclusion, the canonical correlations are high, indicating a strong relationship between the two sets of variables (0.95296). TQM is therefore positively related to engineer performance. Client

satisfaction is the most contributing variable to the formation of TQM, with a value of 0.95620, while engineer skills rank fifth with a value of 0.79696.

4. Practical Implications

The practical applications and direct consequences of the findings of this research, particularly regarding the existence of a largely positive correlation between Total Quality Management (TQM) and engineers' performance, can be summarized as follows: first, continuous training seems to play a key role in improving engineers' performance. This therefore requires implementing training programs by managers throughout the year. In the same vein, mastery of work tools such as design software, modeling tools, measurement instruments, production equipment, etc., is of great importance for organizations. In addition, the importance of a culture of better customer experience is emphasized. Indeed, customer satisfaction, as a company philosophy integrated into TQM, encourages engineers to give their best in their projects. It is therefore essential to make customer satisfaction a company-wide culture.

5. CONCLUSIONS

The study's results demonstrated the existence of a positive relationship between TQM (Total Quality Management) as a new management philosophy and engineers' performance. In other words, the implementation of total quality management contributes to the improvement of engineers' performance, both in terms of the quality of completed projects and productivity.

Furthermore, the study's findings confirm various theoretical assumptions emphasizing the importance of TQM for individual productivity within an organization. Thus, total quality management is a strategic choice in workforce management. However, this work has two limitations: first, the number of variables considered to evaluate engineers' performance is relatively small. Second, although the sample size was validated, it remains limited.

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